Geriatric Orthopedic Emergencies

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No conflicts of interests

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Overview

- General terms & issues
- Open fractures
- Tibial plateau fractures
- Compartment syndrome

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Key Topics

- Insufficiency/Fragility fractures
  - Pelvic, sacral, vertebral
- Hip fractures

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Geriatric patients are not just older adults

- Geriatric orthopedic injuries are unique due to the combination of anatomic, physiologic and social factors.
- Aging affects bone density, muscle mass, and joint integrity, making the elderly more susceptible to fractures, dislocations and other orthopedic injuries even from low-impact trauma such as a simple fall from standing height.
- Conditions like osteoporosis and osteopenia significantly increase the risk of fractures & are associated with more complicated recovery courses compared to younger patients.

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Why Older Adults Are Susceptible

- **Bone Quality Decline**
  - Aging leads to **loss of bone mass** and **microarchitectural deterioration**, weakening bone strength.
  - Cortical thinning and trabecular bone loss make fractures more likely even with minor trauma.
- **Comorbidities**
  - Conditions such as **chronic kidney disease, diabetes, or long-term steroid use** further compromise bone integrity.
  - Pathologic fractures may result from **metastatic lesions or primary bone tumors**, which are more prevalent in older adults.

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Why Older Adults Are Susceptible – Falls & Trauma

- **Age-related neurological changes** further increase injury susceptibility.
  - Slower reflexes, impaired balance & proprioception, and reduced visual acuity
- Older adults may **fail to adequately brace themselves or react quickly**, so minor incidents can produce serious orthopedic injuries.
- These factors increase **fall risk** & when coupled with osteopenia & sarcopenia, even low-energy incidents become fracture-inducing.

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Muscle Mass & Strength

- **Age-related sarcopenia** reduces skeletal muscle mass and strength, impairing the body's ability to absorb forces during a fall.
- Weak muscles **decrease protective reflexes**, such as bracing during a stumble, and reduce the ability to maintain **postural stability**.
- The combination of weaker muscles and fragile bones **increases fall risk and injury severity.**

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Fragility/Insufficiency fractures

- **Fragility fractures** are fractures that occur from **low-energy trauma**
  - A fall from standing height or less
- Marker of systemic skeletal fragility
  - Most commonly due to **osteoporosis**
- Fragility fractures signal a need for **preventive interventions** (bone density assessment, fall prevention)

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Bone Changes

- **Osteopenia** is a condition of **mildly decreased bone mineral density**, often considered a precursor to osteoporosis.
  - T score (-1 to -2.5)
- **Osteoporosis** is **marked bone loss with structural deterioration**, leading to fragile bones that are highly susceptible to fracture.
  - T score (-2.5 or lower)
- Both conditions result from **aging-related changes in bone remodeling**, hormonal decline (e.g., postmenopausal estrogen drop), nutritional deficiencies (calcium, vitamin D), and reduced mechanical loading (sedentary lifestyles).
- Bones are **less dense, more porous, and weaker.**

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Soft Tissue Vulnerability & Healing capacity

- Older adults have **slower wound healing** due to reduced collagen production and decreased vascularization.
- Soft tissue is more **vulnerable to injury** and complicates recovery after an open fracture

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Common Sites

- Areas with **thin soft tissue coverage over bone** are particularly vulnerable:
  - **Distal radius**
  - **Tibia**
  - **Elbows, hands, and ankles**

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Open fractures from low-energy trauma

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Skin and Soft Tissue Fragility

THINNER, LESS ELASTIC SKIN: AGING CAUSES DERMAL THINNING AND LOSS OF SUBCUTANEOUS FAT, WHICH REDUCES PADDING OVER BONY PROMINENCES.

FRAGILE BLOOD VESSELS: CAPILLARY WALLS WEAKEN, INCREASING SUSCEPTIBILITY TO BRUISING AND TEARING.

AS A RESULT, **MINOR TRAUMA CAN LACERATE SKIN OVER THE FRACTURE SITE**, CREATING AN OPEN FRACTURE.

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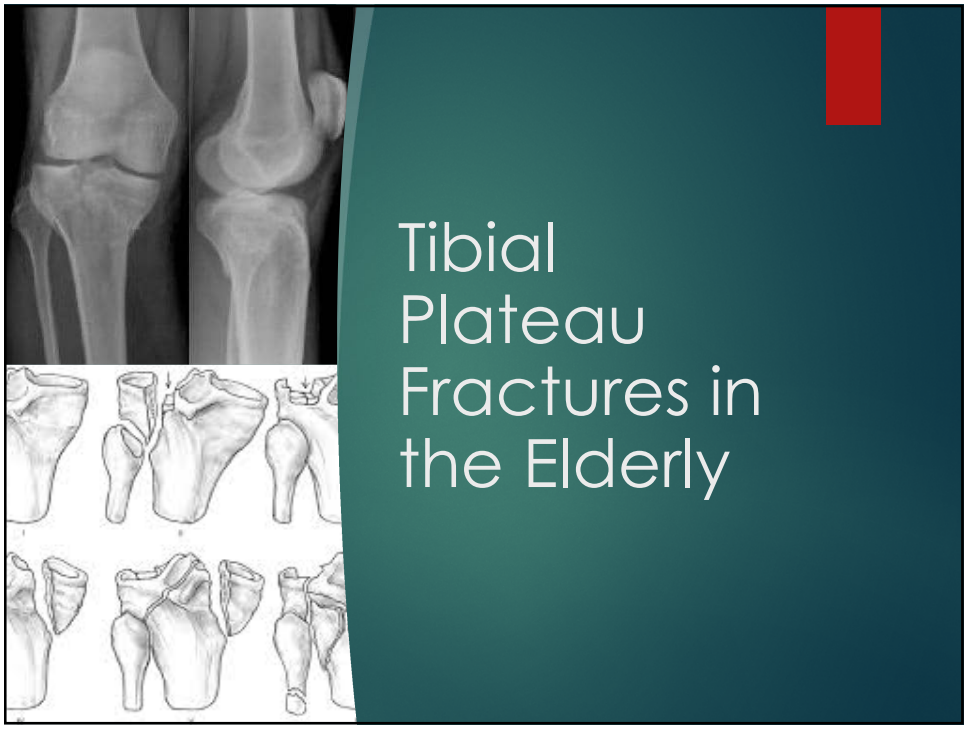

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Tibial Plateau Fractures in the Elderly

- A **fall from standing height** (71-73% of cases) can cause a tibial plateau fracture in older patients, whereas younger individuals require high-energy trauma for the same injury.
- Osteopenia/osteoporosis **(94%)** weakens the subchondral bone, reducing its ability to absorb even low-energy impacts.
- The **lateral tibial plateau** is involved in the majority of cases

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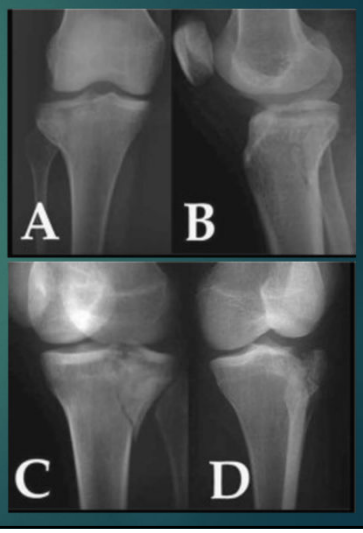
Tibial Plateau Fractures in the Elderly

- **Plain radiographs demonstrate relatively low sensitivity (83%)**
  - CT imaging is 100% sensitive
- **Plain radiographs miss approximately 17% of tibial plateau fractures**
  - Fracture line can be obliquely oriented



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Tibial Plateau Fractures in the Elderly

- 53% of patients with overlooked fractures had worsening of fracture position by the time of diagnosis.
- 36% received significant disability compensation.
- In a study analyzing overlooked tibial plateau fractures, **84% of these missed fractures were visible or suspected on the original films.**

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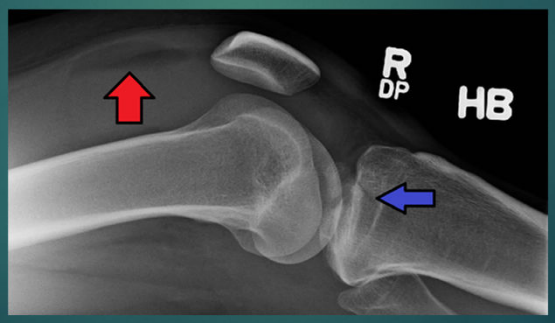
Lipohemarthrosis (Fat-Fluid Level)

- Look for a horizontal fat/fluid level in the suprapatellar recess on lateral view X-ray
- The most reliable sign



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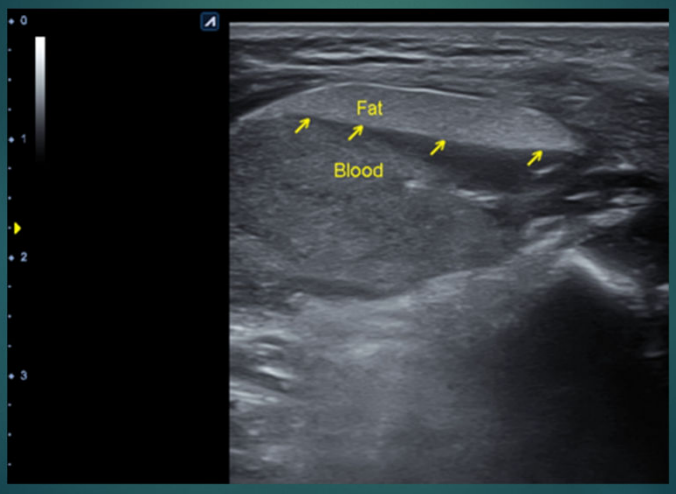
Lipohemarthrosis



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Pathological Widening AP view

- **Normal knee**
  - The tibial plateau is generally aligned with the femoral condyle

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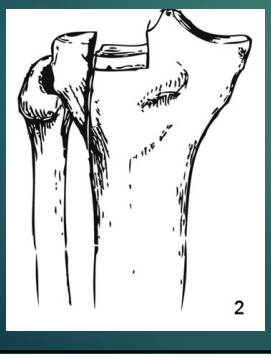
Pathological Widening AP view

Abnormal

- Tibial plateau widening > 2-5mm



Tibial Plateau Fracture

- **Widening** indicates lateral displacement of fracture fragments.

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Look for a sclerotic line indicating **bone impaction or compression**

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Tibial Plateau Fractures in the Elderly

- Despite the low-energy mechanisms, these fractures are often accompanied by:
- Severe **comminution** (up to 69%)
- **Compartment syndrome**
  - 12% of cases requiring fasciotomy

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Soft Tissue Vulnerability & Healing capacity

- Elderly patients have **thinner, less elastic soft tissues**, so even moderate swelling can significantly **increase compartmental pressure**

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Compartment Syndrome

- Occurs when **pressure within a closed muscle compartment rises** above perfusion pressure, causing ischemia and tissue necrosis.
- Tibial plateau fractures in the elderly:
  - **Swelling or hematoma formation** within the lower leg compartments can be exaggerated because **rigid fascial boundaries cannot expand**.
  - Fragile vessels in older adults may **bleed more easily into the compartment**, accelerating pressure rise.

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Clinical Challenges in the Elderly

- **Diagnosis can be delayed:** Pain perception may be blunted by neuropathy or cognitive impairment.
- **Subtle physical findings:** Elderly patients may present with mild pain, paresthesia, or swelling that is overlooked, delaying fasciotomy.
- Delayed diagnosis can lead to:
  - Muscle necrosis
  - Nerve injury
  - Permanent functional loss

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Management Considerations

- **Early recognition:** Vigilant monitoring for **pain out of proportion, tense swelling, and neurovascular deficits**.
- **Surgical intervention:** Fasciotomy may be required **more urgently** than in younger adults due to **limited soft tissue compliance**.

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Insufficiency Fractures

- Pelvic fragility fractures

- Vertebral fractures

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High-Risk Geriatric Population

- Age **>65-70**
  - Risk increases sharply with each decade of age
- Strong female predominance:
  - **Women account for ~80%** of cases
  - Largely due to postmenopausal osteoporosis
- Known or occult osteoporosis
- Prior fragility fracture
  - Hip, pelvis, wrist
- Chronic steroid use
- Low BMI, frailty

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Common Types of Pelvic Fragility Fractures

- **Anterior Ring**
  - Pubic rami fractures
- **Posterior Ring**
  - Sacral insufficiency fractures

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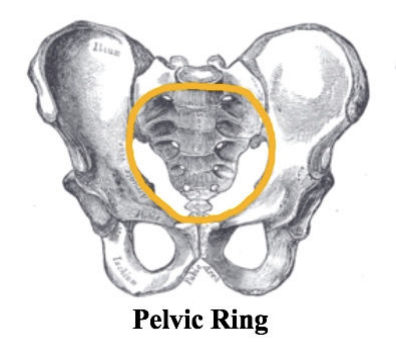
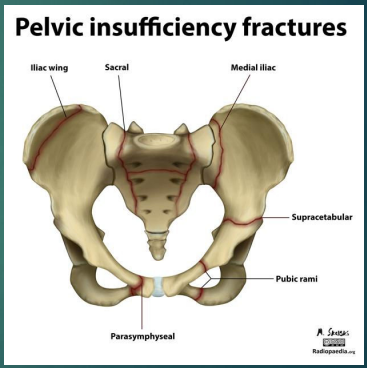
Types of Pelvic Fragility Fractures
Anterior vs Posterior Ring





**Posterior ring involvement determines severity and prognosis **

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Anterior Ring
Pubic rami fractures

- Pain localized to the groin, hip area, or inner thigh, often accompanied by lower back or buttock pain.
- The pain typically develops progressively and is exacerbated by weight-bearing and activity.
- Physical examination reveals an antalgic gait, tenderness over the pubic bones and with provocative maneuvers.

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But patient denies trauma

- Most patients with pelvic insufficiency fractures report a history of low-energy trauma
  - Typically falls from standing
- **Not atypical for patients to present without recalled trauma!**
  - The reported frequency of antecedent trauma varies
    - 55-100% of cases
- The absence of recalled trauma does not exclude the diagnosis!

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Clinical presentation is one of progressive pain

- Normal physiological stresses on weakened bone.
- Fractures without a discrete traumatic event.
- Fracture may develop or progress over time.
- The diagnosis should be pursued based on clinical presentation and risk factors (osteoporosis, advanced age, corticosteroid use) rather than relying solely on trauma history.

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Anterior Ring

Pubic rami fractures (most common)

- **Isolated anterior pelvic ring fractures without posterior involvement are generally considered stable**
  - Allow full weight bearing
- Contrary to this advice, even under strong analgesics, early mobilization is often is not possible requiring hospitalization

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Pubic Rami Fractures Morbidity

- 90% of previous community dwellers need admission
  - Mean duration of 8 -14 days
- 50-65% of patients return home
- 25-35% are transferred to rehabilitation facilities
- At one-year follow-up, the rate of patients living independently at home drops from 80% before fracture to 65%

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Pubic Rami Fractures Mortality

- One-year mortality rates range from 17 to 27%.
- Mortality is 22% in patients aged 80 years or above.
- The 90-day mortality rate is16%

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Pubic Rami Fractures

- **MRI demonstrates the highest diagnostic accuracy for detecting anterior ring insufficiency fractures**
  - **Sensitivity of 99% & specificity approaching 100%**
  - Detects bone marrow edema that accompanies insufficiency fractures, even when fracture lines are not yet visible
  - Excels at detecting fractures of the femoral head and acetabulum
- Significantly outperforming both conventional radiography (sensitivity 50%) and CT (sensitivity 69-90%) in elderly patients with pelvic fragility fractures.

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Anterior Ring
Pubic rami fractures

- Isolated fractures of the anterior pelvic ring are rare.
- A coexistent lesion of the posterior pelvic ring frequently seen.
  - Proper assessment of the posterior pelvic ring (SI joints & sacrum) is difficult on a standard pelvis plain film.

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Pelvic Ring Biomechanics

- The posterior pelvic ring bears **~60–70% of axial load**
  - Sacrum, SI joints, posterior Ilium
- Primary structure responsible for:
  - Weight transfer from spine to lower extremities
  - Stability during standing and walking

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Posterior ring involvement is associated with:

- Higher pain scores
- Longer hospital stays
- Delayed mobilization
- Increased need for rehabilitation or institutional care
- Mortality rates approaching those of hip fractures in some cohorts

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Sacral Insufficiency Fractures - Prevalence

- **More common than previously believed**, but they are **frequently underdiagnosed**
- Account for **up to 1–2% of all fragility fractures** in older adults
- Among elderly patients presenting with **low back, pelvic, or buttock pain**:
  - **5–10%** may have an undiagnosed fracture
- In patients with known pelvic insufficiency fractures: **20–40%** of cases

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Sacral Insufficiency Fractures

- Severe pain with standing or walking
  - Often unable to ambulate
- Often minimal external signs
- Deep, poorly localized pain
  - Low back (36%), coccyx (18%), or gluteal (64%)
- Some patients experiencing multiple pain locations simultaneously
- Presentation may mimic:
  - Lumbar spine disease
  - Sacroiliac pathology
  - Hip osteoarthritis
  - Radiculopathy

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Physical Examination

- Localized sacral or buttock tenderness
- Pain with axial loading or single-leg stance
- Antalgic gait or inability to ambulate
- Usually **no focal neurologic deficit**

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Rarely occur in isolation

- Up to **50–70%** of patients have concurrent fractures:
  - Pubic rami fractures
  - Vertebral compression fractures
- **This clustering reflects advanced skeletal fragility**

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Clinical Significance

- Despite being "low-energy"
- SIFs cause pain comparable to hip fractures
- Lead to prolonged immobility
- Carry increased morbidity and mortality similar to other major fractures
  - 13-27% mortality rates
  - 64-89% loss of independence

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ED Diagnostic Strategy

- **Initial Imaging -** Pelvis X-ray
  - Low sensitivity for posterior injuries
  - Useful mainly to rule out obvious hip or pelvic fractures

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ED Diagnostic Strategy Advanced Imaging

- **CT**
  - Identifies cortical fractures
  - May miss early stress injuries
- **MRI = gold standard**
  - Shows marrow edema
- The ACR recommends MRI without contrast as the preferred imaging modality for detecting posterior ring insufficiency fractures when initial radiographs are negative

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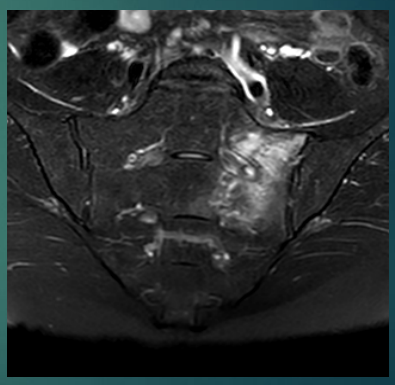
Sacral Insufficiency fractures



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Emergency & Inpatient Settings

- Among elderly patients admitted for **atraumatic low back or pelvic pain**:
  - SIFs are found in **up to 8–15%** when MRI is routinely used
- Many are diagnosed only after repeated ED visits or prolonged hospitalization
- As a result, many SIFs are diagnosed **weeks or months** after symptom onset
  - Symptom variability contributes to diagnostic challenges, as **the mean delay between first visit and accurate diagnosis is 24 days**

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ED Clinical Pearls

- Persistent low back or pelvic pain + osteoporosis = **think SIF**
- Normal X-ray ≠ no fracture
- Early MRI prevents prolonged morbidity
- Early diagnosis improves mobility and outcomes

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What Are Vertebral Compression Fractures?

- **Fragility fractures of the vertebral body**
  - Caused by failure of weakened bone under normal axial load.
  - They are the spinal equivalent of hip and pelvic fragility fractures.
- In older adults, commonly result from:
- Osteoporosis
- Low-energy trauma (falls, bending, coughing)
- Often, **no identifiable trauma**

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Why VCFs Matter in the ED

- Extremely common in older adults
- Frequently **missed or dismissed as "back pain"**
- Can cause severe pain, immobility, delirium, and functional decline
- Strong predictor of **future fractures and mortality**
- **PEARL:** A vertebral compression fracture is a systemic disease marker, not an isolated injury.

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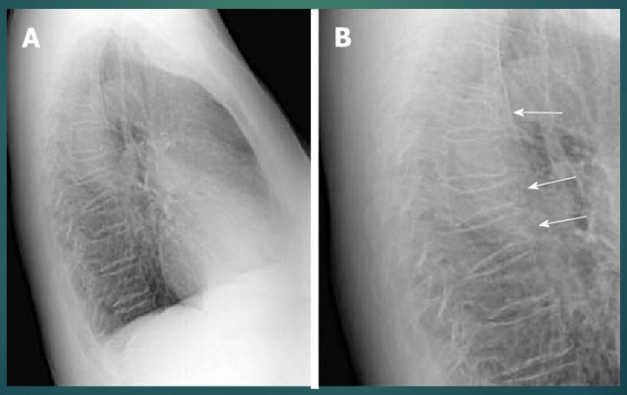
More than two-thirds of patients are asymptomatic

- Incidentally diagnosed on plain radiography



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Clinical Presentation

- Acute or subacute onset of:
  - Mid- or low-back pain
  - Pain worse with:
    - Postural movement, position changes, coughing, sneezing, lifting, or Valsalva

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Physical Examination

- Localized spinal tenderness
- Often **no neurologic deficit**

- Neurologic findings suggest:
  - Retropulsion
  - Burst fracture
  - Pathologic fracture

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3 Clinical Tests to Reliably Indicate VCFs

- The Closed-Fist Percussion Test
- Supine Sign Test
- Back Pain-Inducing Test

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Closed-Fist Percussion Test

- **The examiner stands behind the patient and applies firm percussion with the ulnar side of the fist along the spinous processes of the spine.**
- The test is positive if the patient reports sharp, sudden pain.
- **Sensitivity of 75-87% & specificity of 82-90%** for detecting acute osteoporotic vertebral compression fractures.

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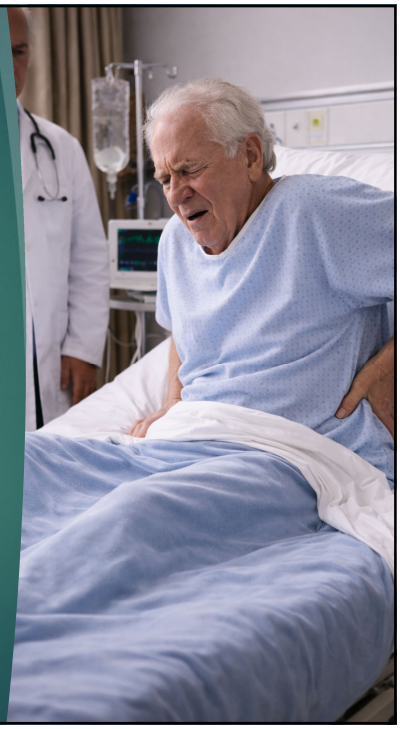
Supine Sign Test

- The patient is asked to lie supine on the examination table.
- Lying on the back increases pressure and compression on the thoracic spine.
- The test result is positive if the patient is unable to do so because of pain.
- **Sensitivity of 81% & specificity of 93%** for acute vertebral compression fractures.



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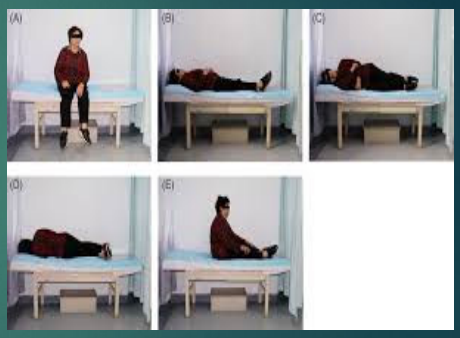
Back Pain-Inducing Test

- The patient performs a series of successive movements without assistance: sitting up on the edge of the examination table with legs hanging off, lying supine on the table, rolling to lateral decubitus on one side and then to the other side, and then sitting back up on the table with legs hanging off.
- The test result is positive if any of the movements cause back pain or if the patient is unable to perform any movement due to back pain.



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Back Pain-Inducing Test

- In a prospective study of 510 back pain patients at risk of osteoporosis:
- **Sensitivity of 99.1% and specificity of 67.9%** for identifying painful vertebral fractures
  - **Negative predictive value of 97.4%**
- **Plain radiography (50% initial detection rate)**
- A negative test rules out painful vertebral fractures so that advanced imaging can be spared/delayed

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Head Elevation Test (HET)

- **A recently published** novel test demonstrated **high accuracy** for vertebral compression fractures
- **The patient is supine on an examination table**
- **The examiner asks the patient to slowly elevate their head while keeping their neck in a neutral position.**
- A positive test is severe midline spinal pain induced before the head reaches 60° of elevation from the horizontal plane
  - Sensitivity of 92% & specificity of 86%

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Clinical Application

- These bedside tests are especially valuable in emergency medicine where MRI is not immediately available
- **Combining both the Closed-Fist Percussion Test & the Head Elevation test**
  - **Sensitivity of 96.6%**
- **Combining both the Closed-Fist Percussion Test & the Back Pain-Inducing Test**
  - **Sensitivity of 96.6%**

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ED Imaging Strategy Initial Imaging

- Plain spine X-rays (AP/lateral)
  - Can identify moderate–severe compression
  - Cannot reliably distinguish acute vs chronic
- **Sensitivity (49% to 82%)**
  - **Depending on fracture acuity, location and severity.**
  - Thoracic spine fractures (sensitivity 49-62%)
  - Lumbar spine fractures (sensitivity 67-82%)
  - **Initial sensitivity is only 50%**
  - After 10-14 days, sensitivity only reaches 30-70%.

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ED Imaging Strategy: Advanced Imaging

- **CT**
  - Excellent bony detail
  - Useful if MRI unavailable
  - Less sensitive for acuity vs MRI
- **CT sensitivity (94-100%) & specificity (99%)**
- CT cannot visualize bone marrow edema, limiting its ability to determine fracture acuity or detect non-displaced fractures without cortical disruption.

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ED Imaging Strategy: Advanced Imaging

- **MRI = gold standard**
  - Detects acute fractures via marrow edema
  - Identifies cord compromise or malignancy
- **MRI sensitivity (97-100%) & specificity (97-100%)**
- MRI modified initial diagnosis in 52% of patients vs. plain film
  - Identified new fractures in 44% and disproved fractures in 8%

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Why Geriatric Hip Fractures Matter

- Common - 300,000 cases/year in the U.S.
- **High mortality**
  - ~5–10% in-hospital mortality
  - ~12–31% mortality at 1 year
- **High morbidity** - Sentinel event → loss of independence
  - Only 50% walk independently again
  - 20% must move to a long-term care facility

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Hip Fracture

- Risk increases with age
  - Risk doubles for each decade after 50
  - Lifetime risk by age 90 = 1/3 women and 1/6 men
- Strongly consider fracture in
  - The elderly (osteopenia plus increased fall risk)
  - Patients on chronic steroid treatment

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Epidemiology & Risk Factors

- Age >65 (peak >80)
- Female > male (osteoporosis)
- Low-energy mechanisms (ground-level falls)
- Contributing factors:
  - Frailty
  - Visual impairment
  - Polypharmacy
  - Prior falls
  - Cognitive impairment

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Clinical Presentation Classic

- Hip or **anterior groin pain**
- **Inability to bear weight**
- **Obvious leg deformity with shortening, external rotation, and abduction**

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Clinical Presentation Atypical/Occult

- In some instances, patients with hip fractures may complain only of vague pain in their buttocks, knees, thighs, or back
- **Some patients' ability to walk may be unaffected**

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Geriatric Hip Fractures

Don't walk the patient!

- Clinicians should not attempt to have elderly patients with suspected hip fracture walk prior to definitive imaging.
- This is due to the significant risk of converting a non-displaced fracture to a displaced fracture.
- If a nondisplaced or impacted femoral neck fracture is treated without fixation, there is a 12% to 33% risk of fracture displacement prior to healing.

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Screw fixation is the standard of care for nondisplaced femoral neck fractures

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Don't ambulate the patient

- The rationale for surgical stabilization is precisely to avoid the risk of displacement that occurs with weight-bearing on an unstable fracture
- Risks converting a potentially salvageable nondisplaced fracture into a displaced fracture
- Approach changes from simple internal fixation to arthroplasty
  - Hemiarthroplasty or total arthroplasty

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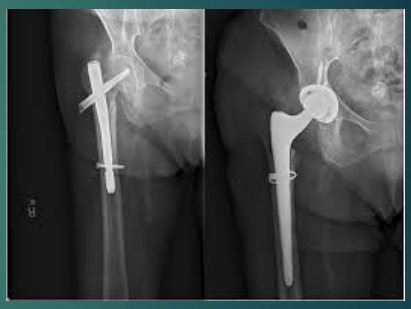
Fundamentally changes the surgical approach

- This represents a more extensive operation with potentially higher perioperative risk, particularly in frail elderly patients.
- A retrospective analysis of 1,273 patients with nondisplaced femoral neck fractures found that the 1-year mortality rate for hip screws was 2 - 2.5%, and for hemiarthroplasty was 9%.



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2024 ACR Appropriateness Criteria

- Plain radiography with AP & lateral views for initial imaging of acute hip pain with suspected fracture.

- However

- The ACR acknowledges that multiple studies have demonstrated that radiographs have limited sensitivity for fracture detection of the proximal femur in elderly osteoporotic patients.

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Plain Radiography

- **The sensitivity of plain radiography for hip fractures ranges from 49% to over 90%**
  - Depends on the study population and fracture characteristics
  - **Specificity 94-100%**
- **X-ray is excellent for ruling in hip fracture when positive, but inadequate for ruling out fracture when negative.**

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Plain Radiography

- **9% rate of radiographically occult hip fractures**
- A meta-analysis found that among 2,992 elderly patients (mean age 76.8 years) with clinically suspected hip fracture, **39% had radiographically occult surgical hip fractures when no definite fracture was visible on initial radiographs.**
- **Non-displaced and impacted fractures are particularly difficult to detect on plain radiographs.**

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Plain Radiography

- The systematic review found that **in patients with radiographic evidence of isolated greater trochanter fracture, 92% actually had additional occult surgical hip fractures** when evaluated with MRI
  - Significant injuries to the femoral neck or intertrochanteric region that required surgical intervention.

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PEARL

- The presence of any fracture fragment visible on radiographs in an elderly patient with hip pain should not provide false reassurance that the full extent of injury has been identified.
- It should trigger immediate advanced imaging to identify the associated surgical fracture that is frequently present.

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A pilot study analyzing initial radiographs of occult femoral neck fractures

- The prevalence of occult femoral neck fracture was 3.3%, and that **initial radiographs were not routinely negative**
  - **87.5% of patients with occult fractures had at least one subtle radiographic sign** that was missed on initial interpretation.
  - Many "occult" fractures are actually visible retrospectively but are overlooked during initial ED evaluation.

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Hip X-ray tips

- Important radiographic line of the normal hip
  - Shenton's line
- "Lazy S" lines
- Trabecular markings

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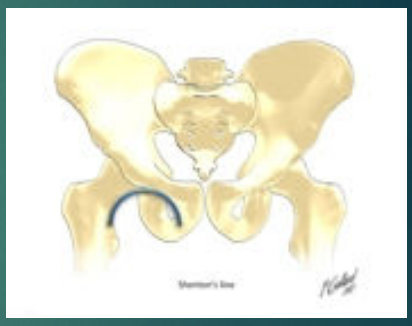
Shenton's line

- An arc line connecting the **inferior margin of the superior pubic** ramus should connect with the **inferior margin of the femoral neck**
- Step-off or discontinuity raise suspicion for subtle cases of femoral head/neck fractures or hip dislocation



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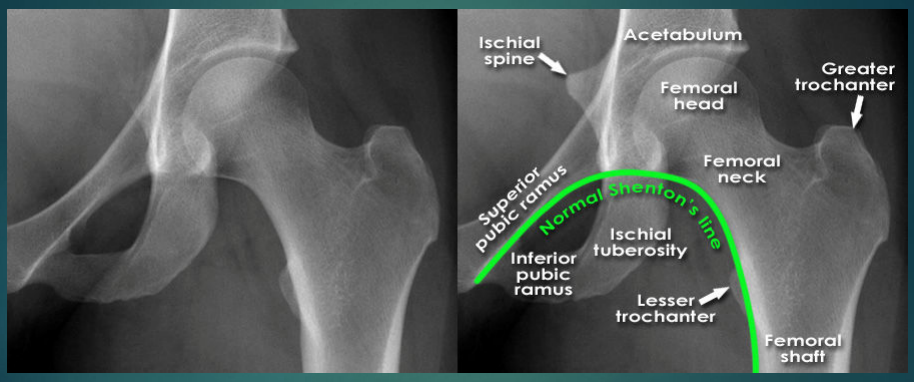

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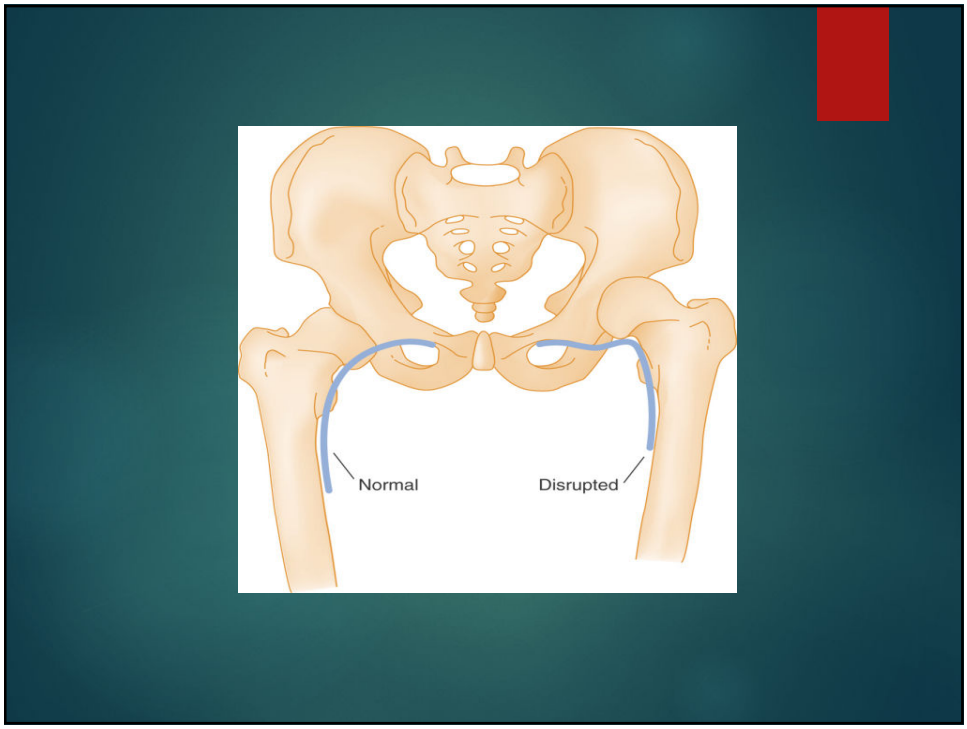

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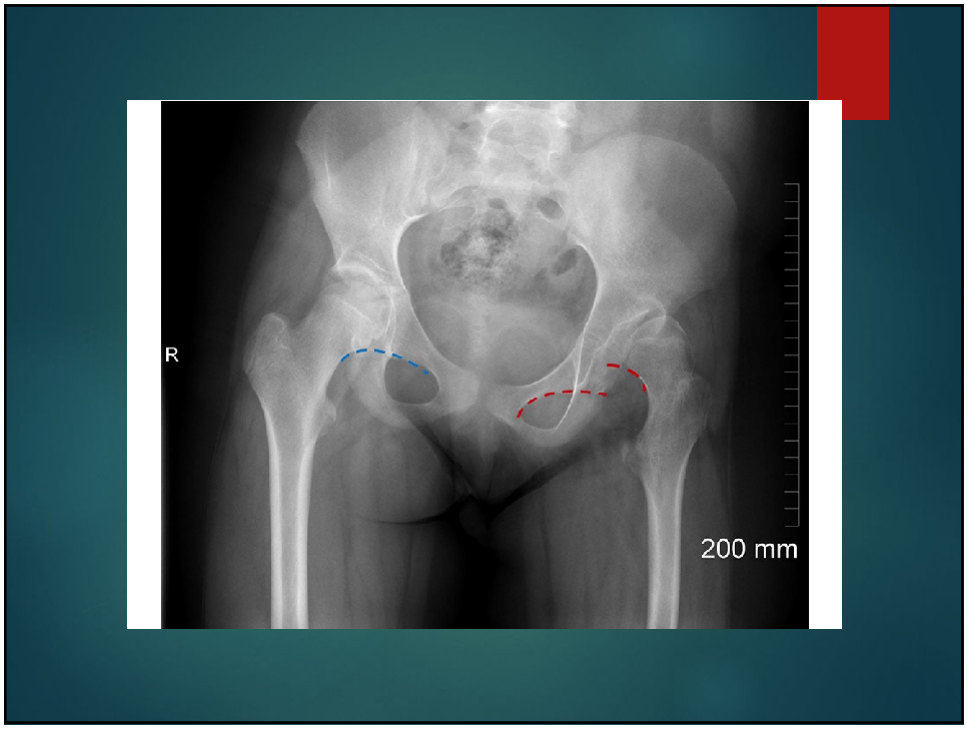

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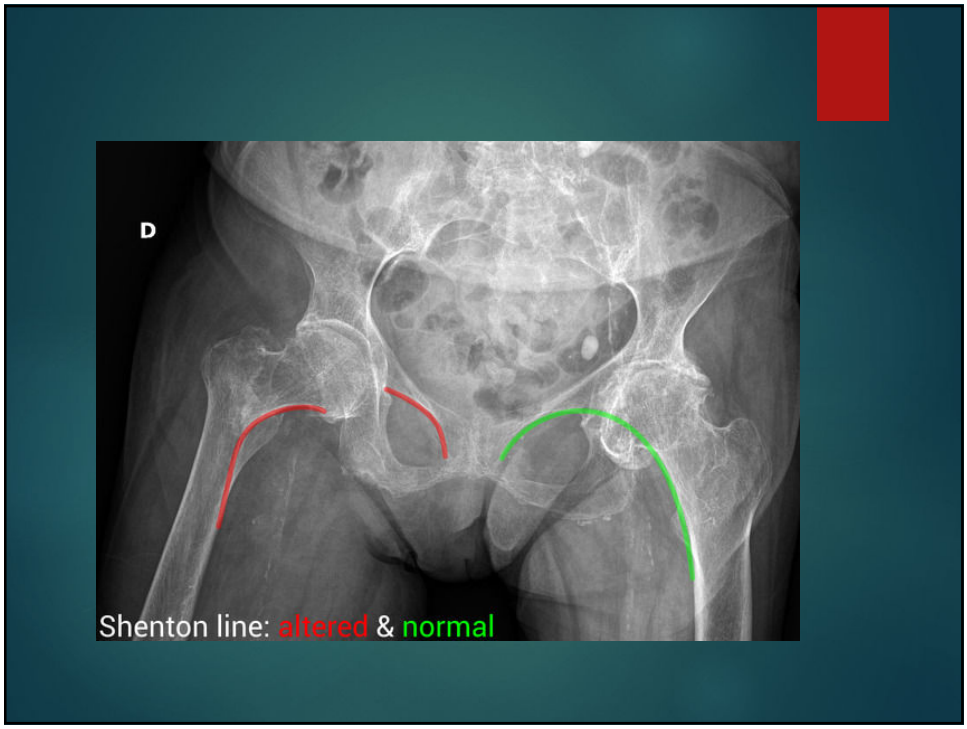

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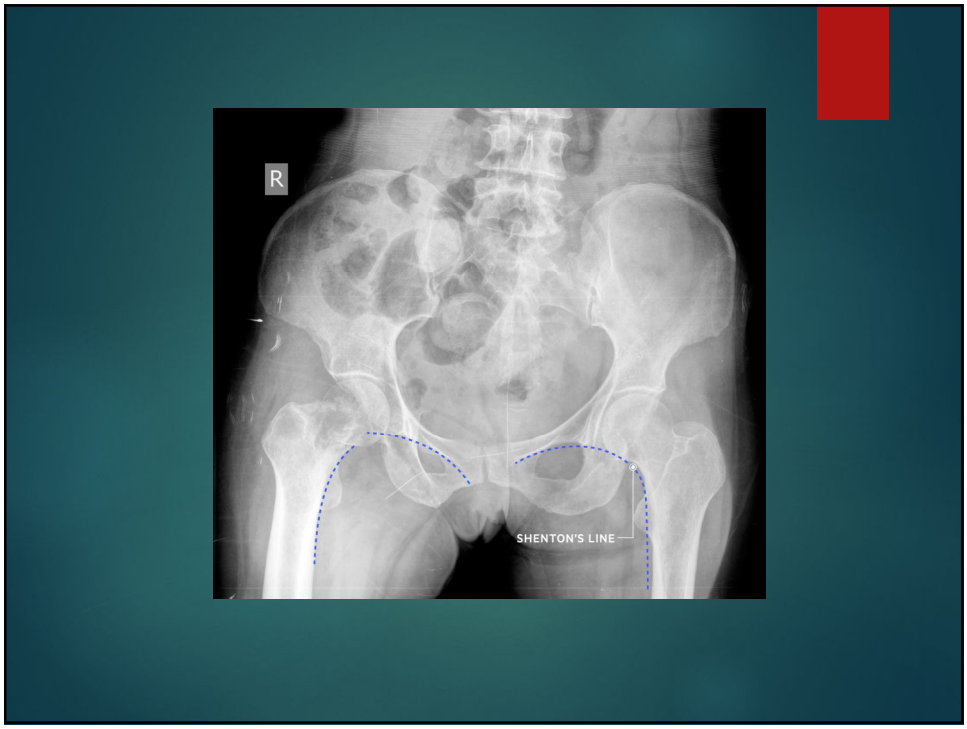


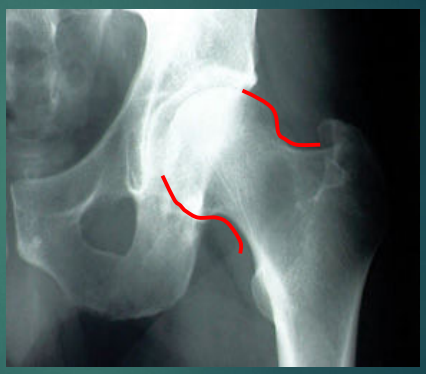
90

The Lazy **S** Sign

- The normal radiographic anatomy of the femoral head and neck reveal a **convex outline of femoral head joining the concave outline of femoral neck**
- This is seen on all radiographic views

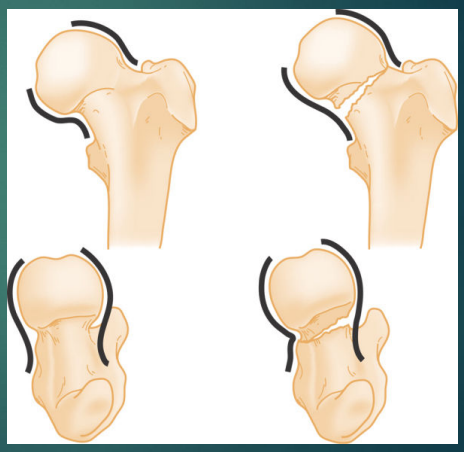
91

- The outline produces the image of an "S" or a reversed "S" curve



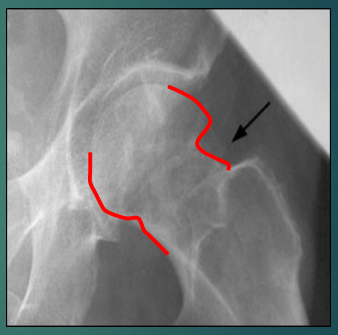
92

- A fracture will produce a tangential or sharp angle



93

- A fracture will produce a tangential or sharp angle



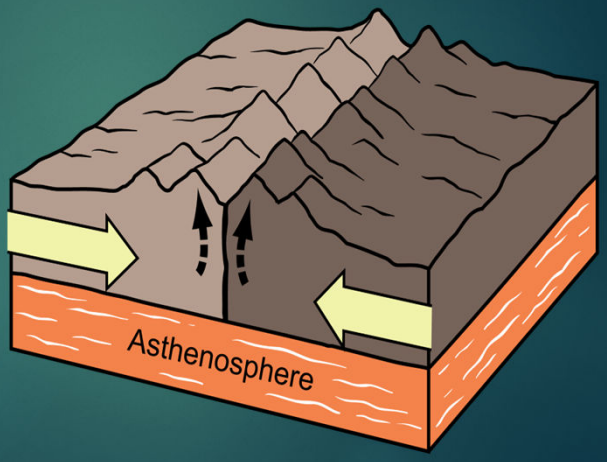
94

Occult Femoral neck fracture

- The most commonly missed hip fracture
  - Patients with nondisplaced fractures
    - 15 – 20% may walk with a limp

95

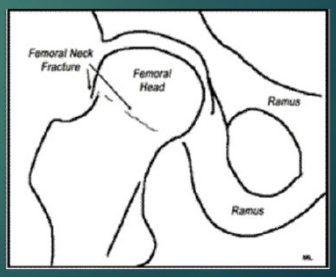
- Telescoping of the femoral neck into the head, which compresses and jams the trabeculae together, creating a distinct sclerotic line



96

Femoral Neck Fracture

- Look for overlap of trabecular markings – Impacted fracture
- Appears at the junction of the femoral head and neck
- A distinct line of increased density consisting of overlapped trabecular bone.



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Validated Radiographic Signs for occult femoral neck fracture

- **The lateral and posterior cortical sign**
  - Sensitivity of 87.5% and specificity of 90.6%
- **Elevation of the fat pad (≥1.5 mm)**
  - Sensitivity of 86.7% and specificity of 85.7%

98

Occult femoral neck fractures

- **The lateral cortical sign and posterior cortical sign demonstrate the highest diagnostic accuracy.**
- These cortical signs represent subtle disruptions or irregularities in the cortical outline of the femoral neck that may be the only radiographic evidence of a non-displaced fracture.

99

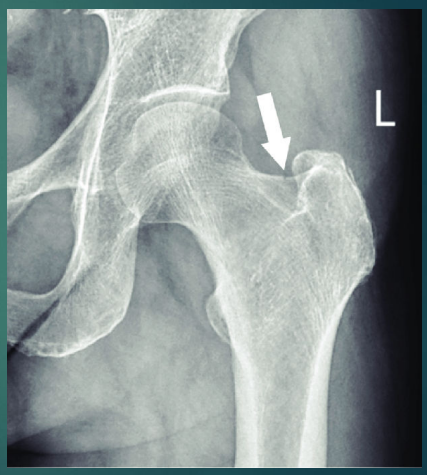
Definition and Radiographic Appearance

- The **lateral cortical sign** is identified on the **AP view**
- Carefully examining the lateral (superior) cortical margin of the femoral neck.
  - Using adequate magnification
  - Comparing the affected side to the contralateral hip for asymmetry
- Normally, this cortical outline should appear as a smooth, continuous line extending from the femoral head to the intertrochanteric region.
- **A positive lateral cortical sign is present when there is visible disruption, step-off, irregularity, or subtle lucency along this normally smooth cortical outline.**

100

Lateral Cortical Sign

- The sign may be subtle and requires systematic evaluation of the entire lateral femoral neck cortex
- The disruption may be small and easily overlooked during rapid ED interpretation
- The fracture line in occult femoral neck fractures is often oriented perpendicular to the cortex, creating a subtle break in the cortical continuity



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Definition and Radiographic Appearance

- **Posterior cortical sign: Disruption or irregularity in the posterior cortical outline of the femoral neck visible on lateral radiographs**
- Carefully examine the posterior (dorsal) cortical margin of the femoral neck.
- Normally, this cortical outline should appear as a smooth, continuous line extending from the femoral head posteriorly along the femoral neck.
- **A positive posterior cortical sign is present when there is visible disruption, step-off, irregularity, or subtle lucency along this normally smooth cortical outline.**

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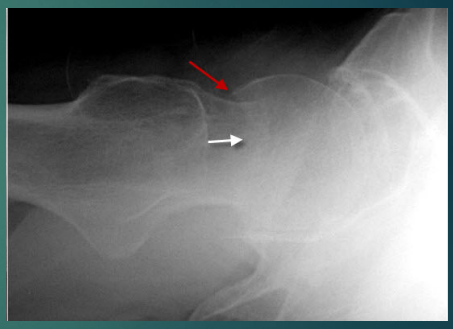
Posterior Cortical Sign

- The sign may be subtle and requires systematic evaluation of the entire posterior femoral neck cortex.
- The disruption may be small, subtle and easily overlooked during rapid ED interpretation.
- The fracture line in occult femoral neck fractures is often oriented perpendicular to the cortex, creating a subtle break in the cortical continuity.



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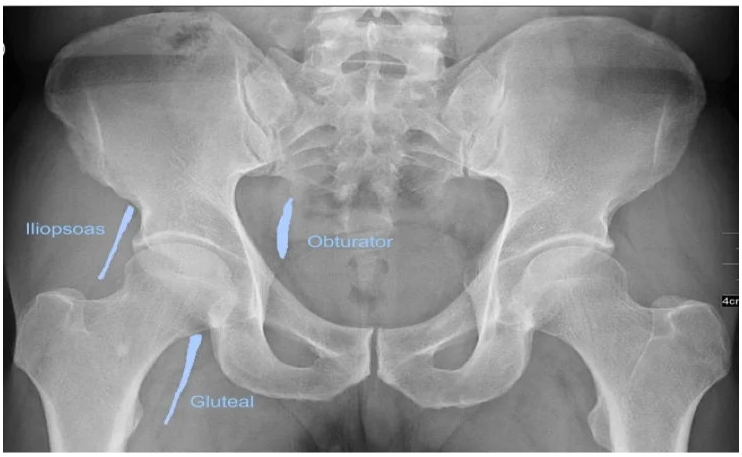
Fat Pads



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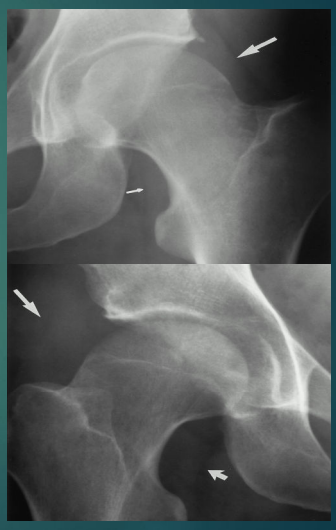
Elevation of the fat pad ≥1.5 mm

- High sensitivity (86.7%) & specificity (85.7%) for diagnosing occult femoral neck fracture
- The fat pad sign reflects joint effusion or hemarthrosis secondary to the fracture
- Measure the distance of fat pad displacement from normal position



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ED Imaging Strategy

- **Initial:** AP pelvis + lateral hip X-rays
- **If negative, do I obtain more views or proceed to advanced imaging?**

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Proceed directly to CT

- The ACR found that increasing the number of radiographic projections **did not decrease the need for CT** in a recent meta-analysis
- This finding supports the recommendation to proceed directly to CT rather than obtaining additional plain film views when initial radiographs are negative or indeterminate but clinical suspicion persists.

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AP pelvis + lateral hip X-rays

- **If negative but suspicion remains:**
  - **Non contrast CT**
  - However, when clinical suspicion remains, despite a normal or inconclusive CT scan, an MR is warranted
  - **MRI = gold standard**
- The ACR notes that CT has advantages over MRI in terms of speed as well as use in patients with significant confusion, an important consideration in the geriatric population

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CT: The good, the bad/ugly

- In a meta-analysis of 1,248 patients with clinically suspected hip fracture and negative radiographs, CT demonstrated 94% sensitivity and 100% specificity.
- CT after negative radiographs found occult hip fractures in 24% of patients and led to a change in management in 20% of cases.

- **BUT**

- There were 50 false-negative CT examinations in the study cohort.

109

MRI: The Gold Standard **100% sensitive**

- In a retrospective study of patients with clinically suspected but radiographically occult hip fracture, all patients underwent CT, and if the CT was negative, the patients then had MRI to exclude CT-occult fracture.
- 49% of patients were diagnosed with fracture by CT alone, **23% of the negative CT patients were found to have a fracture on MRI that necessitated surgery**.
- The mean time from admission to diagnosis was 3 hours for the CT-only group and 40 hours for the CT plus MRI group, illustrating the trade-off between CT's speed and MRI's superior sensitivity.

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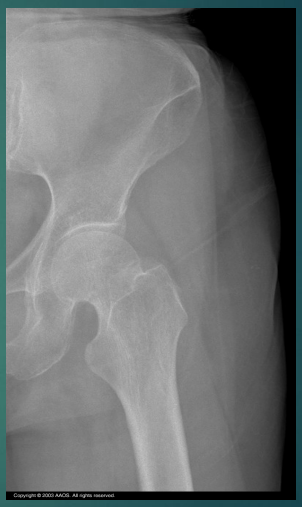
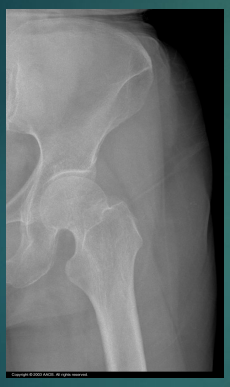
Normal appearing AP view of the L femur



111

T1-weighted MRI of the same left femur



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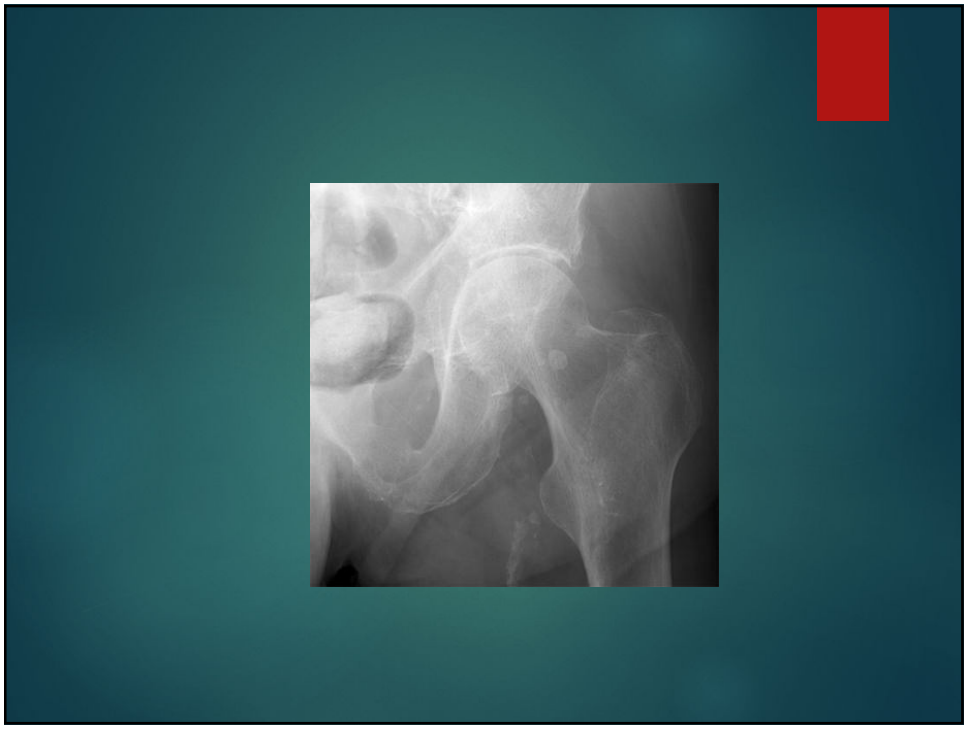

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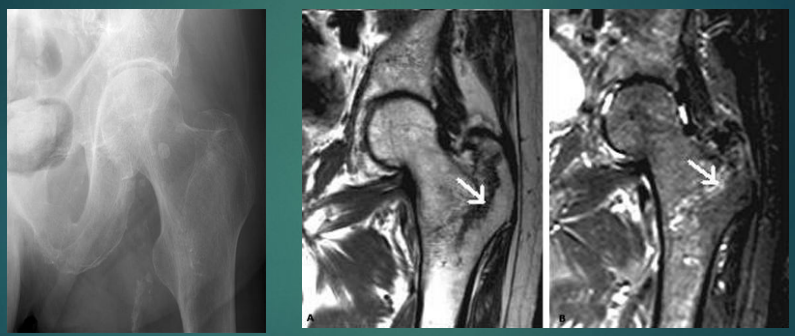
Plain film versus MRI



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CT vs MRI

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Let's Review the Imaging Algorithm

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The Imaging Algorithm

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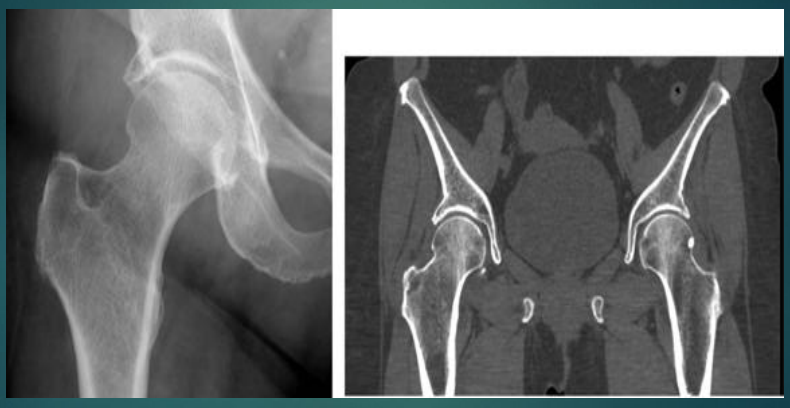
The Imaging Algorithm



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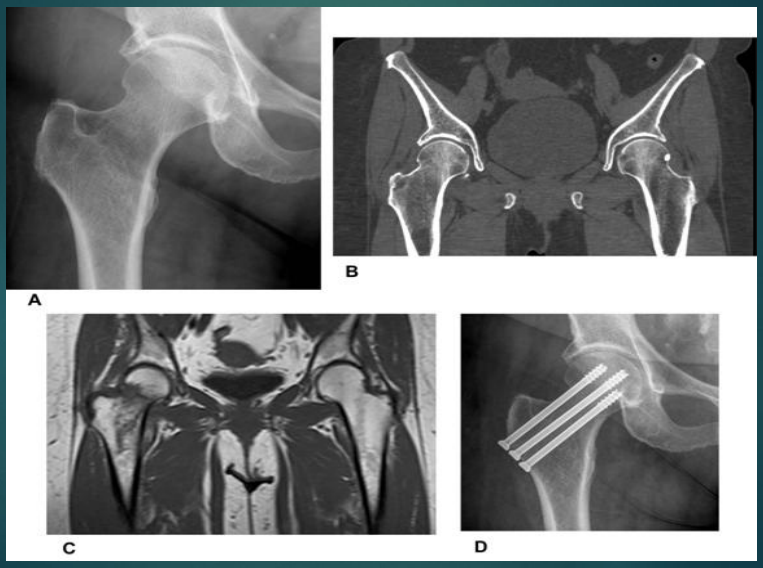
The Imaging Algorithm



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The End

THANK YOU FOR YOUR TIME AND ATTENTION

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