Geriatric Fractures

Michael Maher, MD

AHN Orthopaedic Trauma

Disclosures

- none

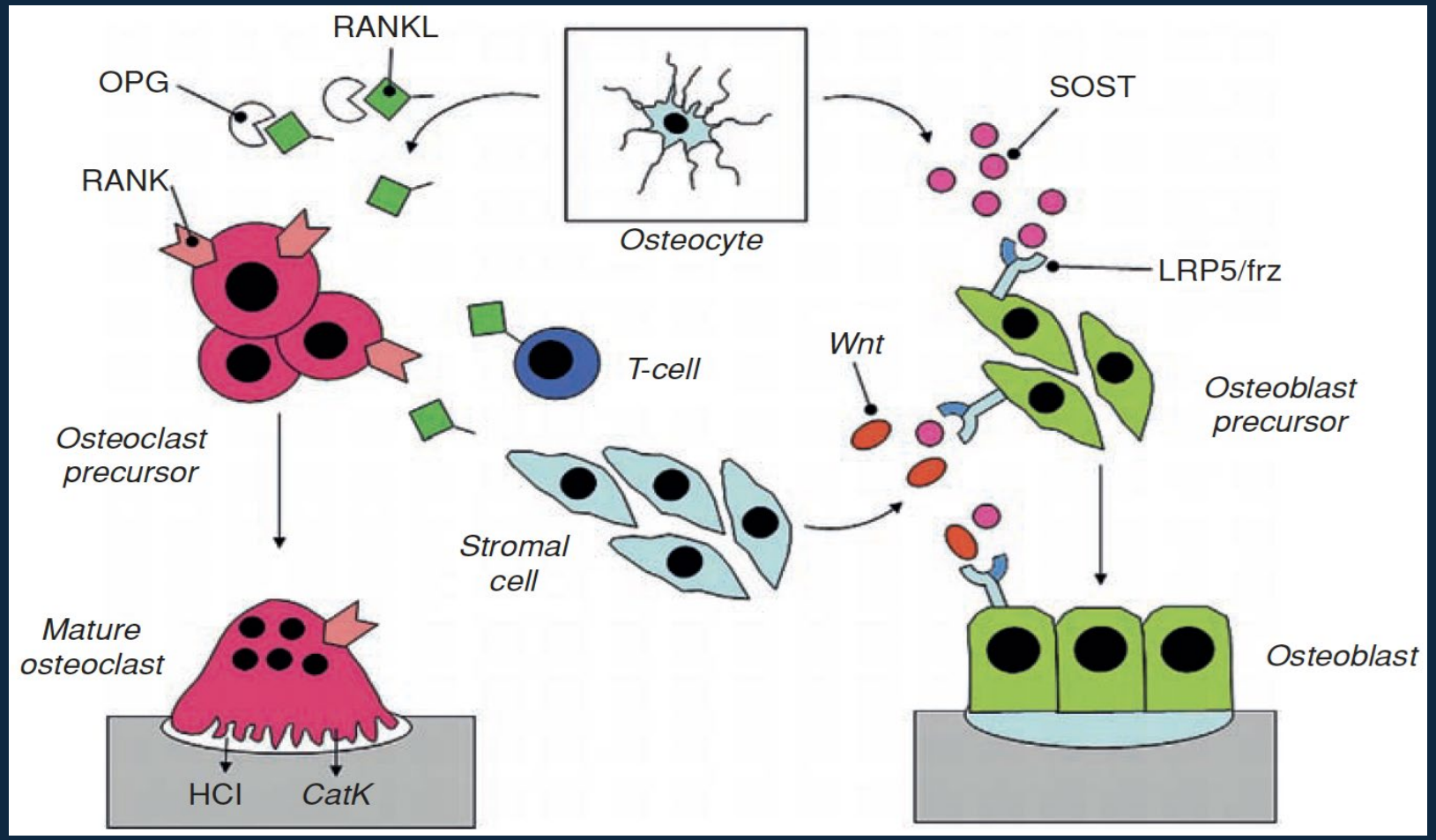
Acknowledgement OTA Core Curriculum

Goals

Review

- Osteoporosis
- Common geriatric fractures
- Treatment considerations
- Cases

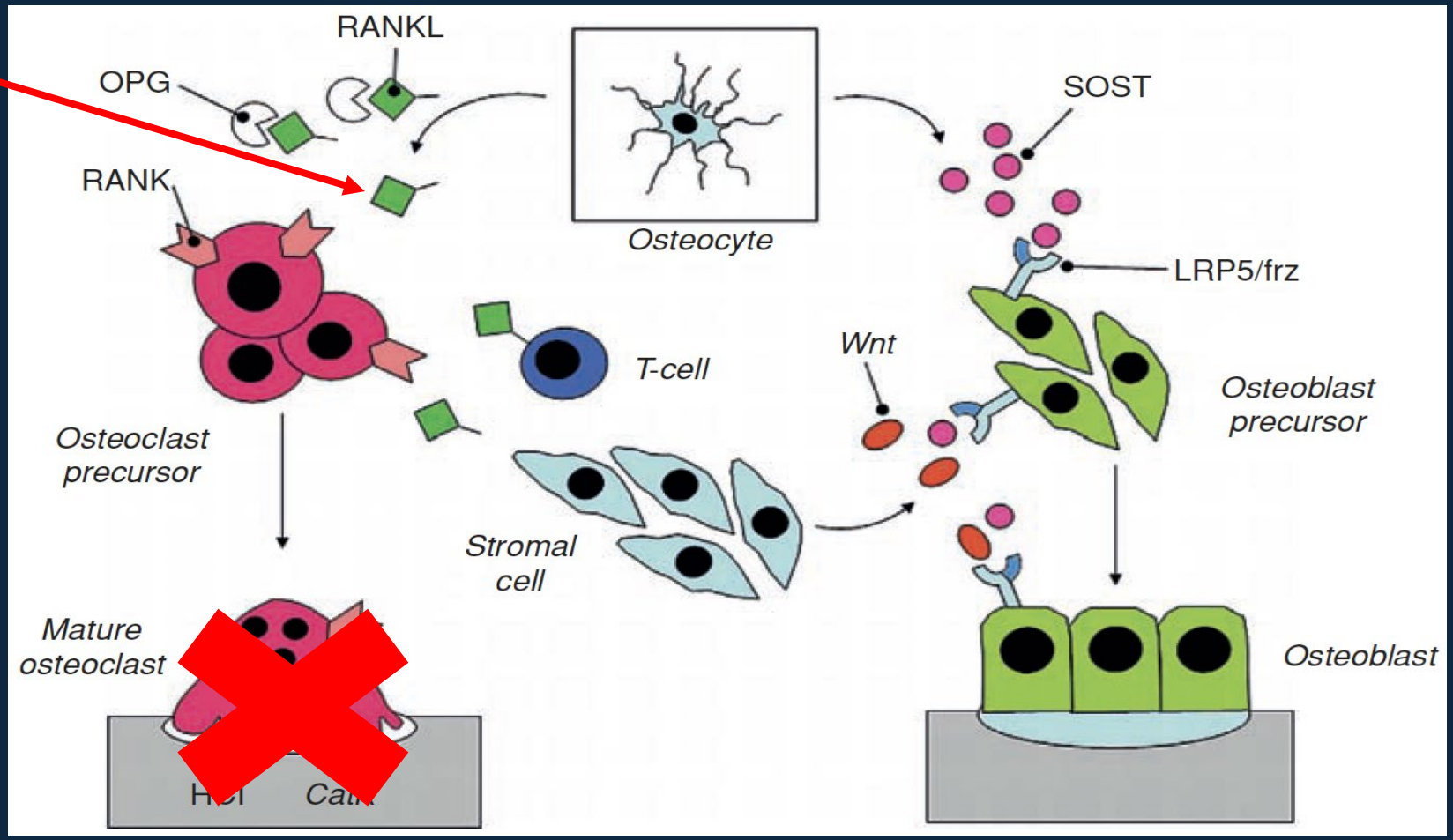
Molecular Regulation of Bone



Molecular Regulation of Bone

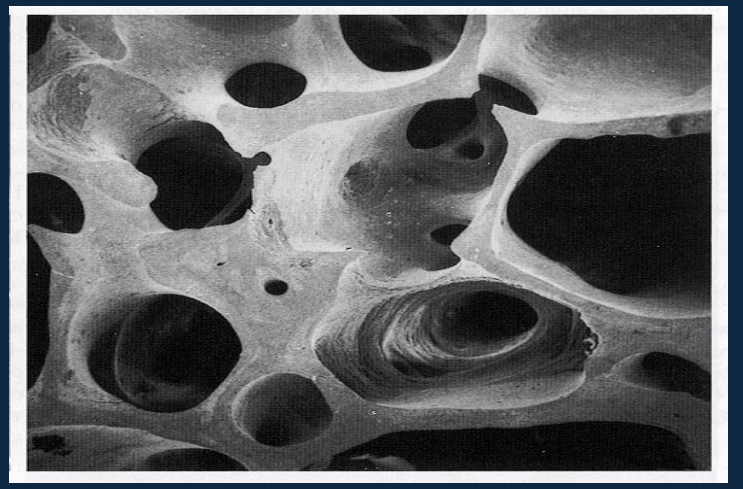
Prolia (denosumab)

Bisphosphonates



Basic Science

- Bone mass increases until age 25-30
- Osteoclast activity > osteoblast activity as age increases, particularly after menopause in women
- Results in thinned trabeculae and fragile cortices



Normal Trabeculae

Osteoporotic Trabeculae

Osteoporosis

- Definition:
  - Metabolic bone disease characterized by reduced bone mass and microarchitectural deterioration of bone tissue
- Diagnosis:
  - T-score less than -2.5
  - Z-score less than -2.0
  - Hounsfield units less than 85-110
  - Presence of a fragility fracture (low energy fracture of vertebral body, hip, proximal humerus, or distal radius)

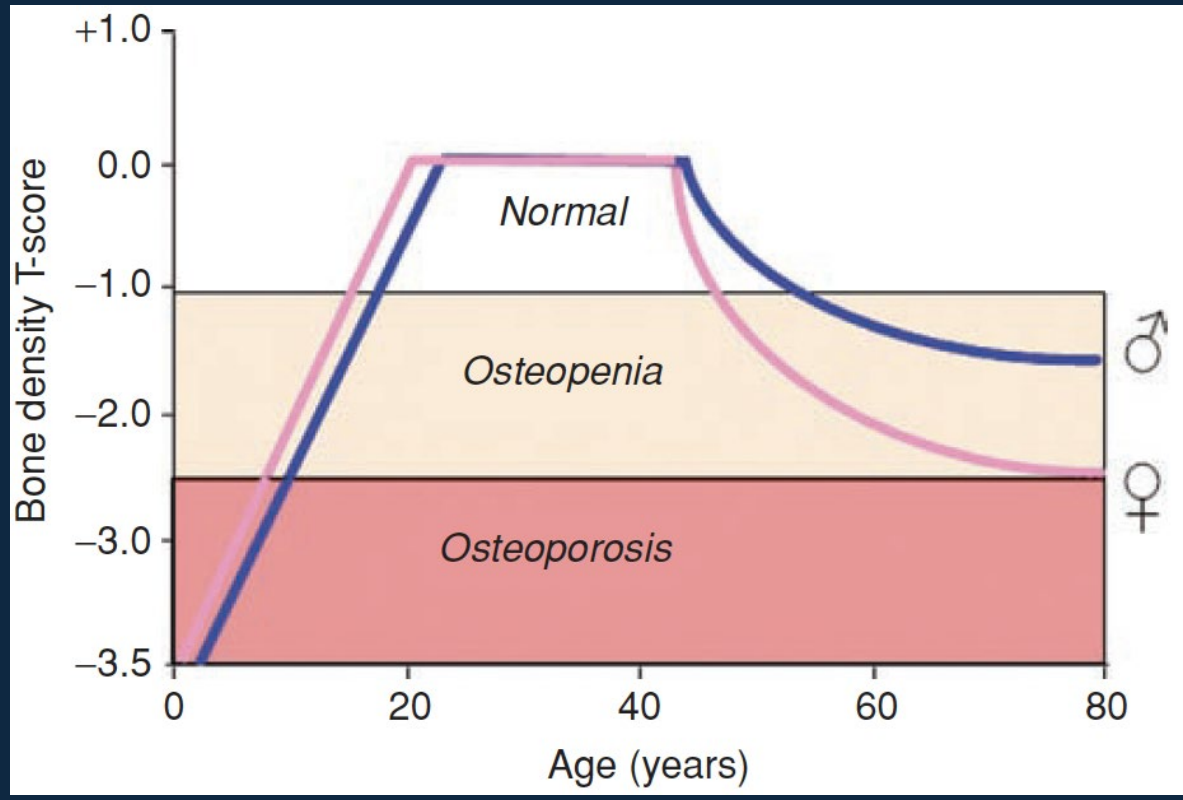
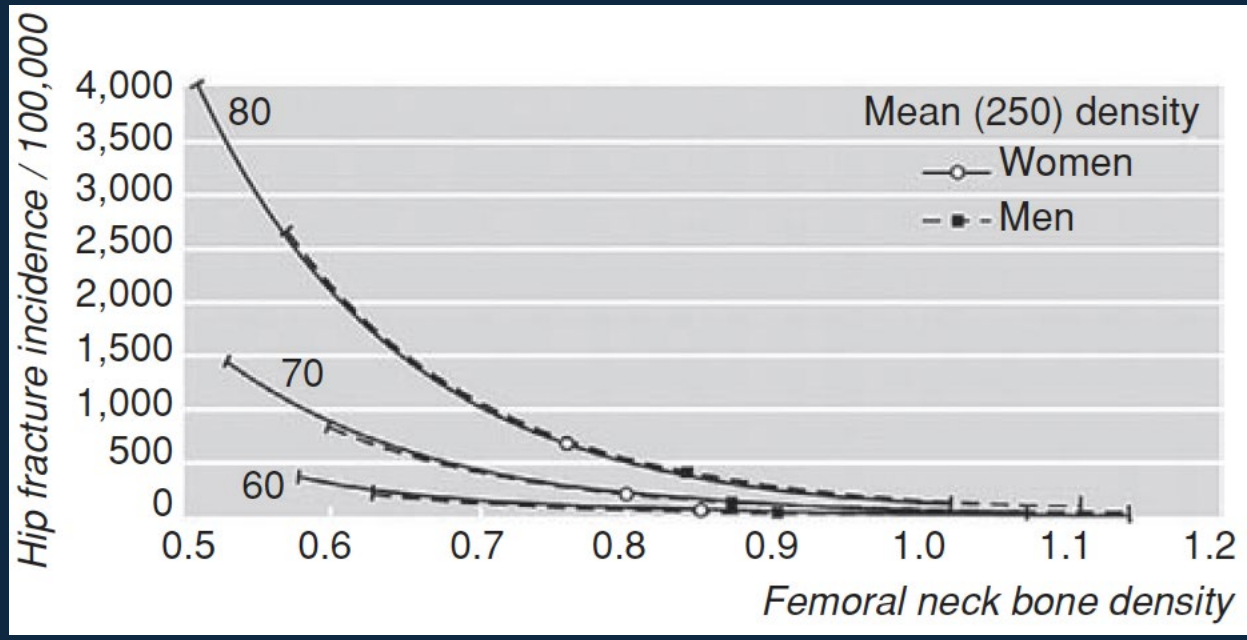


TABLE 19-1 Risk Factors for Osteoporosis and Fractures

- Smoking
- Excessive alcohol intake (>3 units/day)
- Low body weight (BMI <19)
- Early menopause
- Genetic factors
  - Race
  - Family history hip fracture
- Diseases
  - Thyrotoxicosis
  - Rheumatoid arthritis
  - Primary hyperparathyroidism
  - Cushing syndrome
  - Hypogonadism
  - Anorexia nervosa
  - Cancer
  - Chronic liver disease
  - Celiac disease
  - Cystic fibrosis
  - Epilepsy
- Drugs
  - Corticosteroids
  - Thyroxine
  - Gonadotrophin releasing hormone agonists
  - Sedatives
  - Anticonvulsants

Why do we care?

- Aging population
- Lifetime risk of fragility fracture ~40-50% in females and 13-22% in males
- Likelihood increases with age
- Surgical Issues With Osteoporotic Bone
  - Thin, fragile cortices
  - Poor screw purchase
  - High risk of screw “cutout”
  - Difficult to obtain rigid fixation
  - Decreased healing potential



Osteoporosis Treatment

- Antiresoptive medications – inhibit bone breakdown
  - Bisphosphonates (oral and IV)
  - Prolia (denosumab)
  - Selctive estrogen reuptake modulators (SERMs)
  - Calcitonin
- Anabolic medications – stimulate bone formation
  - Parathyroid hormone analog (Forteo/Teriparatide)
  - Parathyroid hormone related protein analog (Tymlos/Abaloparatide)
  - Sclerostin Inhibitors (Evenity/Romososumab)

Treatment Goals

- Mobilize
  - WBAT
  - Minimize periods of bedrest

- Minimize surgical morbidity
  - Safest operation
  - Decrease chance of reoperation

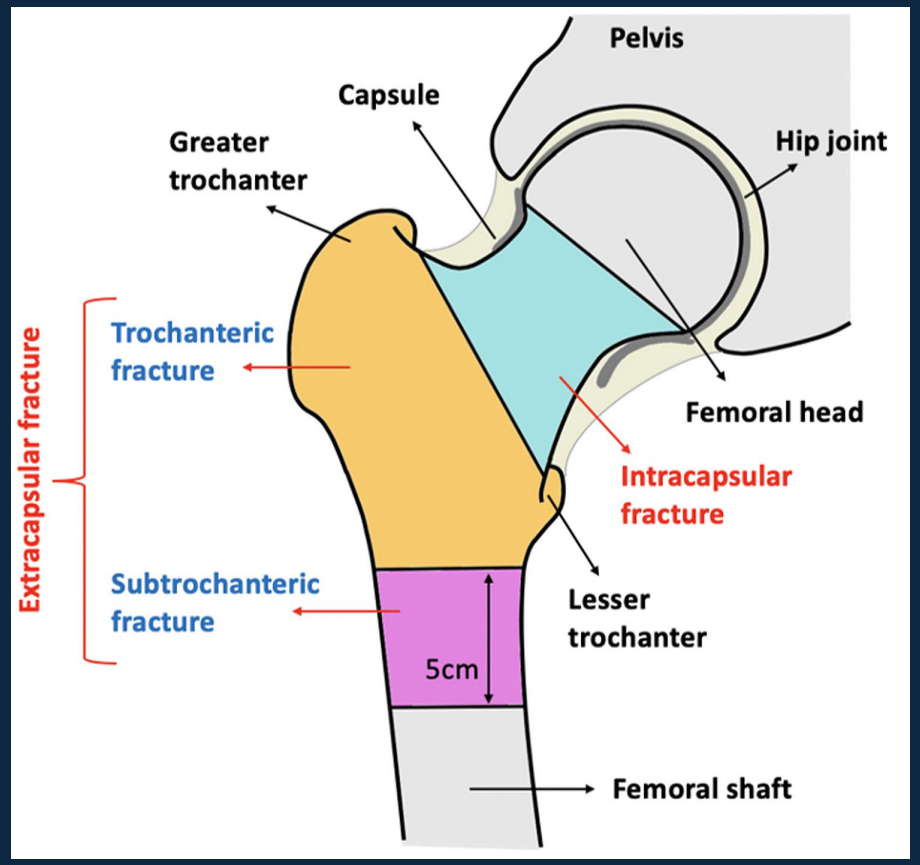
- In general, the treatment of osteoporotic fractures increase the difficulty of treatment and likelihood of complications…

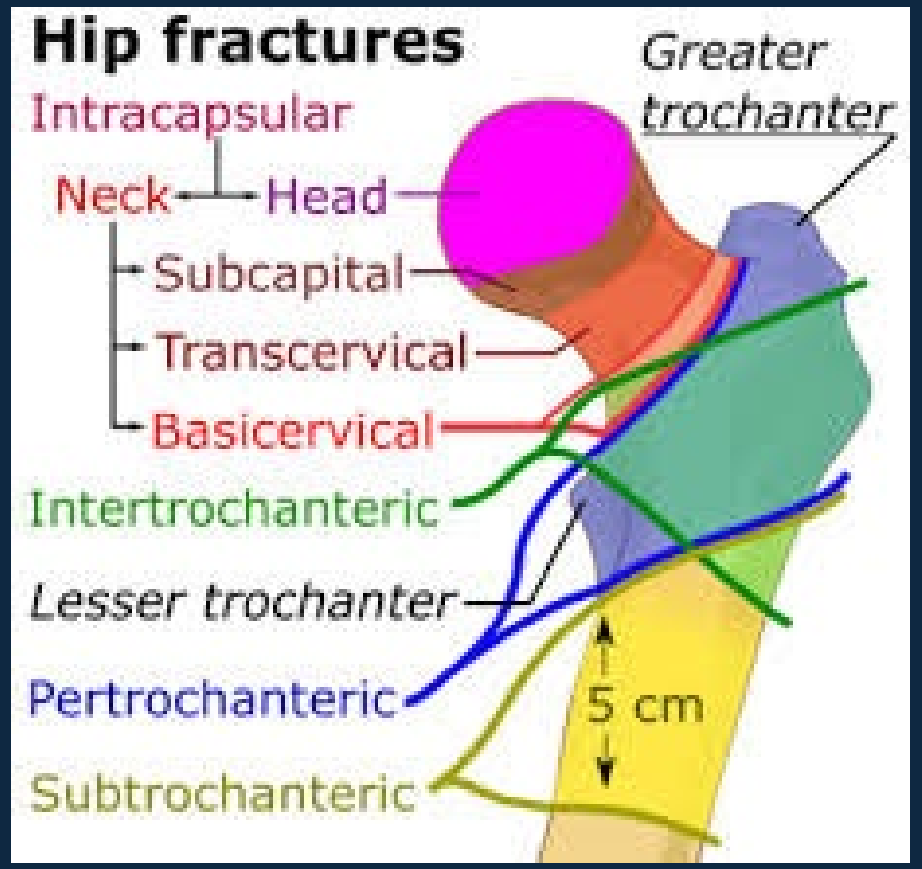
Common Fractures

Hip Fractures

Femoral Neck Fractures

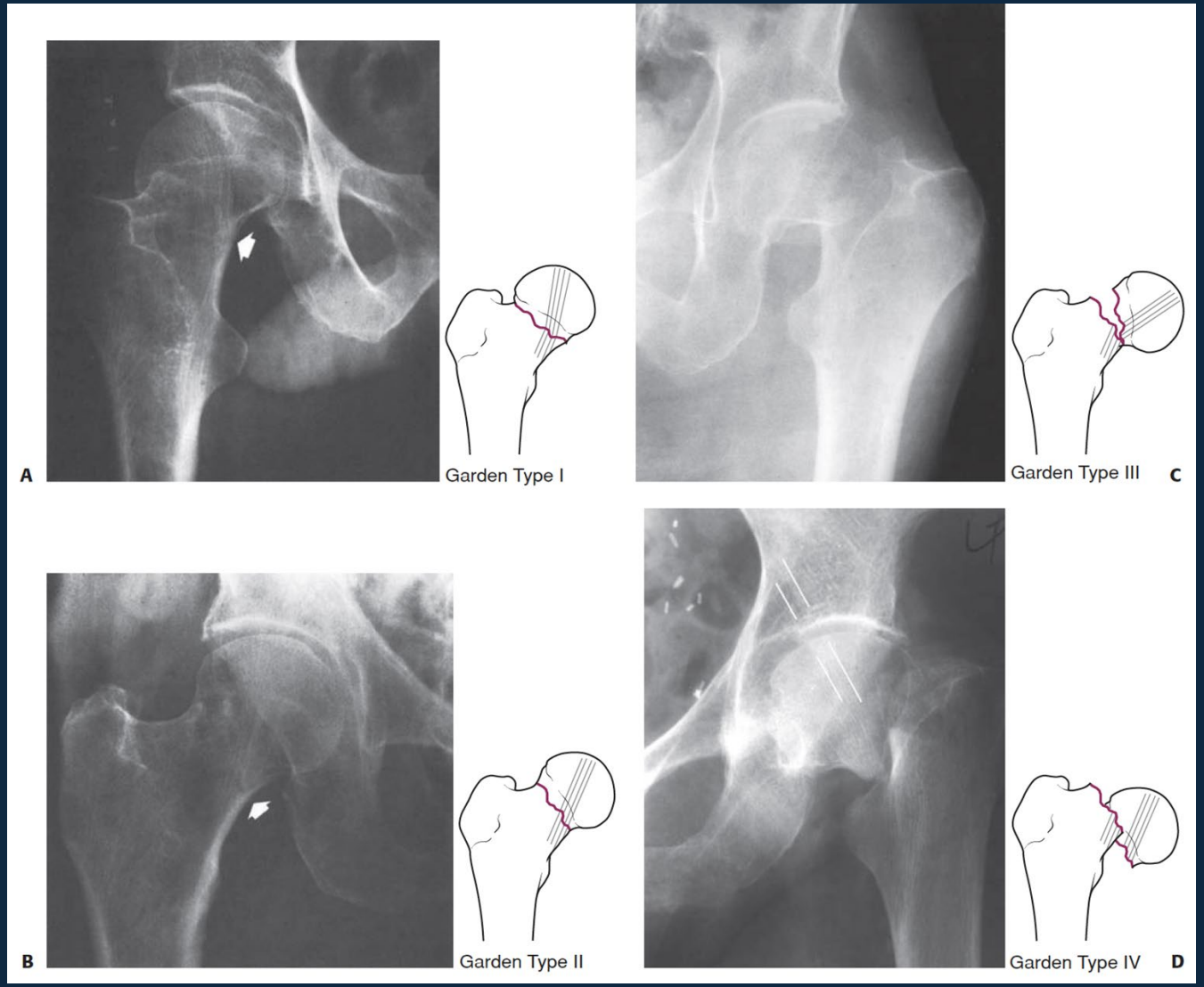
- Intracapsular





Femoral Neck Fractures

- Garden Classification
  - Simplified:
    - Nondisplaced
      - I (valgus impacted)
      - II (nondisplaced)
    - Displaced
      - III and IV

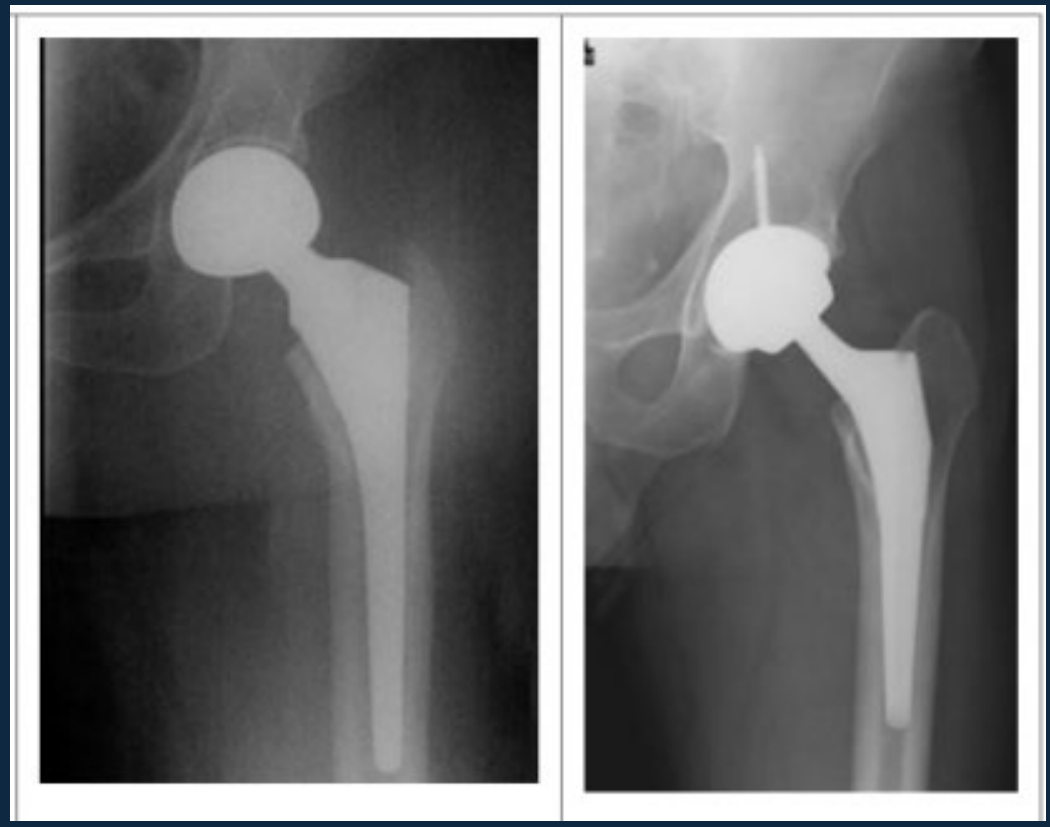


Femoral Neck Treatment Strategies

- Non op – reserved for patient with low chance of survival due to medical comorbidities
  - *rare
- **Nondisplaced – ~~O~~RIF**
  - Cannulated screws
  - Siding hip screw device
- Displaced – Arthroplasty
  - Hemiarthroplasty
    - Cemented vs. Uncemented
    - Unipolar vs. Bipolar
  - Total hip arthroplasty

Femoral Neck Treatment Strategies

- Non op – reserved for patient with low chance of survival due to medical comorbidities
  - *rare
- Nondisplaced – ORIF
  - Cannulated screws
  - Siding hip screw device
- **Displaced – Arthroplasty**
  - Hemiarthroplasty
    - Cemented vs. Uncemented
    - Unipolar vs. Bipolar
  - Total hip arthroplasty



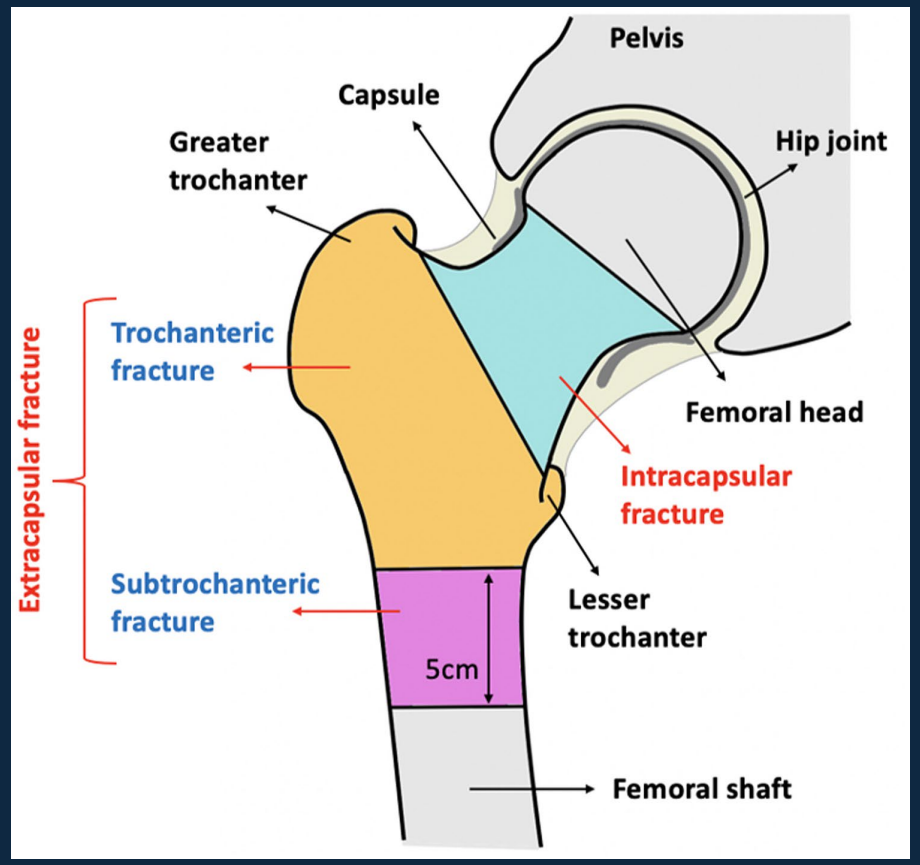
Femoral Neck Treatment Strategies

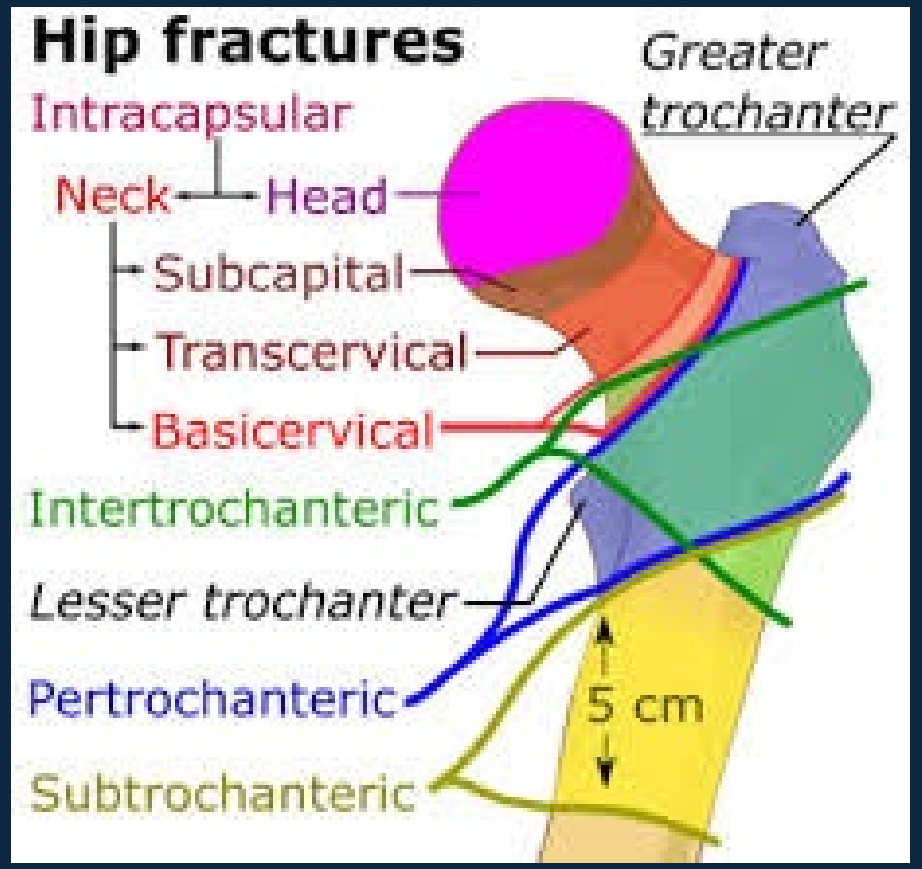
Pitfalls

- Nonunion
- Hardware failure
- Gait abnormalities
- Conversion arthroplasty

Intertrochanteric Femur Fractures

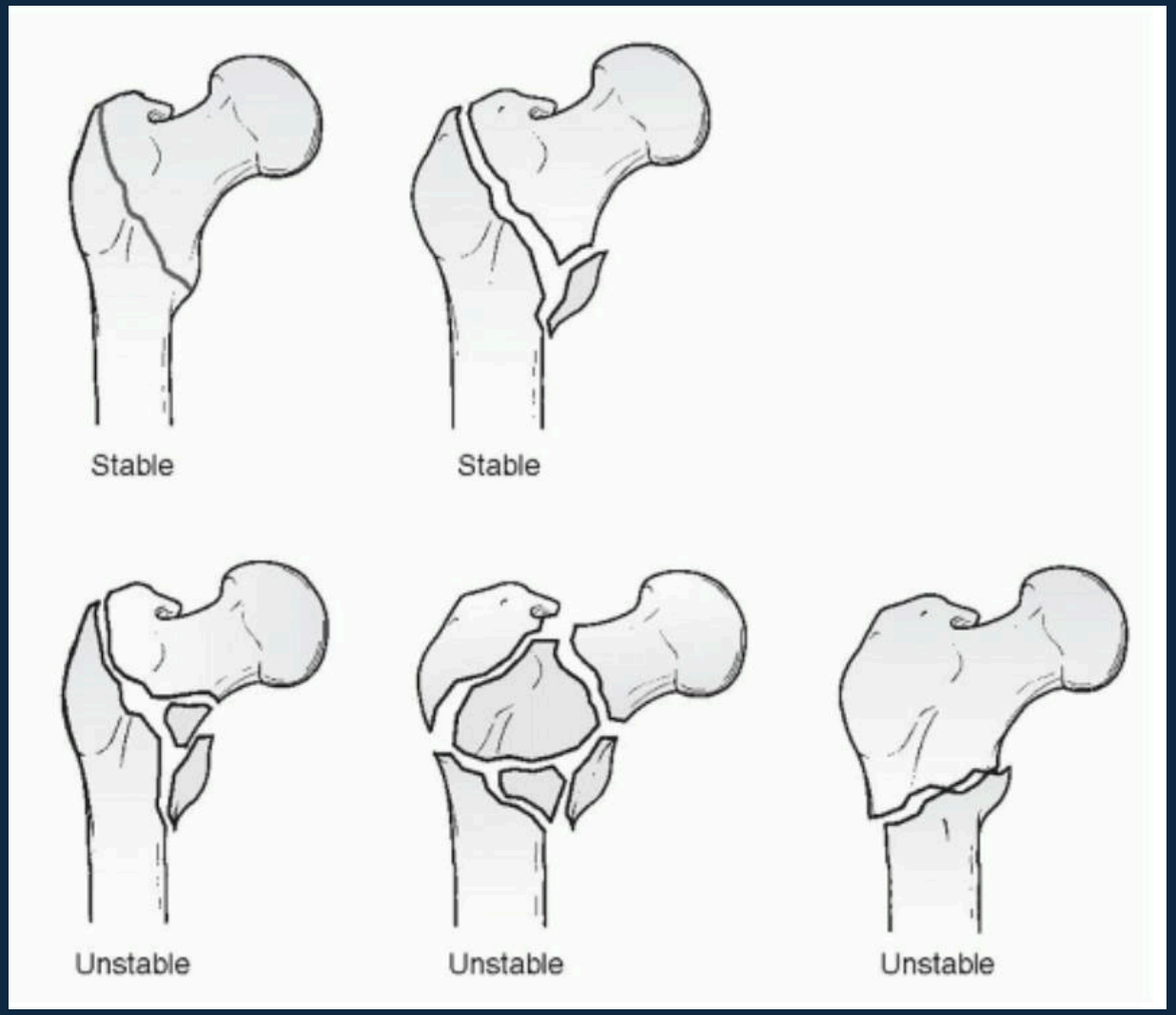
- Extracapsular





Intertrochanteric Treatment Strategies

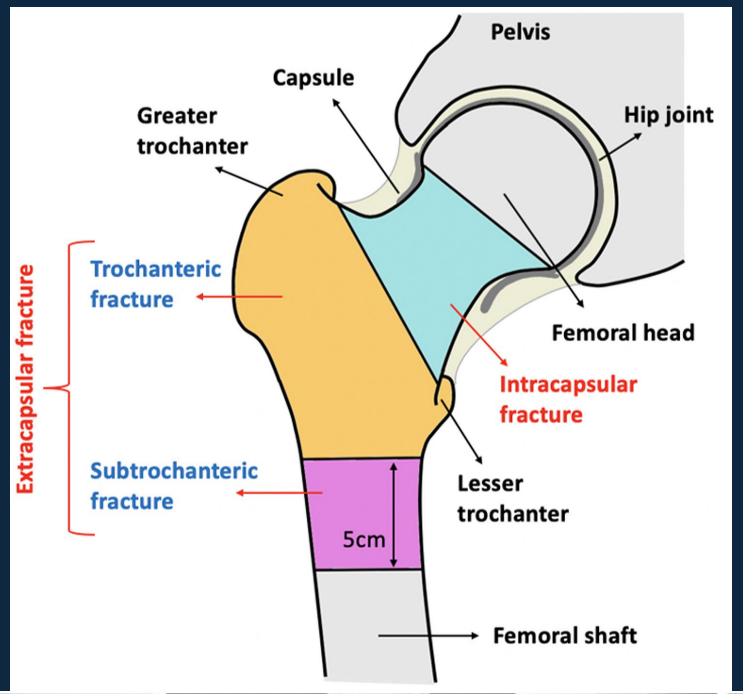
- Stable
- Unstable

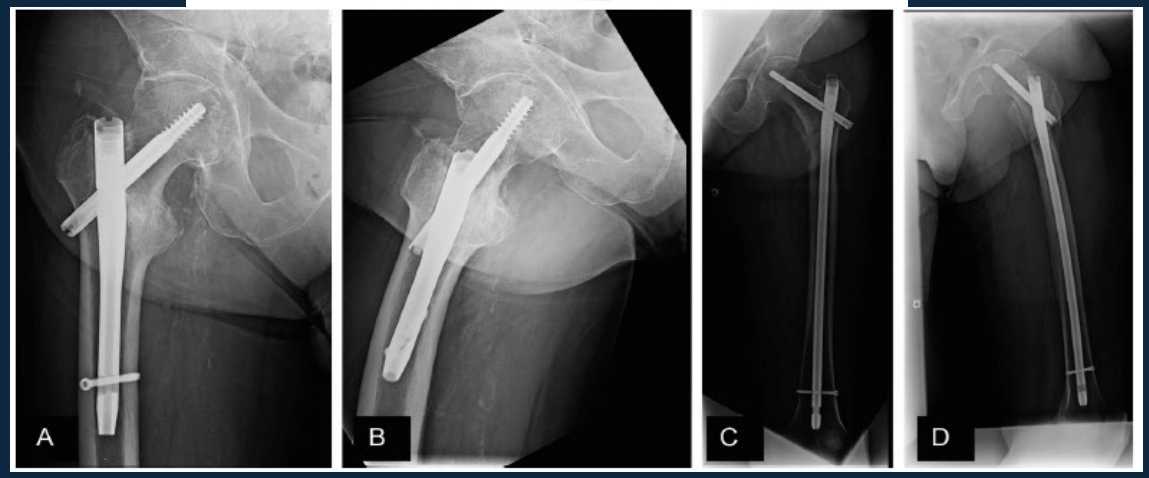


Intertrochanteric Treatment Strategies

Short vs Long

- What the literature says:
  - Long = longer operative time, increased blood loss, no difference in outcomes
  - Indications for long:
    - Subtroch extension >3-4cm
- Arguments for long nail in all patients
  - Protect entire femur in this osteoporotic femur that has proven to be prone to falls
  - Counter – more bone stock for fixation distal to a short nail in case of peri-implant fracture





Intertrochanteric Treatment Strategies

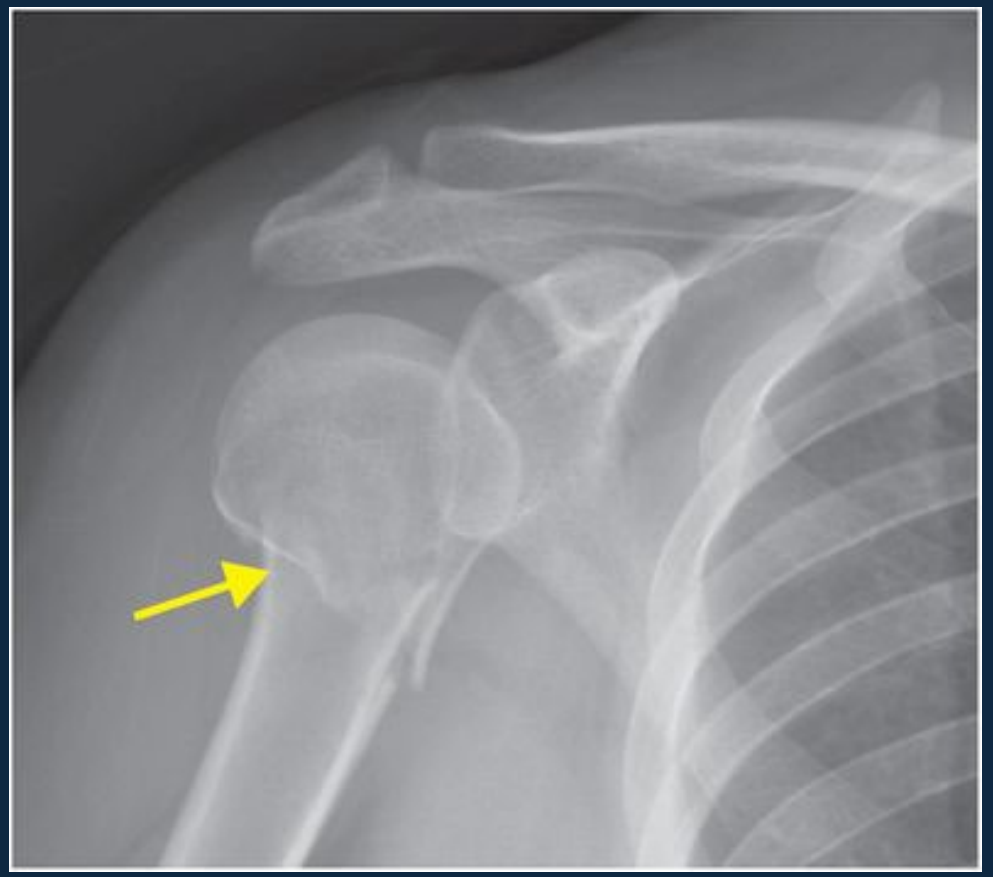
Pitfalls

- Implant choice
- Screw cutout
- Subtrochanteric involvement

Proximal Humerus Fractures

Proximal Humerus Fractures

- Common fractures in older patients with osteoporotic bone
- third most common non-vertebral fracture pattern seen in the elderly (>65 years old)
- two-part surgical neck fractures are most common
- 2:1 female to male ratio
- Low-energy falls



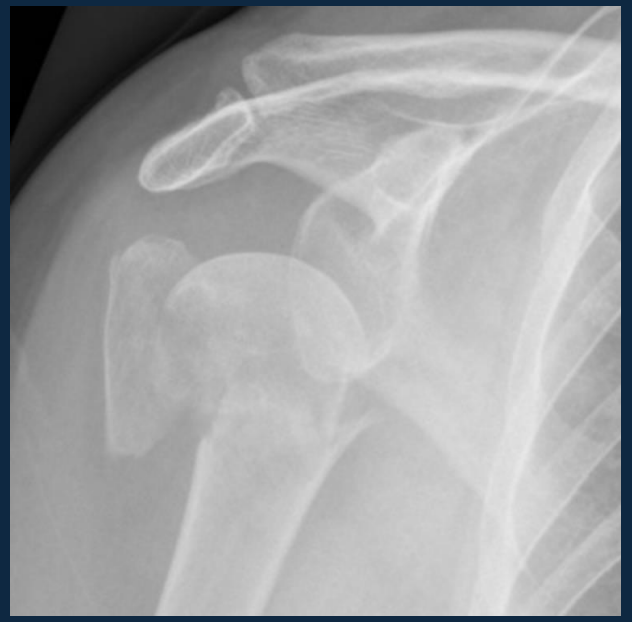
Proximal Humerus Fractures

Locations

- surgical neck, anatomic neck, greater tuberosity, and lesser tuberosity

Risk factors for fracture

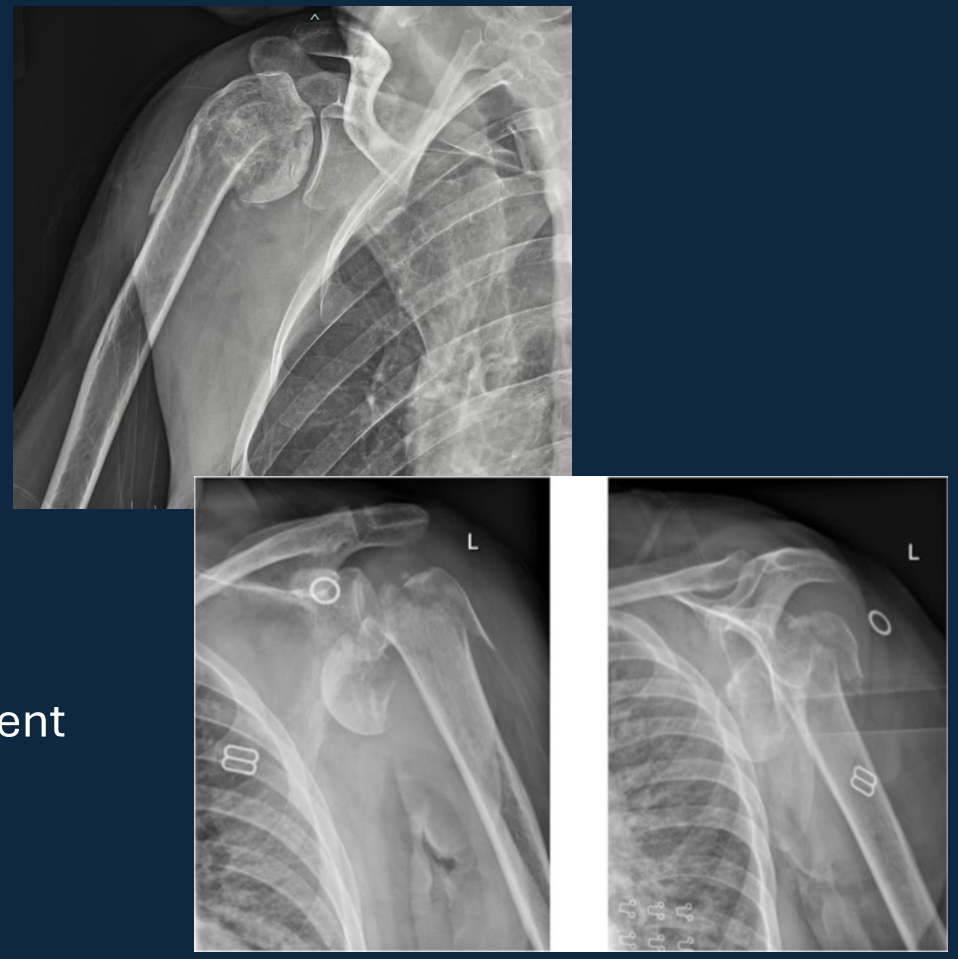
- osteoporosis
- diabetes
- epilepsy
- female gender



Proximal Humerus

Considerations for operative vs non-op

- Patient function
  - Independence/Age/Dominance
  - Compensation
  - Other injuries
- Success of ORIF
  - Fracture complexity
  - Bone quality
  - Healing potential
    - Poor prognosis increasing fracture # and displacement
    - Head-splitting fracture
- Improving outcomes with arthroplasty



Proximal Humerus Treatment Strategies

Non-operative Management

- Minimally displaced fractures
- Low demand patients
- Majority of elderly patients
- Sling immobilization
- Progressive ROM and WBAT

Proximal Humerus Treatment Strategies

Abstract

The ProFHER (PROximal Fracture of the Humerus: Evaluation by Randomisation) trial – a pragmatic multicentre randomised controlled trial evaluating the clinical effectiveness and cost-effectiveness of surgical compared with non-surgical treatment for proximal fracture of the humerus in adults

Helen Handoll,[1*] Stephen Brealey,[2] Amar Rangan,[3] Ada Keding,[2] Belen Corbacho,[2] Laura Jefferson,[2] Ling-Hsiang Chuang,[4] Lorna Goodchild,[5] Catherine Hewitt[2] and David Torgerson[2]

[1]Health and Social Care Institute, School of Health and Social Care, Teesside University, Middlesbrough, UK
[2]York Trials Unit, Department of Health Sciences, University of York, York, UK
[3]Department of Trauma and Orthopaedics, James Cook University Hospital, Middlesbrough, UK
[4]Pharmerit Europe, Rotterdam, the Netherlands
[5]Department of Rehabilitation, James Cook University Hospital, Middlesbrough, UK

Proximal Humerus Treatment Strategies

ORIF

- Plate fixation
  - More invasive
  - Increased fixation
- Intramedullary nailing
  - Less invasive
  - Risk to rotator cuff

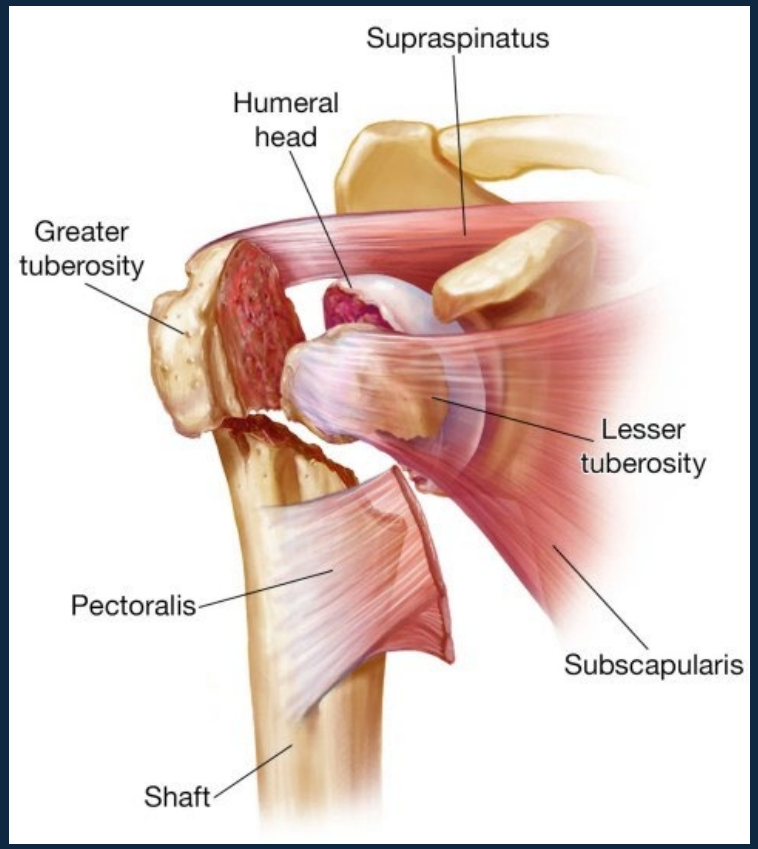
- Pros
  - Restore normal anatomy
- Cons
  - Nonunion, AVN, hardware failure/prominence, conversion arthroplasty

Proximal Humerus Treatment Strategies

Arthroplasty

- Hemiarthroplasty
- Reverse Total Shoulder Arthroplasty

- Pros
  - No arthritis
  - No need for bony healing *
- Cons
  - Instability
  - infection

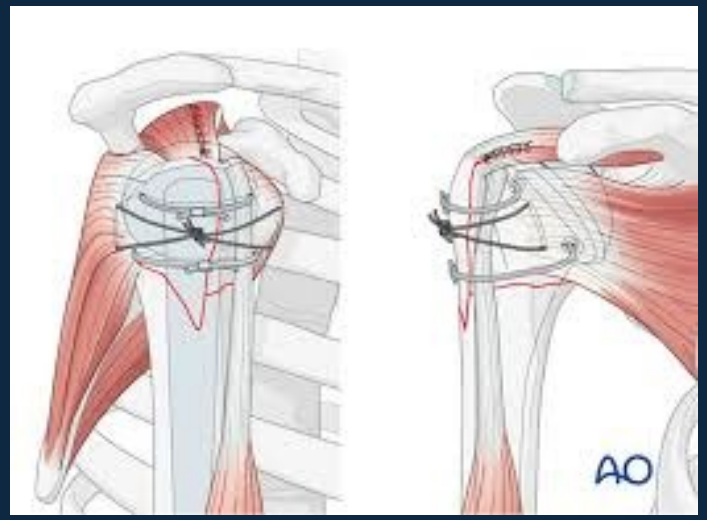


Proximal Humerus Treatment Strategies

Arthroplasty

- Hemiarthroplasty
  - Maintain tuberosities
  - Rotator cuff dependent

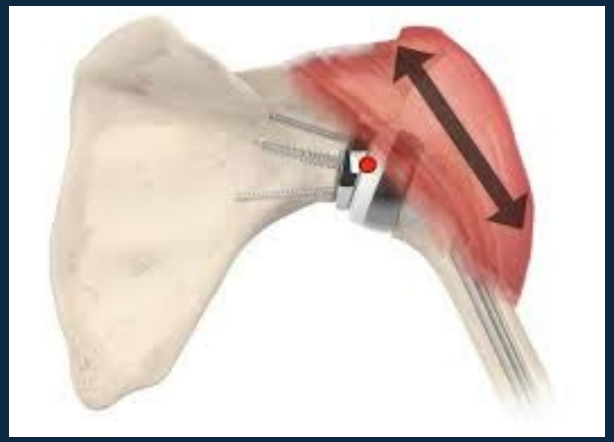
  - Pros
    - Physiologic
  - Cons
    - Nonunion and instability
    - Conversion to RevTSA



Proximal Humerus Treatment Strategies

Arthroplasty

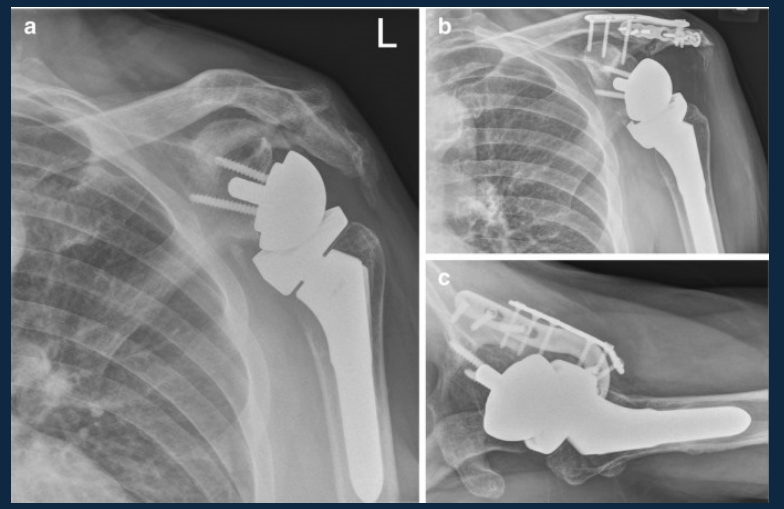
- Reverse Total Shoulder Arthroplasty
  - utilizes deltoid for stability
  - Reliable
    - Indications increasing
  - Studies show improved outcomes with early treatment

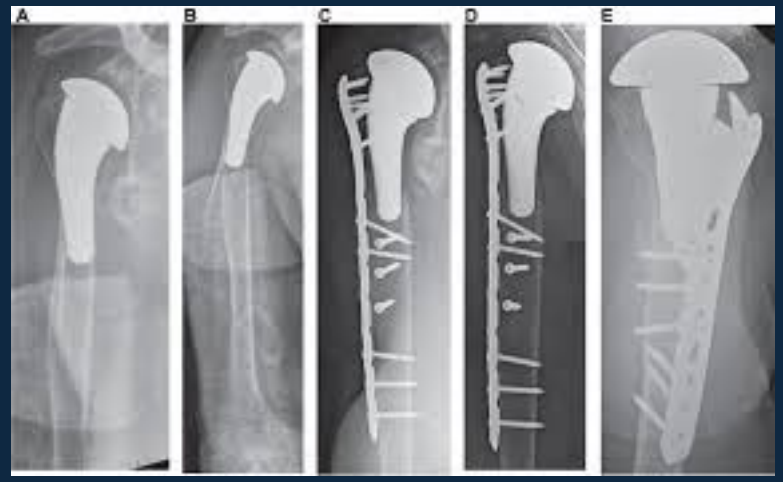


Proximal Humerus Treatment Strategies

Pitfalls

- Treatment highly patient and surgeon specific
- Loss of motion and function associated with all treatments
- RevTSA increasingly utilized, but not risk free





Distal Radius Fractures

Distal Radius Fractures

- Most common orthopaedic injury
  - 17.5% of all fractures in adults
  - lifetime risk is 15% for women and 2% for men

- Commonly result from fall on an outstretched hand (FOOSH) in older patients

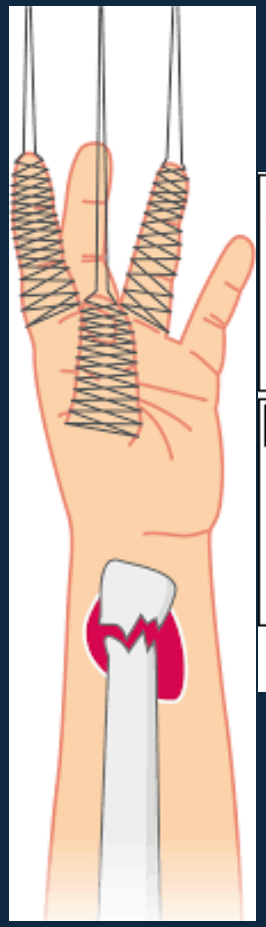
- considered fragility fracture and warrants further bone density workup

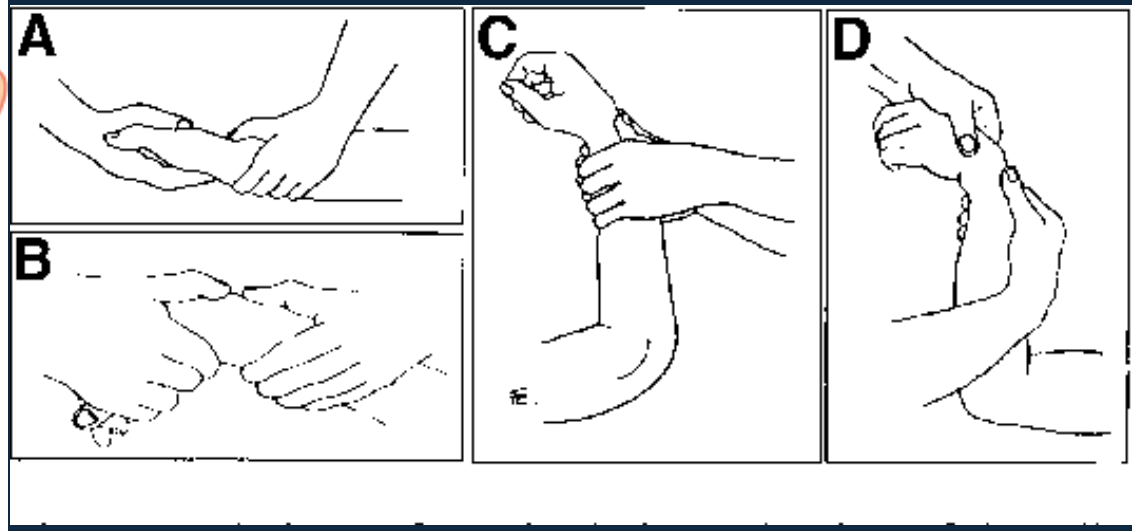
Distal Radius Treatment Strategies

- Immobilization
  - Extra-articular
  - Minimally displaced
  - Unfit for OR
- ORIF
  - Articular involvement
  - Displacement/angulation
  - Comminution/associated fractures
  - Severe osteoporosis
- CRPP/External fixation
  - Rare
  - Open contaminated fractures
  - Medically unstable

Distal Radius Treatment Strategies

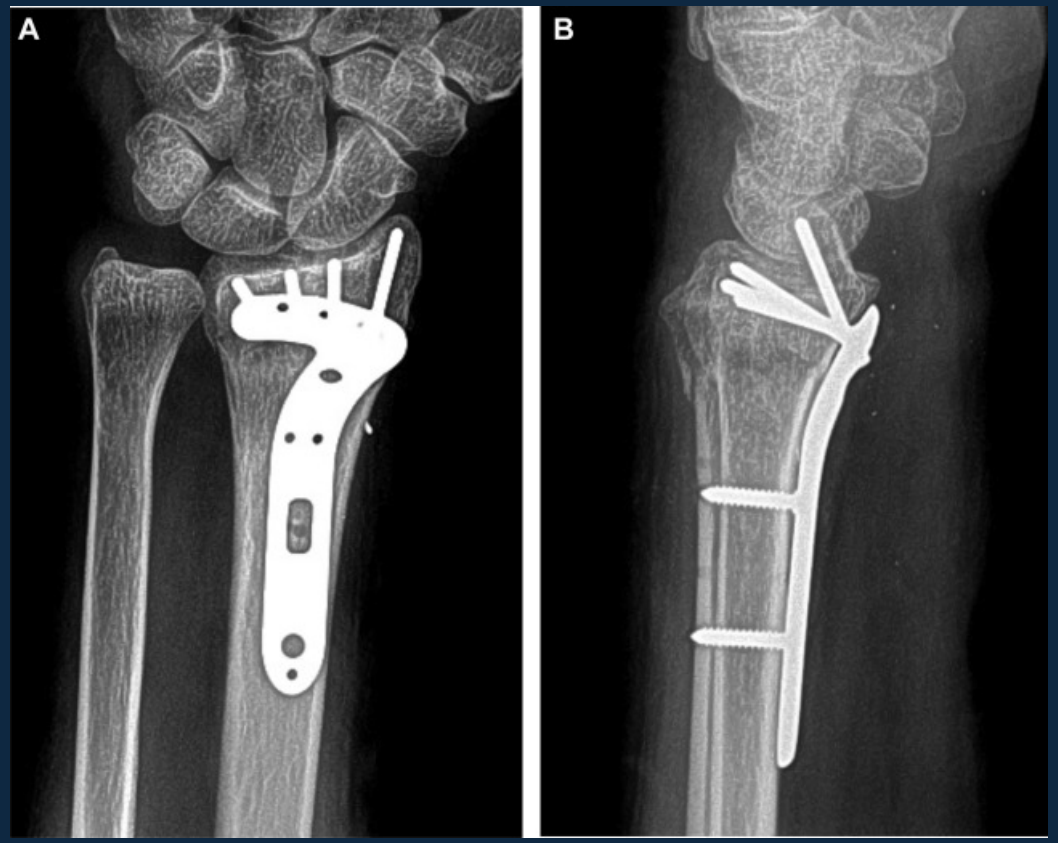
- Non-operative
  - Extra-articular
  - Minimally displaced
  - Unfit for OR
  - Risk of displacement





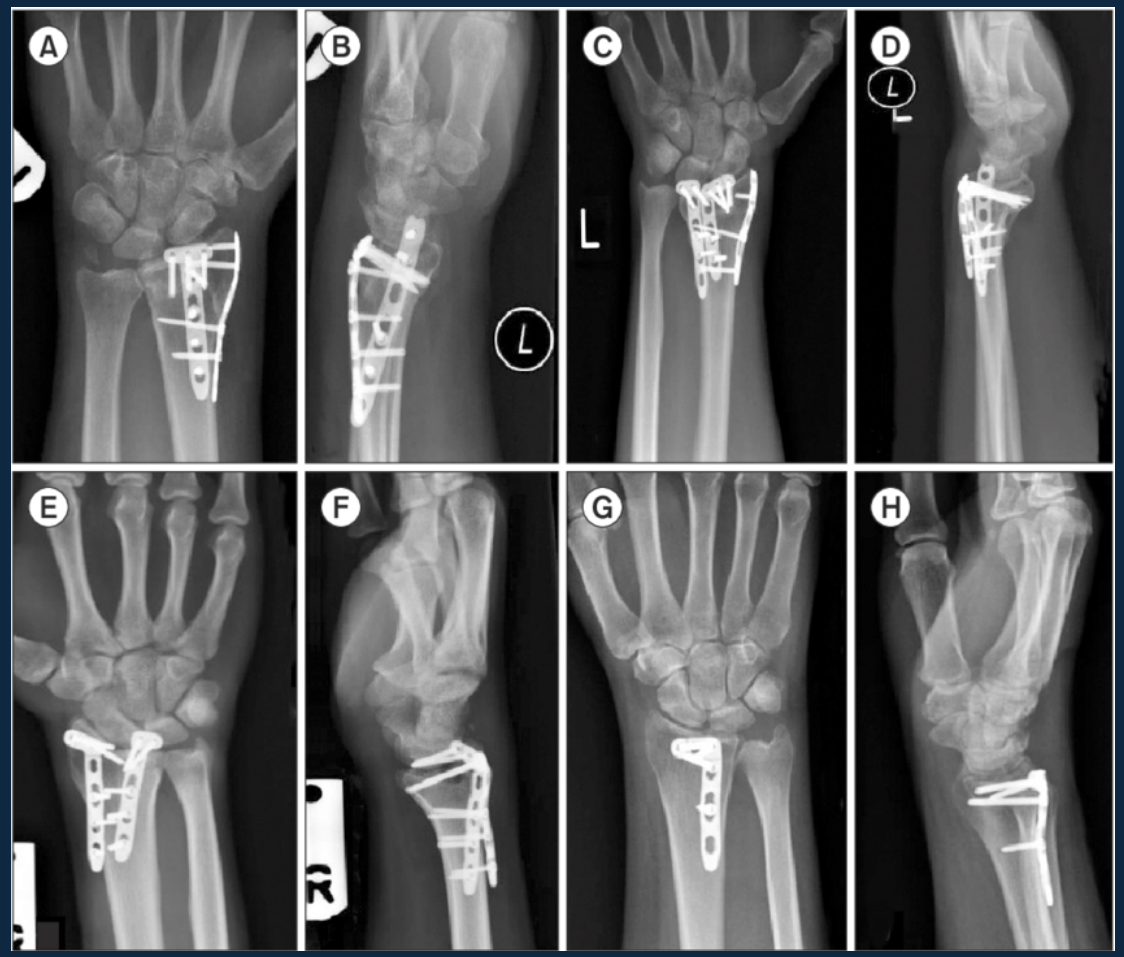
Distal Radius Treatment Strategies

- ORIF
  - Volar
    - Most common



Distal Radius Treatment Strategies

- ORIF
  - Dorsal
    - Fracture specific
    - Tendon irritation and prominence



Distal Radius Treatment Strategies

- ORIF
  - Bridge plating
    - Unreconstructible injury
    - Polytrauma
    - Hardware removal
    - Arthrofibrosis

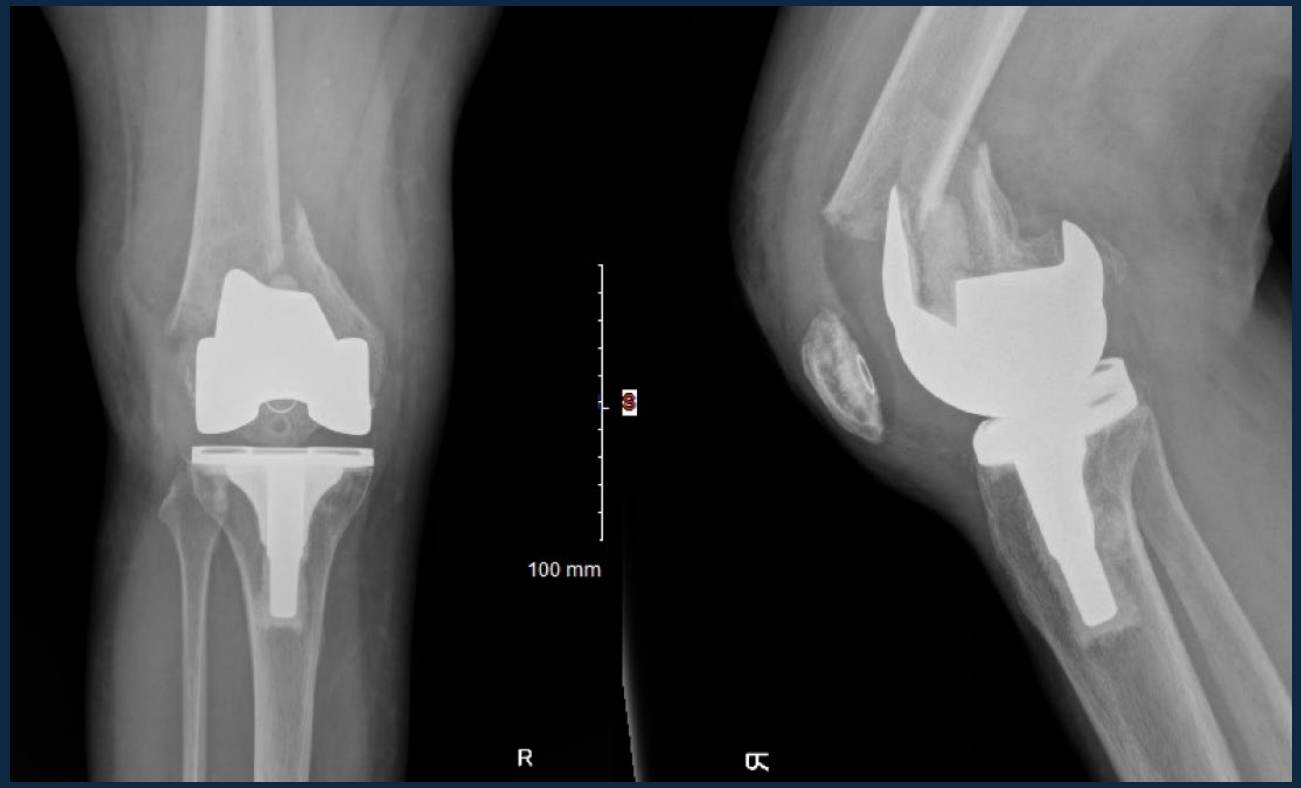
Distal Radius Treatment Strategies

- Pitfalls
  - Median neuropathy
  - Tendon rupture
  - Post-traumatic arthritis
  - Ulnar impaction syndrome

Distal Femur Fractures

Distal Femur Fractures

- Similar mortality rates to hip fractures
- Increasing incidence
- Periprosthetic fractures increasingly common
  - Stress shielding

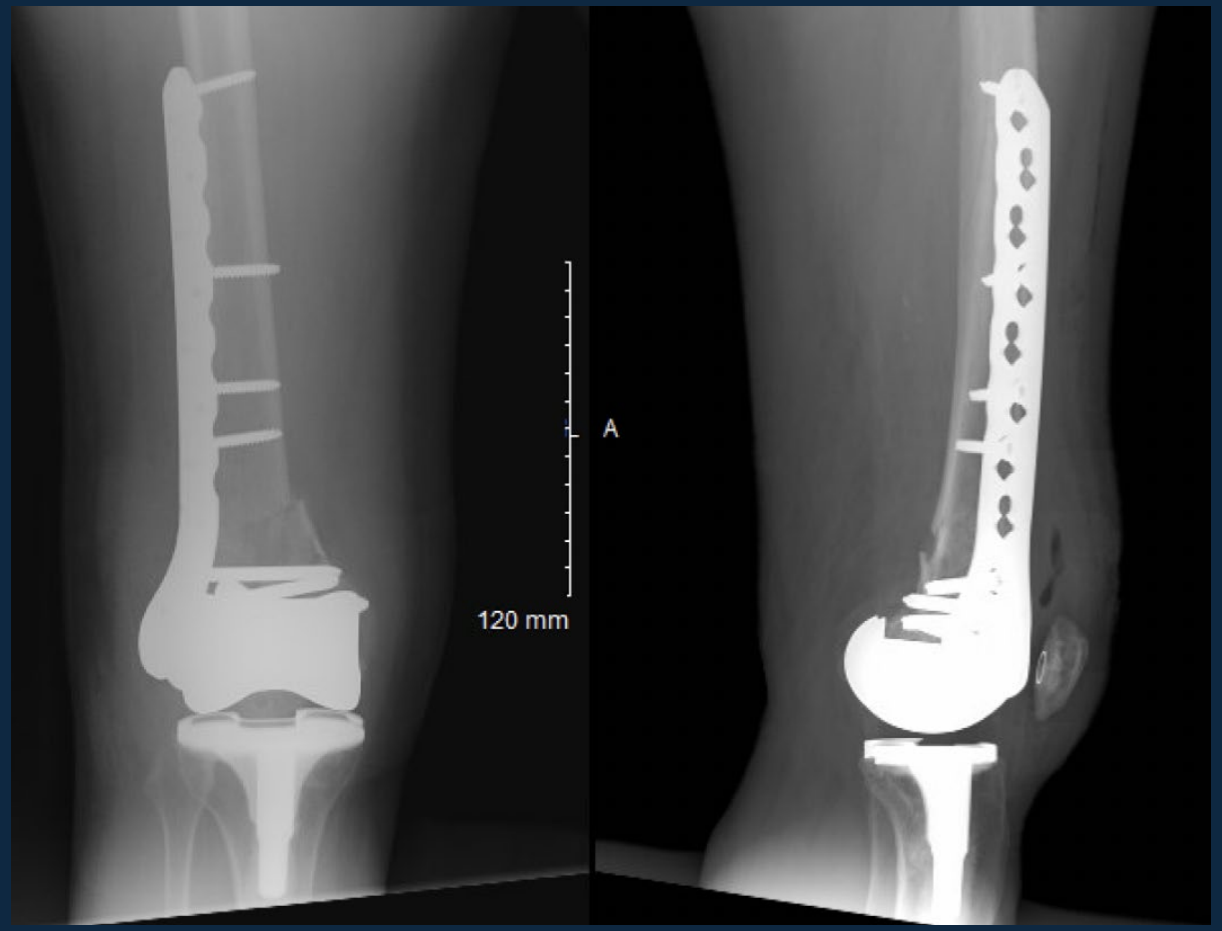


Distal Femur Treatment Strategies

- Lateral locked plating
- Dual Plating
- Retrograde IMN
- Nail Plate Combination (NPC)
  - Immediate WBAT
- Distal Femur Replacement (DFR)
  - Immediate WBAT

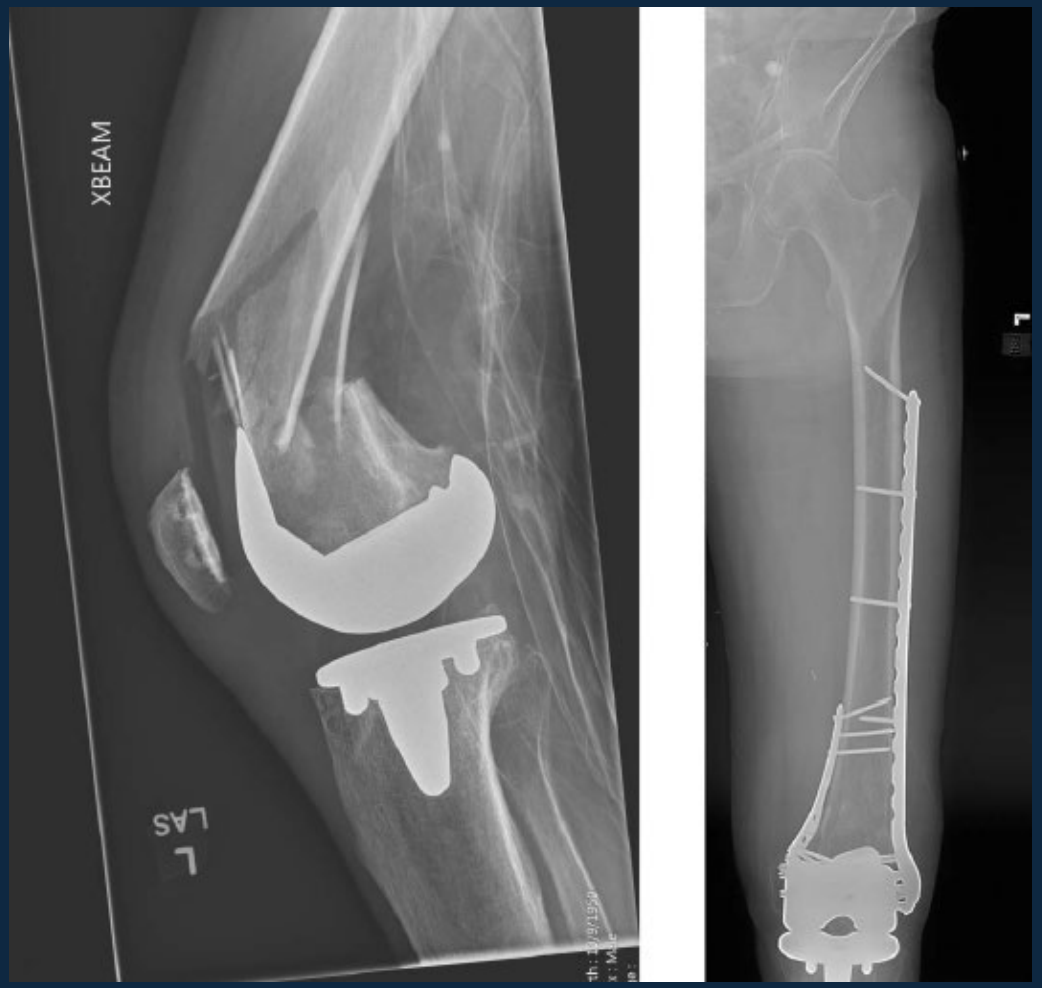
Distal Femur Lateral Plating

- Commonly used treatment
- Can be done via minimally invasive approach
- Cons
  - Nonunion rates (up to 31%)
  - Non weight bearing post op



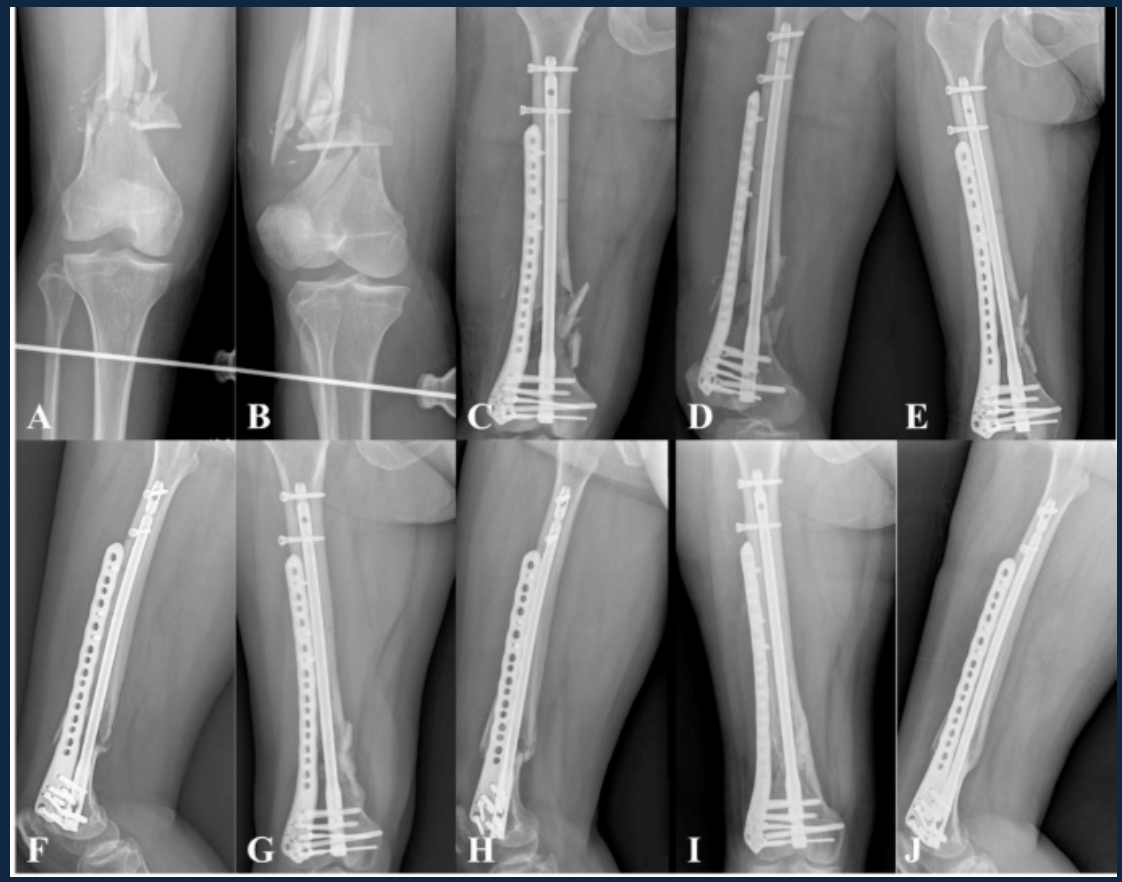
Distal Femur Dual Plating

- Increase stability
- Allows for earlier weightbearing
- Option if retrograde nail is not possible



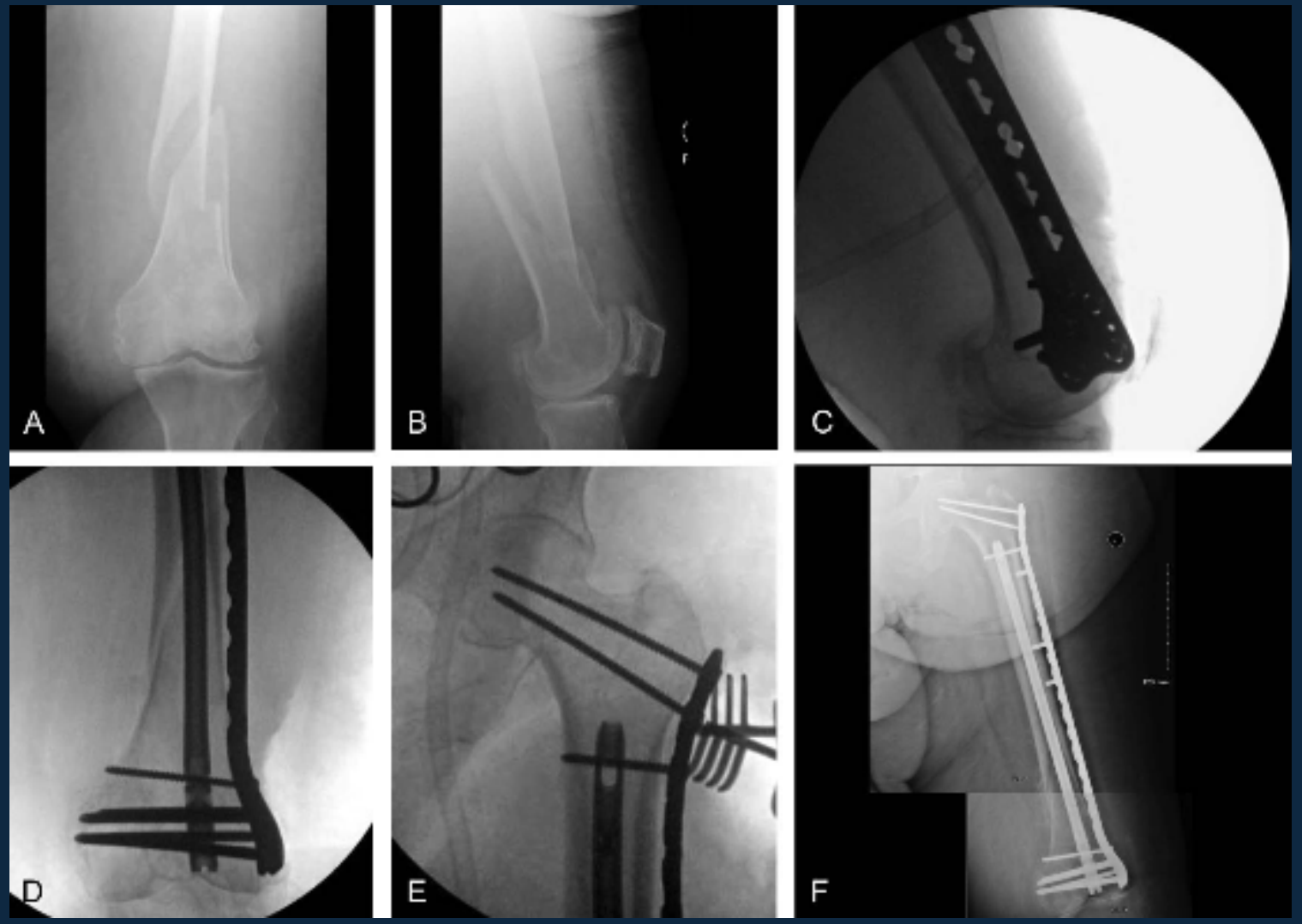
Distal Femur Nail Plate Combo

- Biomechanical Rationale:
  - Protect fracture propagation by spanning the bone
    - Distal femur thin cortex and soft metaphyseal bone
  - Decrease nonunion risk
    - The load is more evenly distributed btw bone and implants



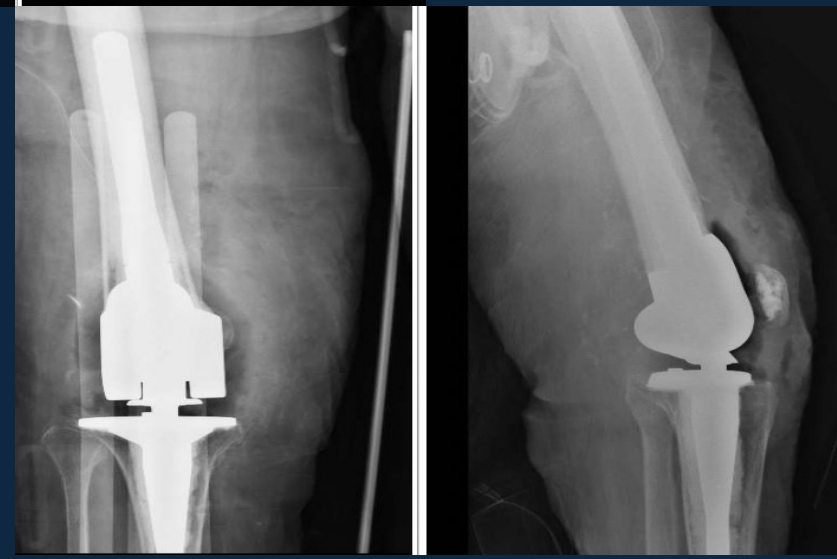
Distal Femur Nail Plate Combo

- Immediate weight-bearing
  - Isolated nail or plate
    - protected weight bearing
  - **Combo** offers well-balanced, stronger fixation
    - Early WBAT



Distal Femoral Replacement

- Indication:
  - Un-reconstructable fracture
  - Fracture around prior total knee arthroplasty with loose component
  - Osteoarthritis
- Also allows immediate weight bearing
- Outcomes:
  - Similar overall complication rates with surgical fixation vs. DFR



Pelvis Fractures

Fragility vs Insufficiency Fracture

- Fragility fracture: Injury that would be insufficient to fracture normal bone, result of reduced compressive and/or torsional strength

- Insufficiency fracture: A fracture caused from normal physiologic activity in very weak bone – a progressive event

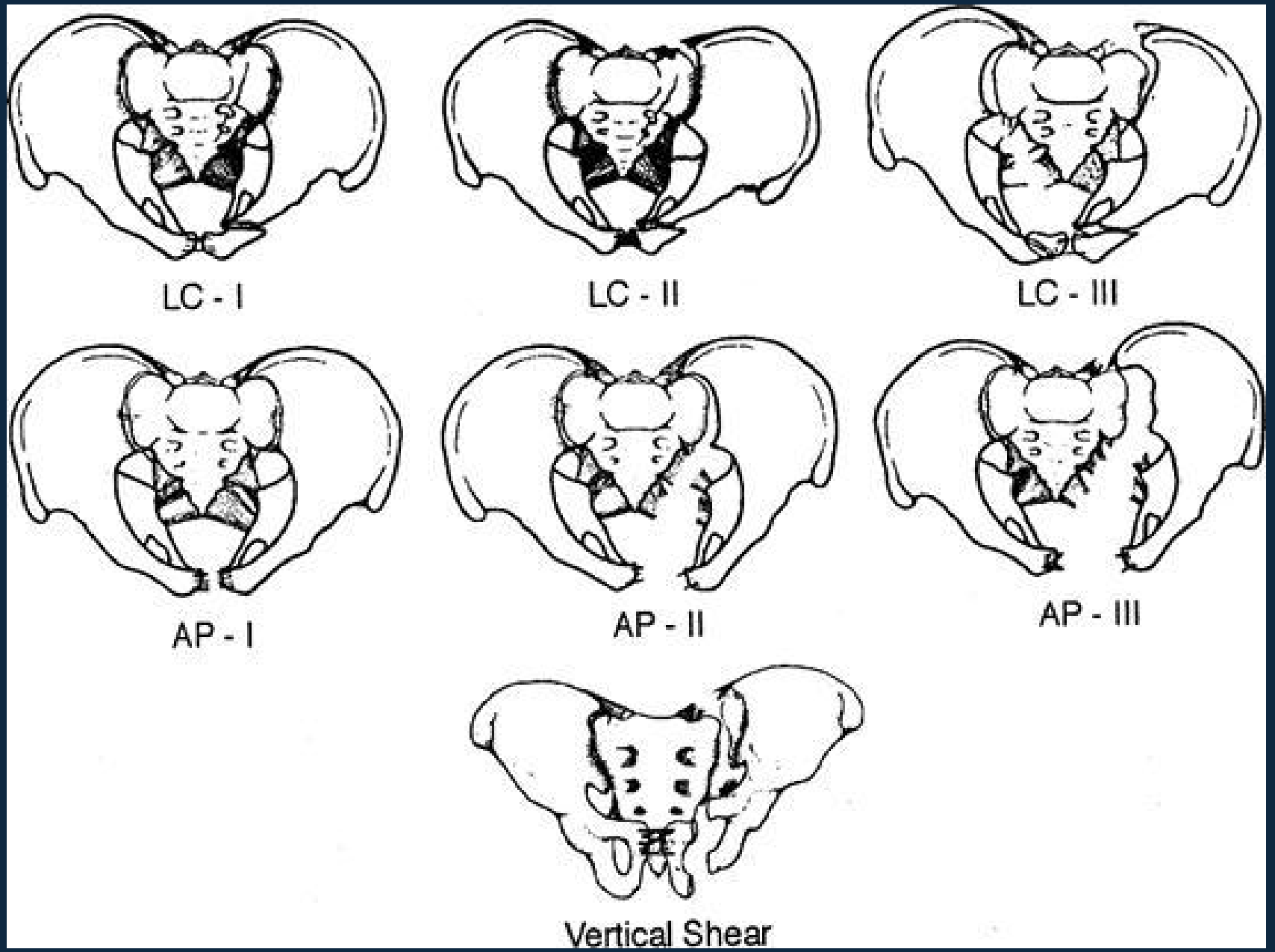
Pelvis Fractures

Young Pelvic Ring Injury

- High energy
- Good bone quality
- Frequently operative

Geriatric Pelvic Ring Injury

- Low energy
- Osteoporotic bone
- Non-operative vs operative


LC - I
LC - II
LC - III
AP - I
AP - II
AP - III
Vertical Shear

Pelvis Fractures Mortality Rates

	Pelvis	Hip
30 day	7-20%	5-16%
1-year	20-27%	17- 30%
3-year	~ 41%	40%

Pelvis Fractures

- Decline in independence
- 49% decrease in mobility
  - increased need for assistance with ADLs
  - increase in institutionalization
  - Increased depression
- 58% of non-operatively treated sustain a complication

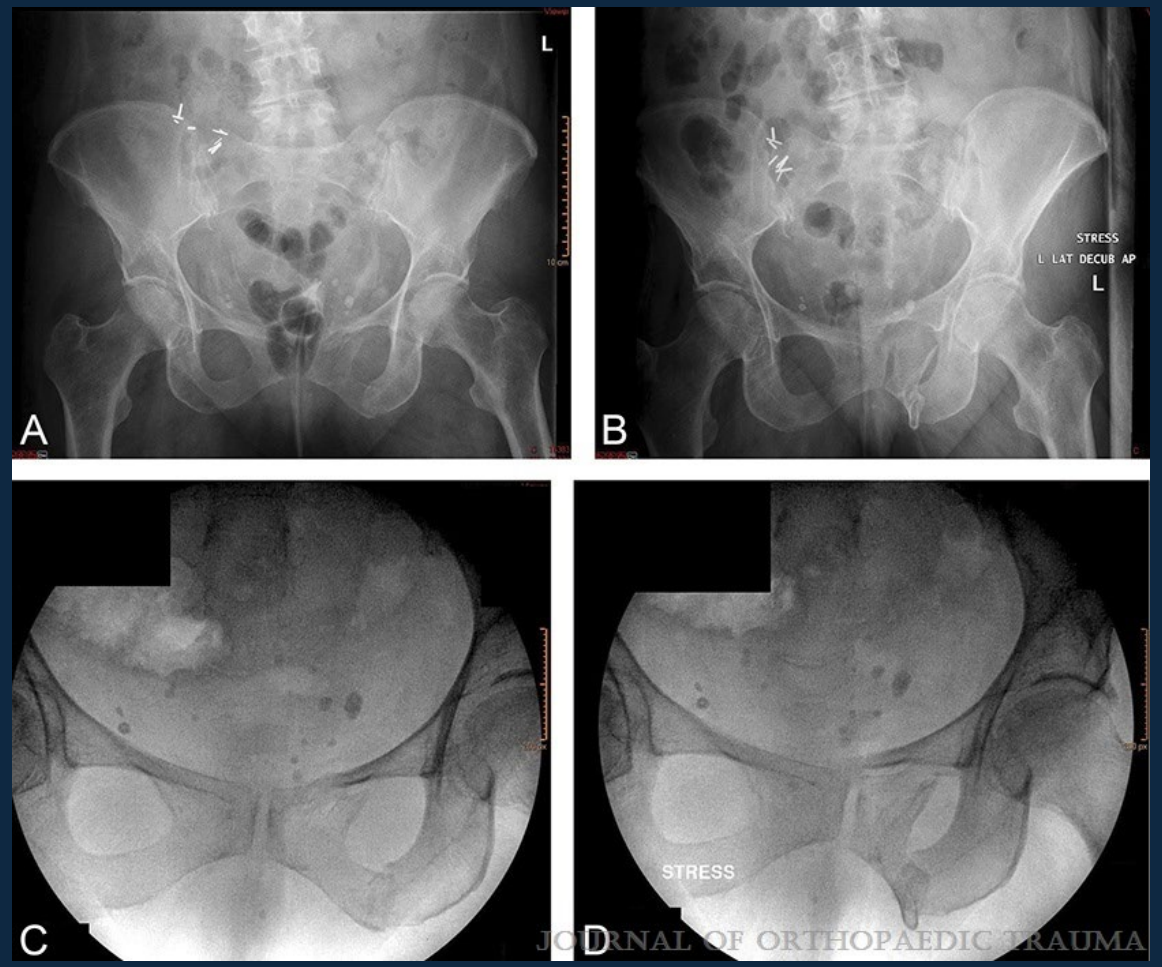
Pelvis Fractures Treatment Strategy

Stable?

Unstable

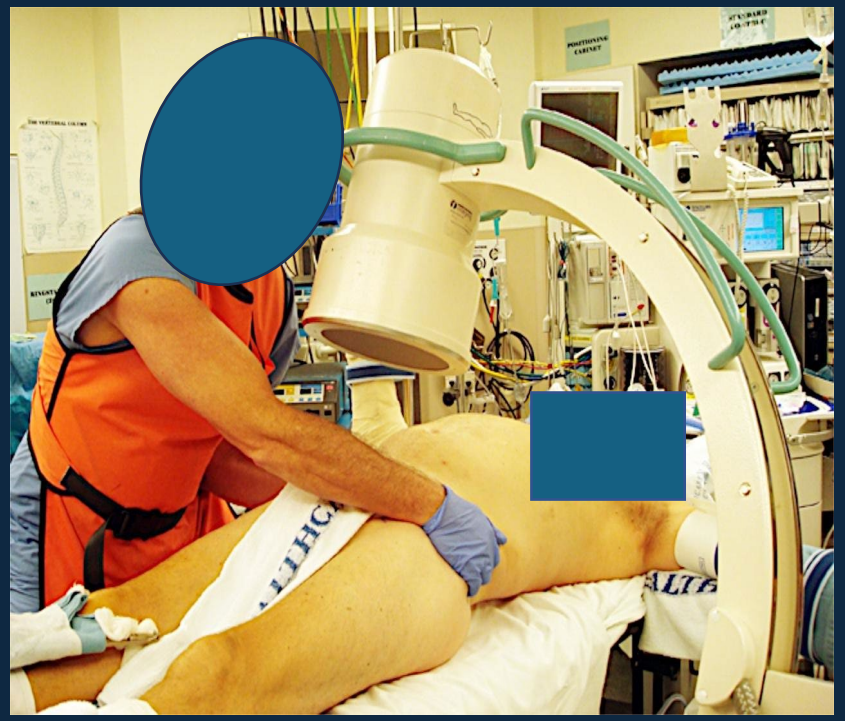
Pelvis Fractures Treatment Strategy

- Trial of mobilization
- Stress views
  - Emergency Room
  - Operating Room



Pelvis Fractures Treatment Strategy

- Trial of mobilization
- Stress views
  - Emergency Room
  - Operating Room



Pelvis Fractures Treatment Strategy

- Trial of mobilization
- Stress views
  - Emergency Room
  - Operating Room

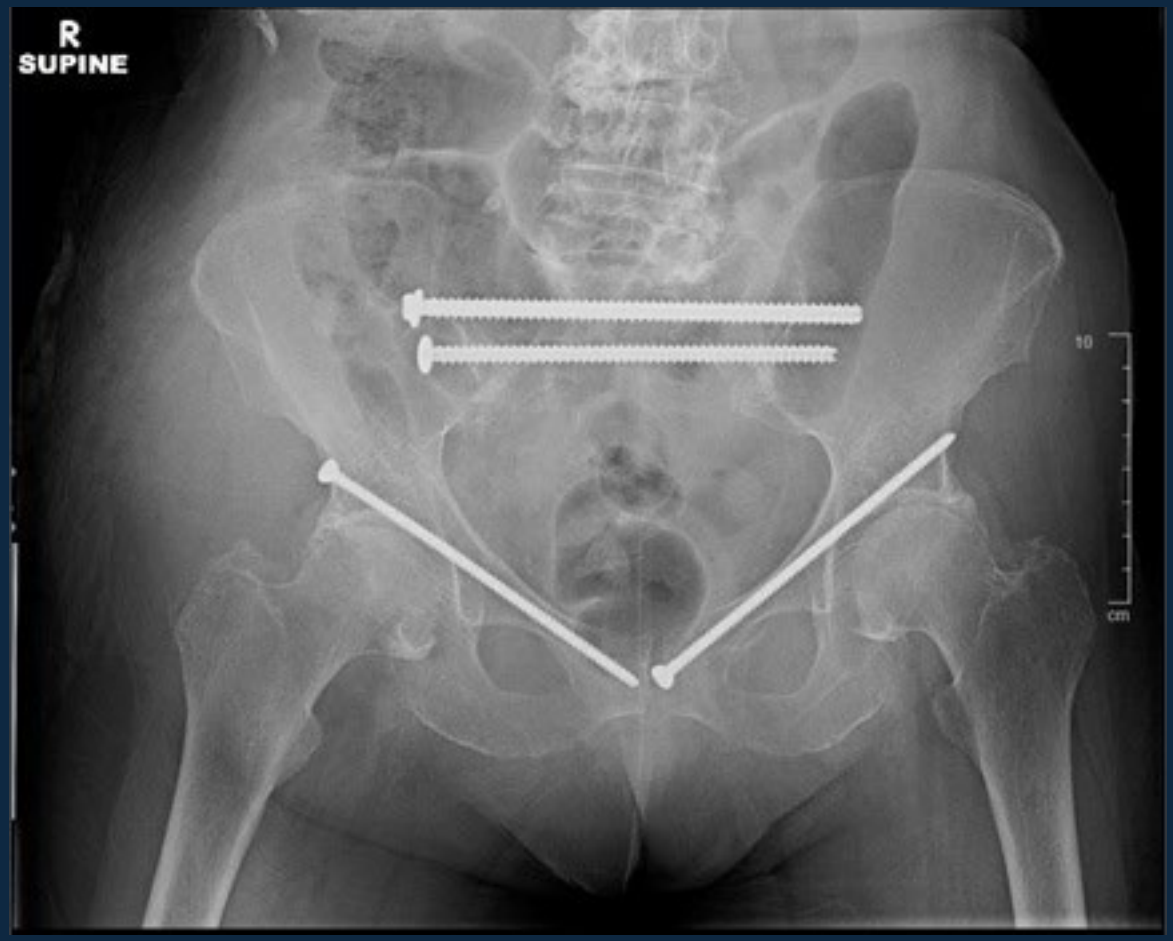
Pelvis Fractures Treatment Strategy

Stable

- Mobilize with physical therapy
  - WBAT

Unstable

- Percutaneous fixation



Pelvis Fractures Treatment Strategy

Pitfalls

- Early vs late diagnosis
- Weight bearing protocols
- Technically demanding

Bisphosphonate Fractures

Bisphosphonates

Non-nitrogen containing
- Tiludronate (Skelid)
- Clodronate (Bonefos)
- Etidronate (Didronel)

Nitrogen containing
- Alendronate (Fosamax)
- Ibandronate (Boniva)
- Risedronate (Actonel, Atelvia)
- Pamidronate (Aredia)
- Zolendronate (Zometa, Reclast)
    - zoledronic acid - relatively new and appealing to patients, due to IV adminstration every 12 months

Bisphosphonates

Prevent bone mass loss by inhibiting osteoclast resorption

- prevent formation of osteoclast microtubules, causing apoptosis
- inhibition of osteoclasts also interferes with normal bone healing and remodeling

Complications

- Jaw osteonecrosis
- Atypical subtrochanteric and femoral stress fractures

Bisphosphonates

Osteoblast activity > Osteoclast
- increased bone formation
- brittle bone

- Repeated cycles of tension sided micro fractures
  - callous healing lateral cortical beaking
- Minimal/No Trauma completion of fracture
  - Transverse with medial spike
  - May have antecedent thigh/groin pain

Atypical Fracture Prevention

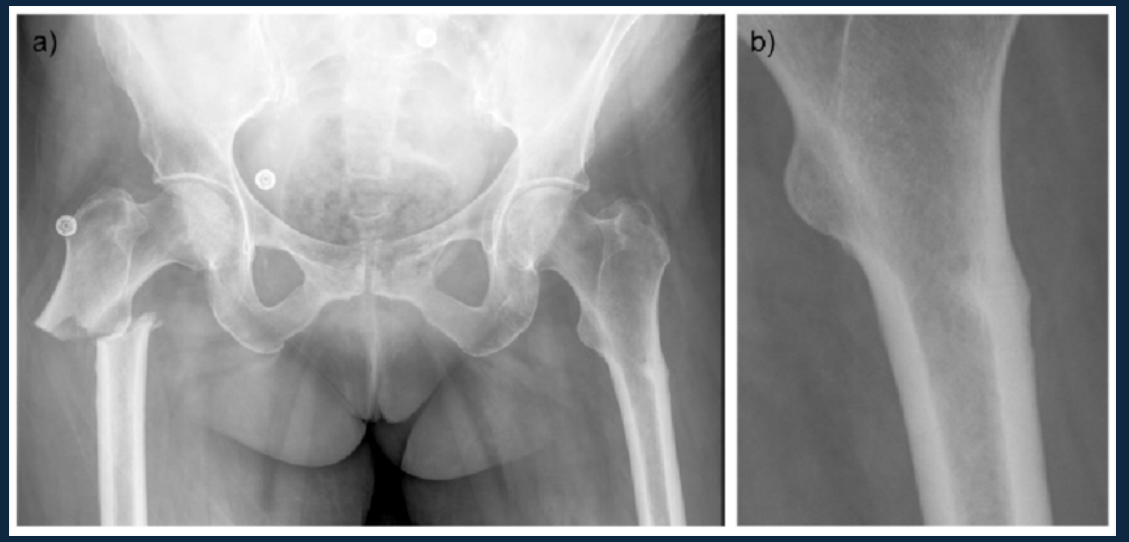
- Possibly a role for bisphosphonate holiday in patients at lower risk for fragility fractures

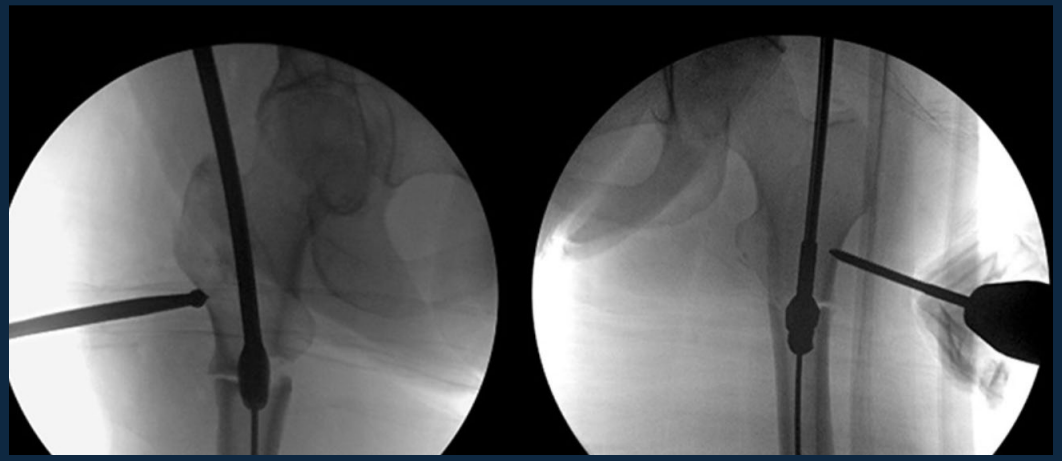
- FLEX study- continuing alendronate after 5 years of use decreases bone loss, vert compression fractures, NOT other fractures
- HORIZON study- continuing zoledronic acid after 3 years of use decreases bone loss, vert compression fractures, NOT other fractures

- Adler et al (16)- recommends discontinuation of BPs after 3-5 years if…
  - No fragility fractures before or during BP use
  - DEXA T score >-2.5
  - Low fracture risk

Atypical Fracture Prevention

- Diagnose before fracture completes and displaces
  - Technically difficult to treat
  - Increased risk of nonunion
- Check for prodromal pain
- Check contralateral x-rays
  - 25% patients develop contralateral fracture





Questions?

CASES

Case 1

71 year old female

Fall onto outstretched hand

Large open wound over ulna

Case 1

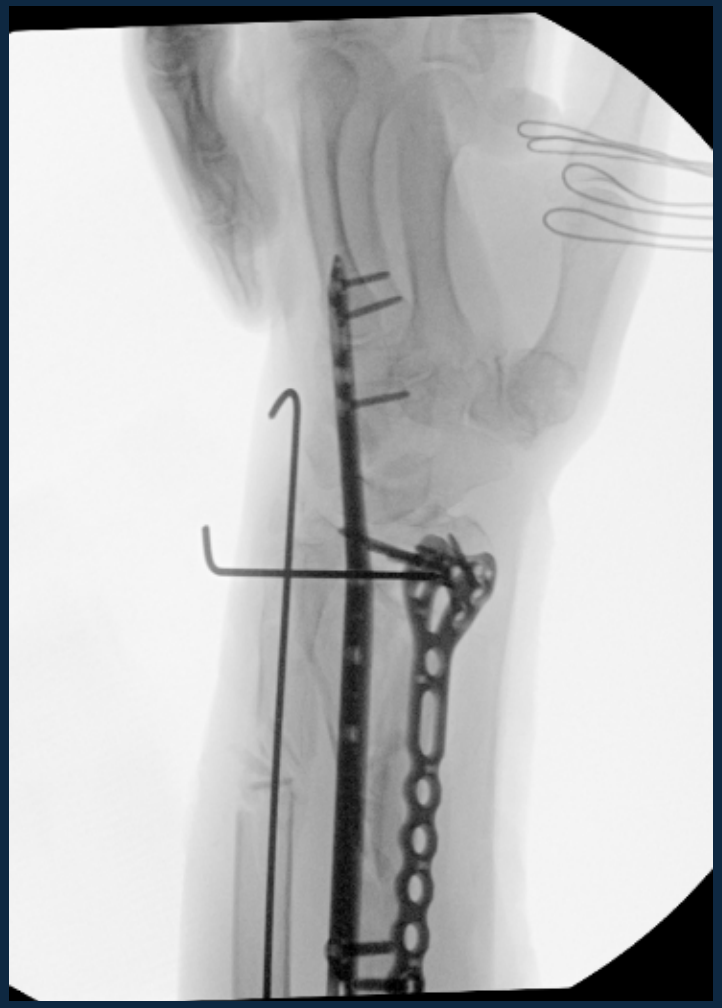
Problems

- Open injury
- Reconstructible?

Case 1

Case 1

Case 1



Case 1

Post-op

Case 1

6 weeks

Case 1

3 months

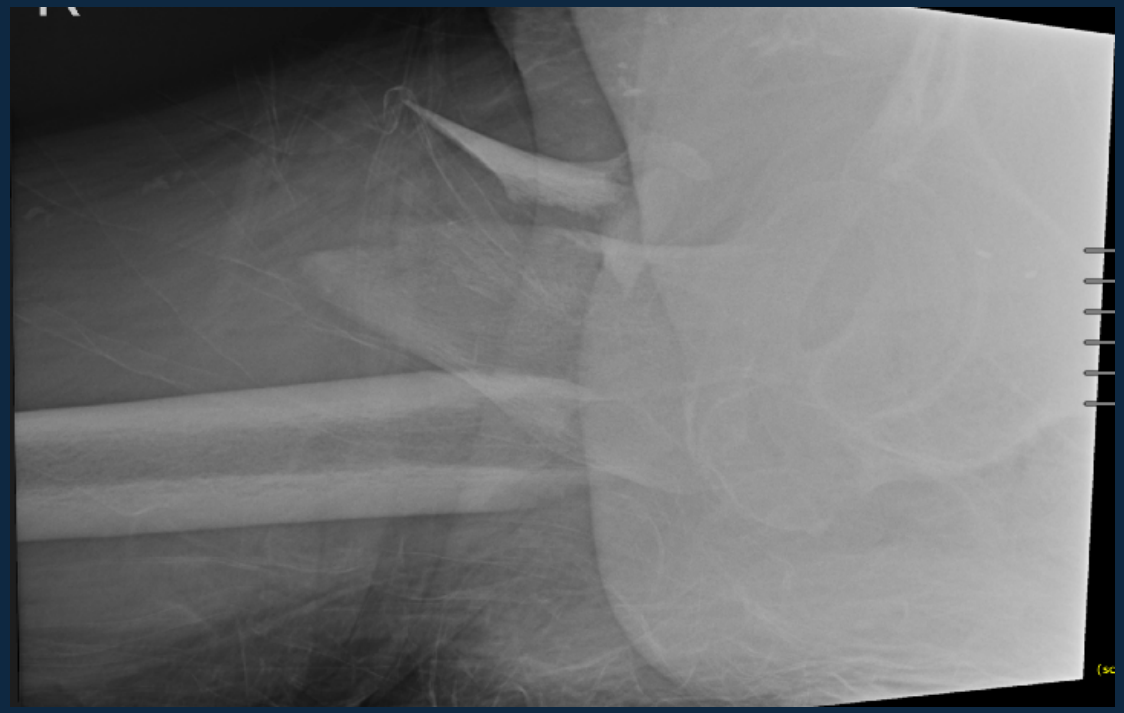
Case 1

Bridge plate removal

Case 2

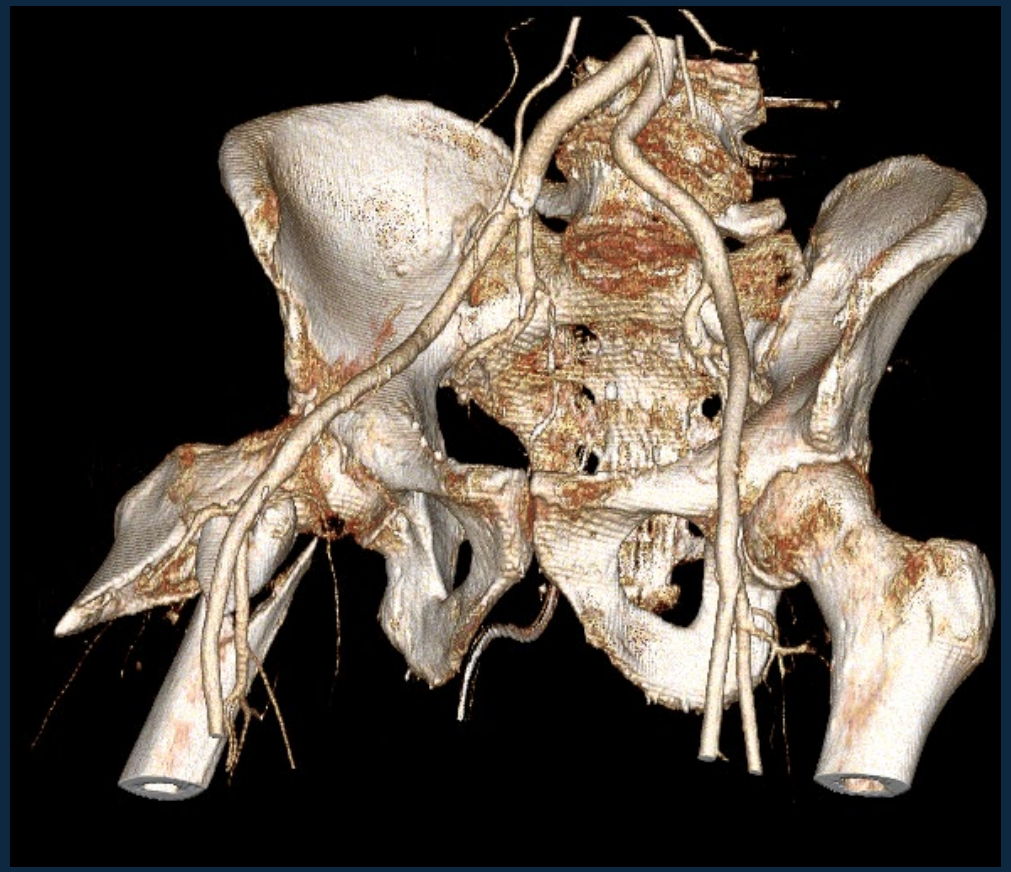
Case 2

- 90 year old male
- Ground level fall



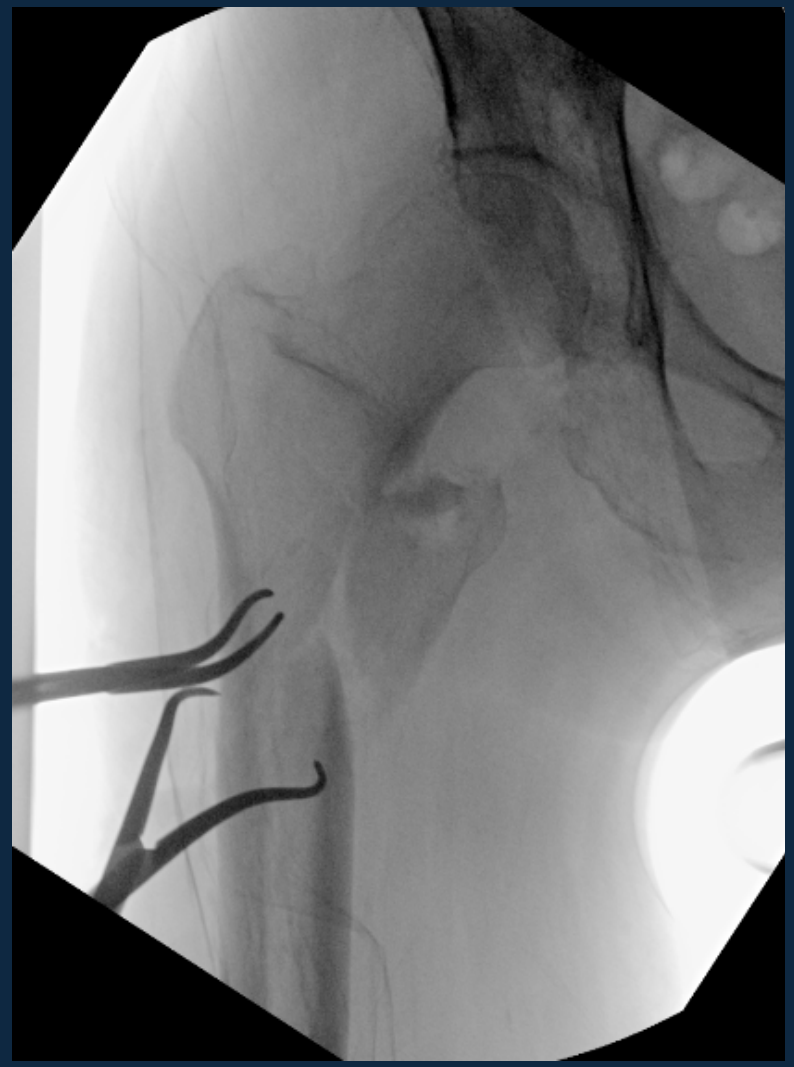
Case 2

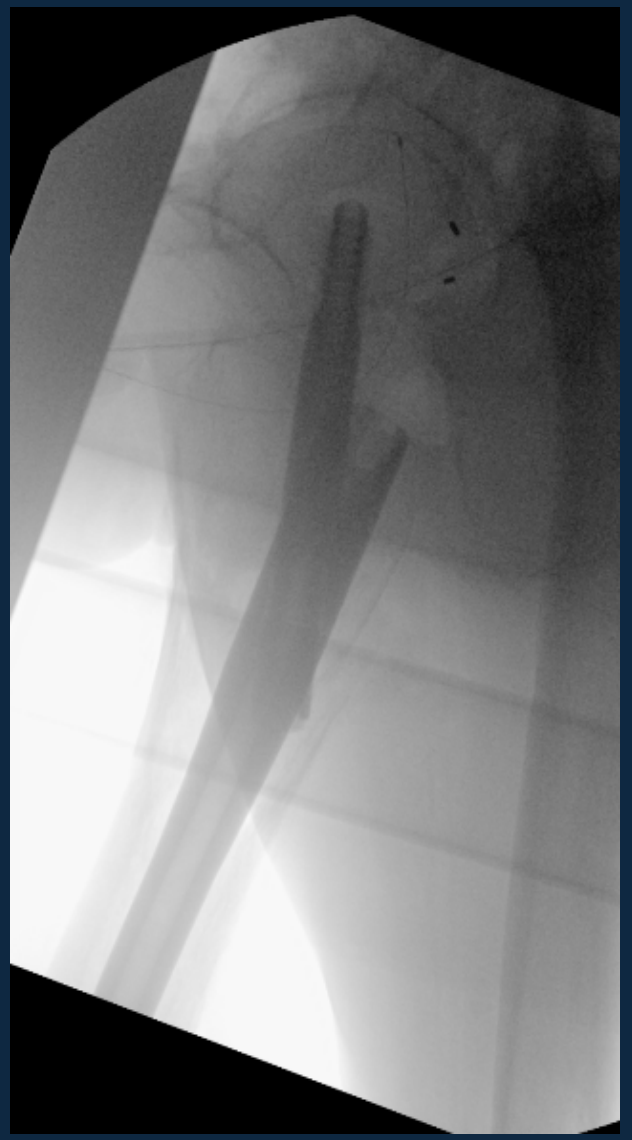
- 90 year old male
- Ground level fall



Case 2

OR





Case 2

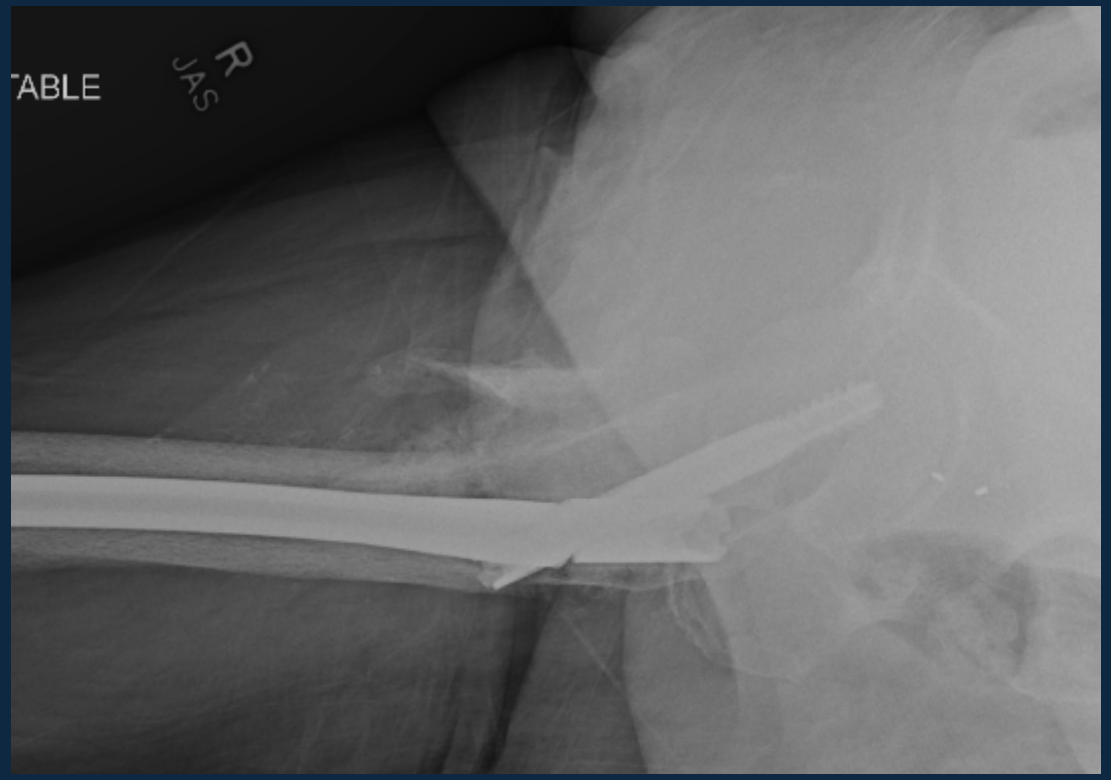
Post-op

Case 2

3 months

Case 2

4 months



Case 2B

Problems

- Stability?
- Bone stock?
- Time to weight bearing?

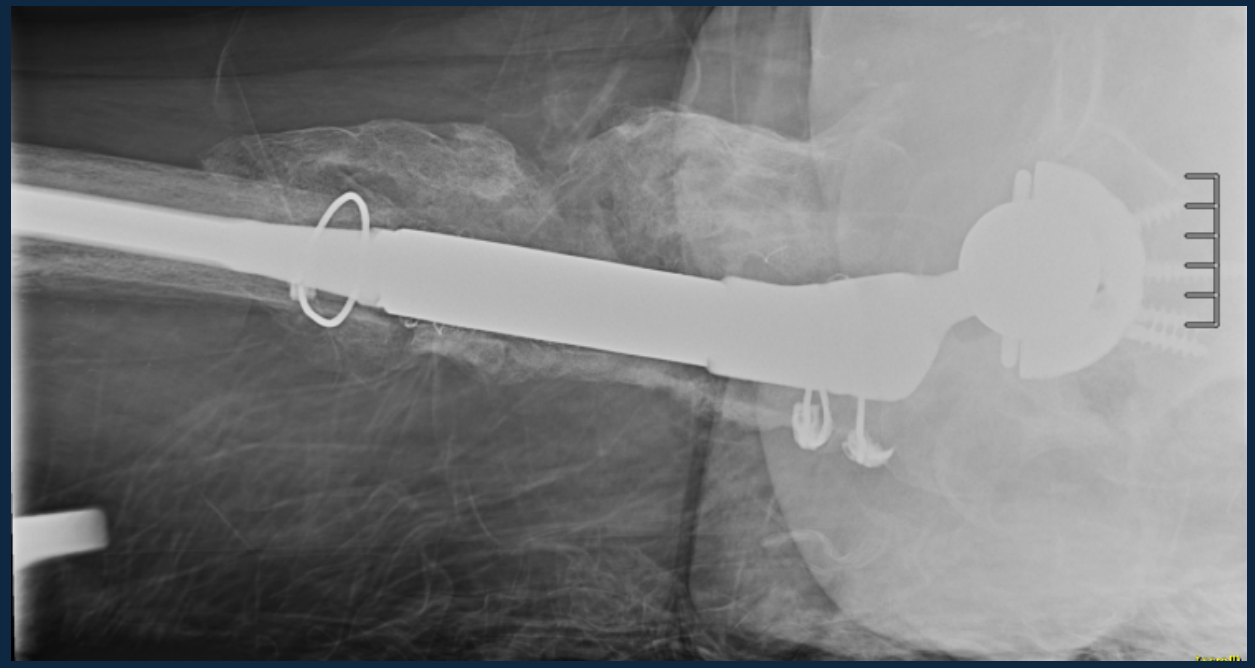
Case 2B

2 months

Case 2B

9 months post-op

Fall onto his knee



Case 2B

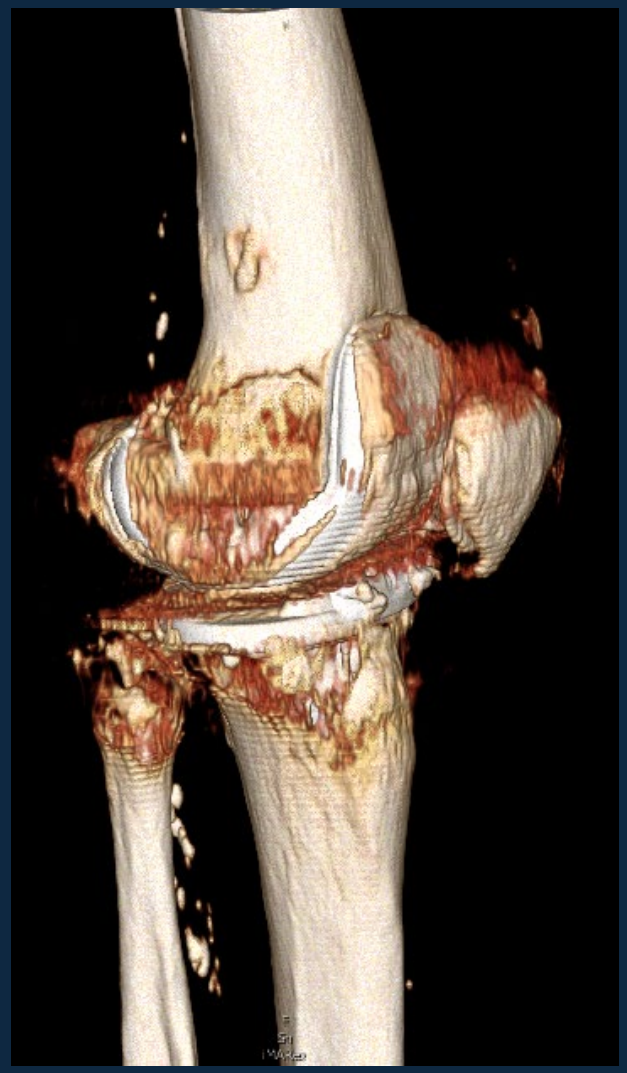
9 months post-op

Fall onto his knee

Case 2B

9 months post-op

Fall onto his knee



Case 2B

Problem

- Fixation below PFR and TKA

Case 2B

6 months post-op

Case 3

Case 3

95 year old female

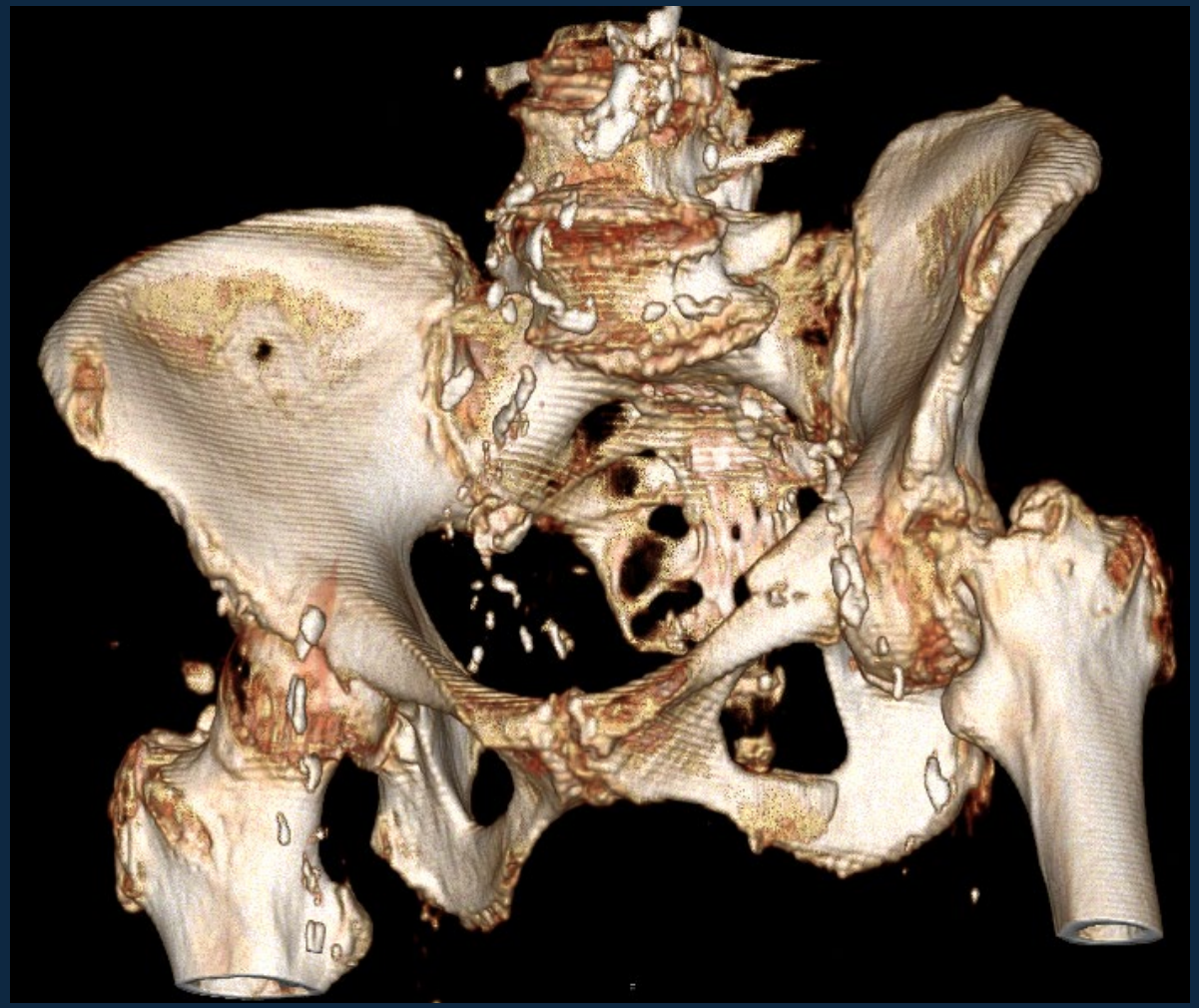
Ground level fall

Left hip pain

Case 3

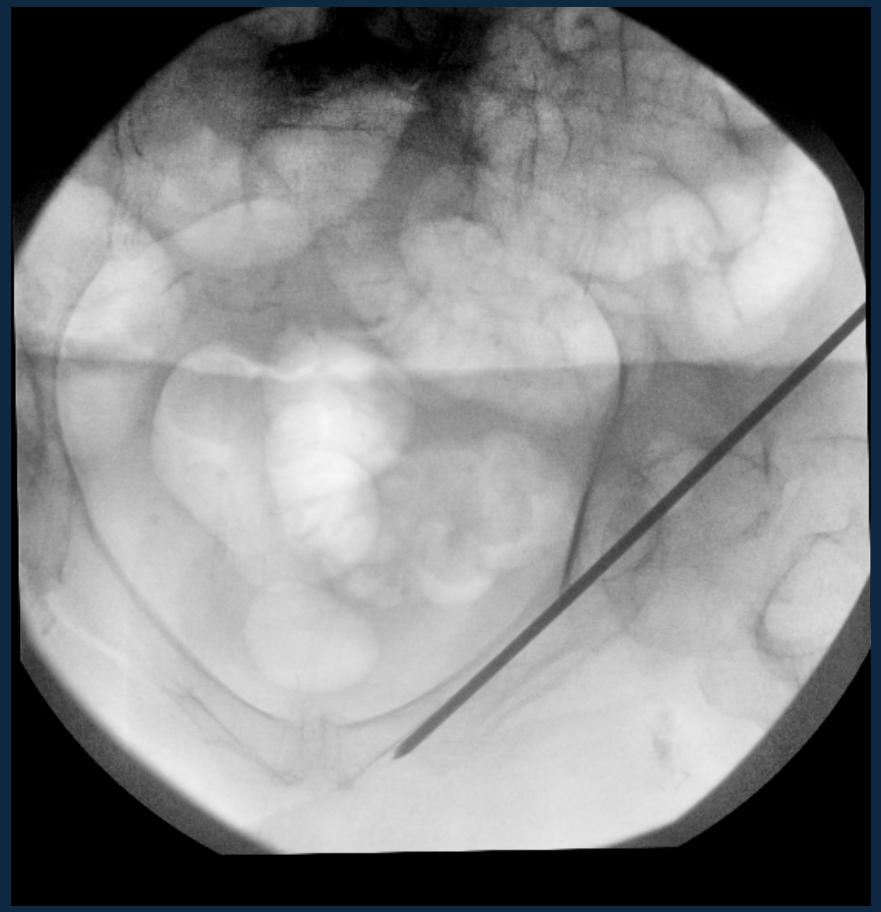
Problems

- Multiple fragility fractures
  - Mobilization
  - Fixation
  - Morbidity
  - Fix 1 or both?
  - Simultaneous vs staged



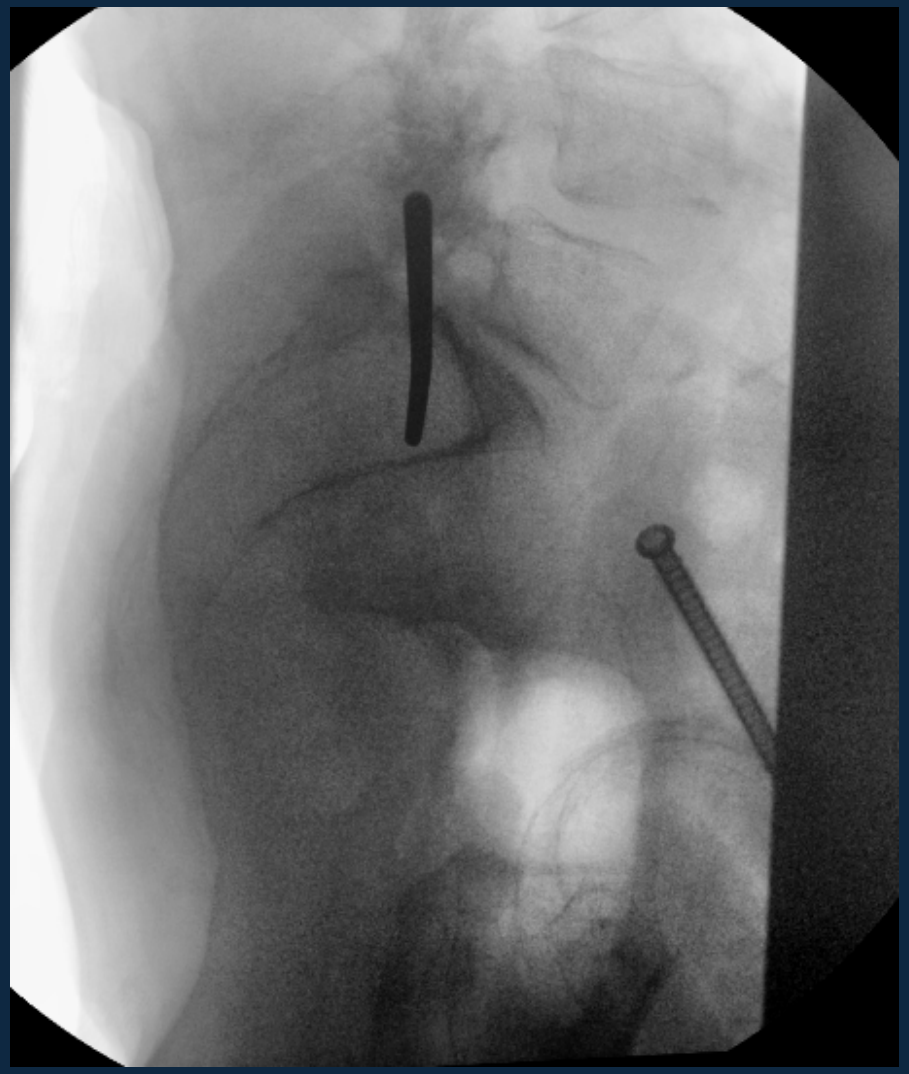
Case 3

OR



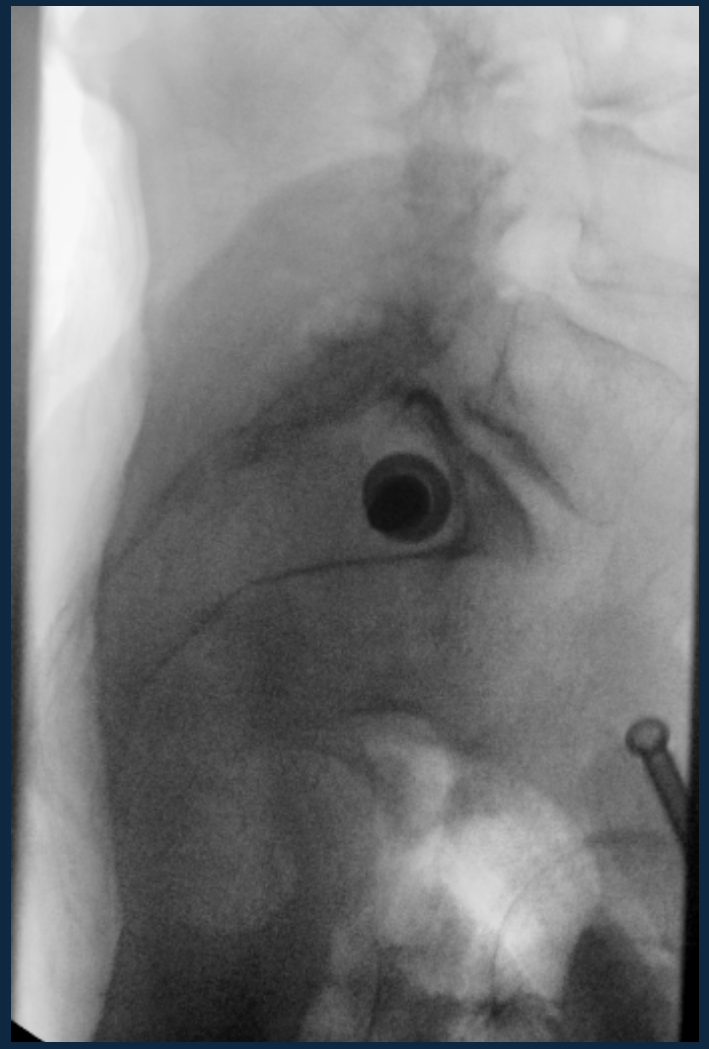
Case 3

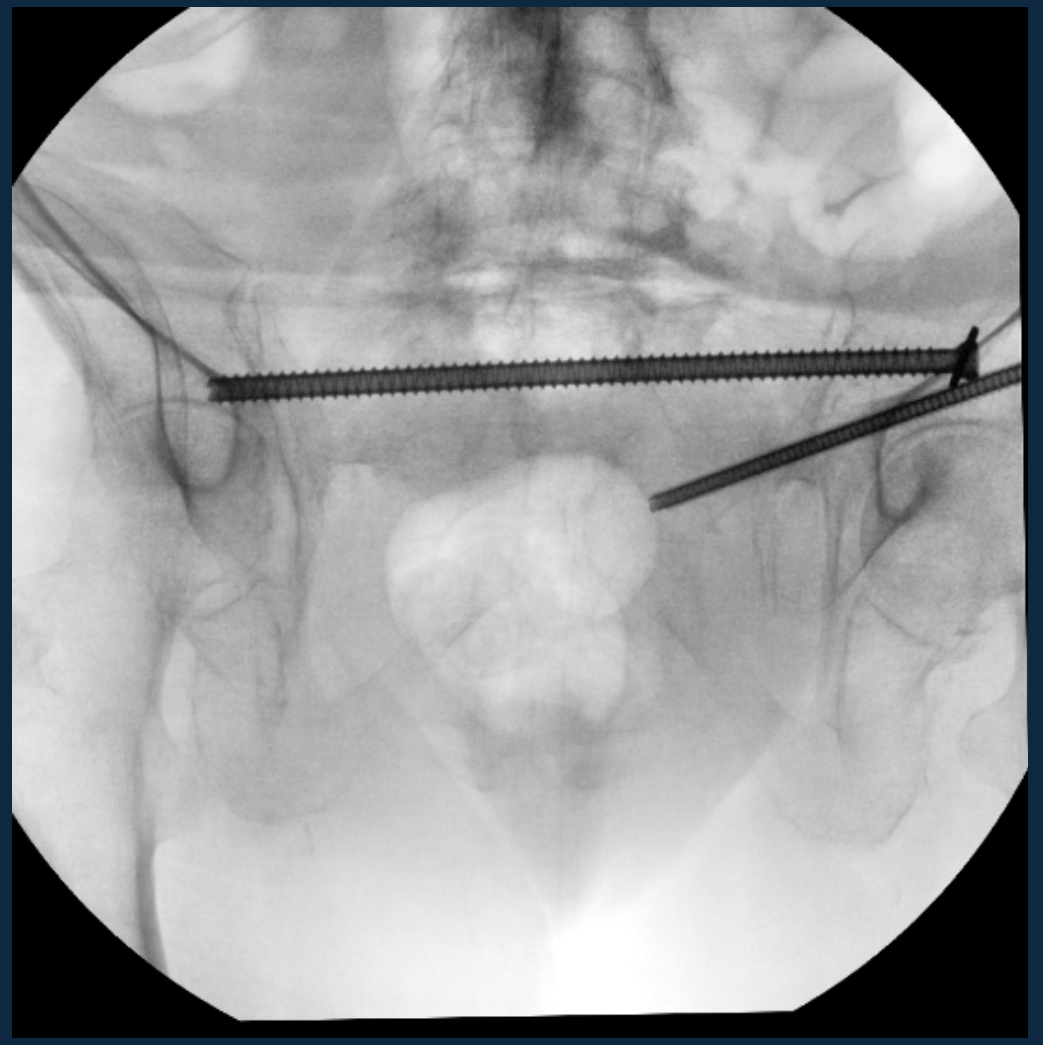
OR



Case 3

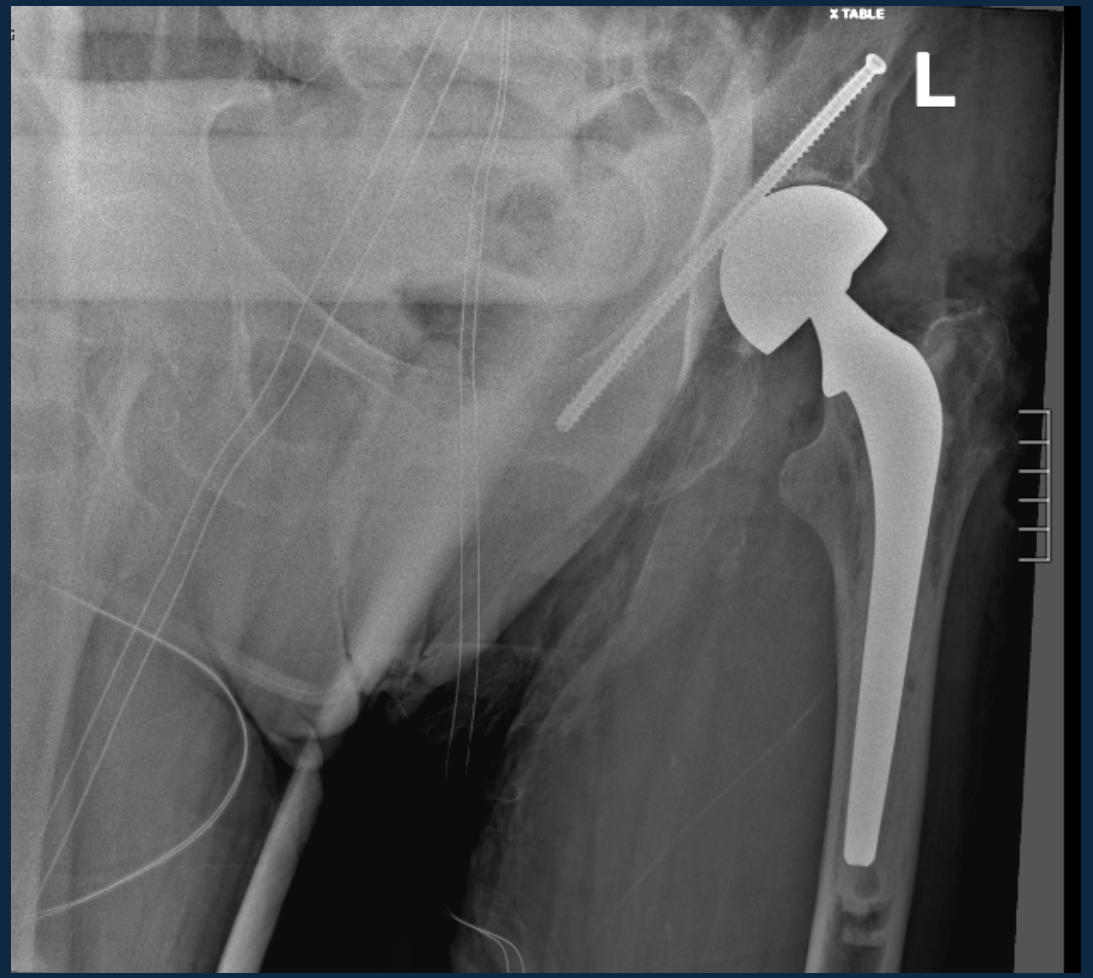
OR





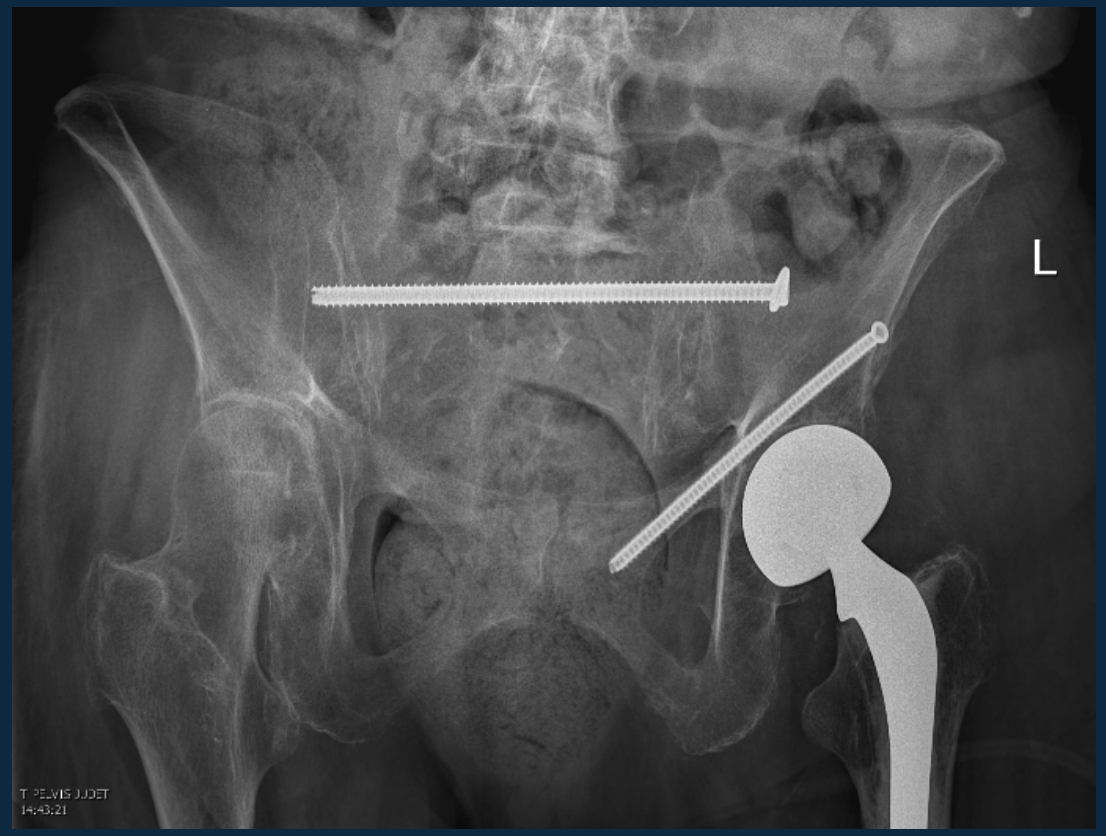
Case 3

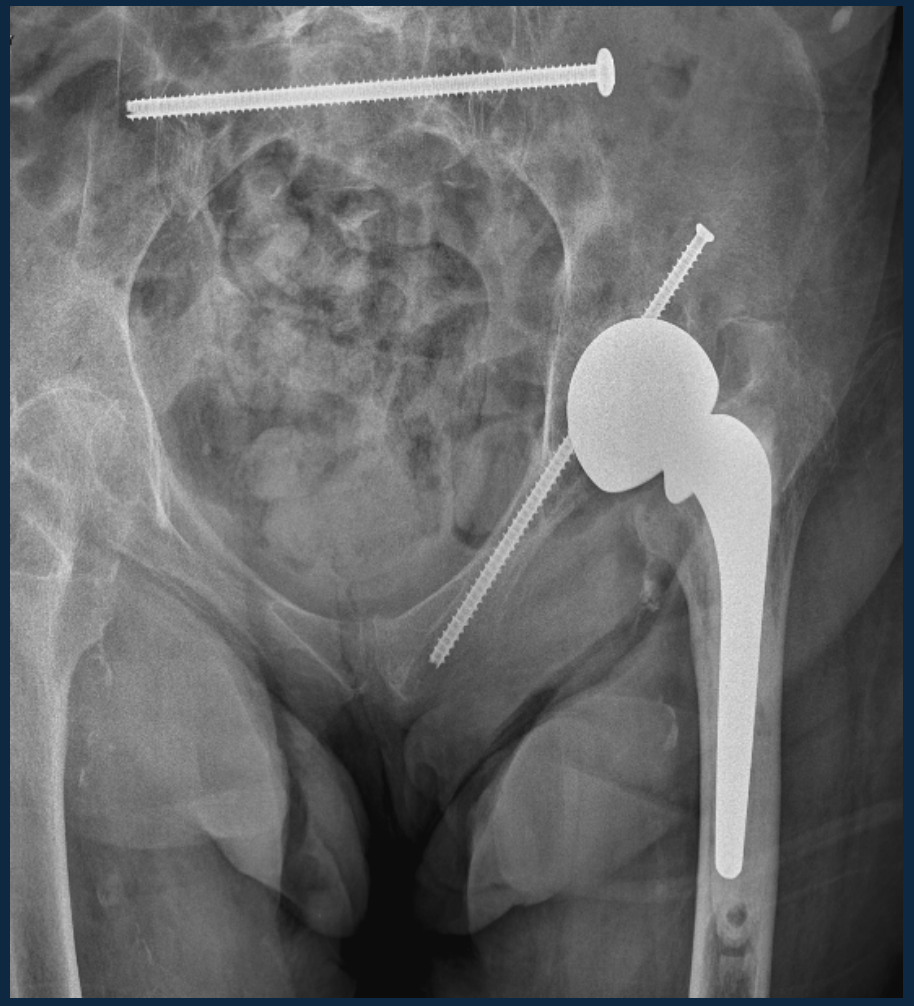
OR



Case 3

2 months





Case 3

2 years

Case 4

Case 4

73 year old female

Ground level fall

Longstanding
Fosamax use

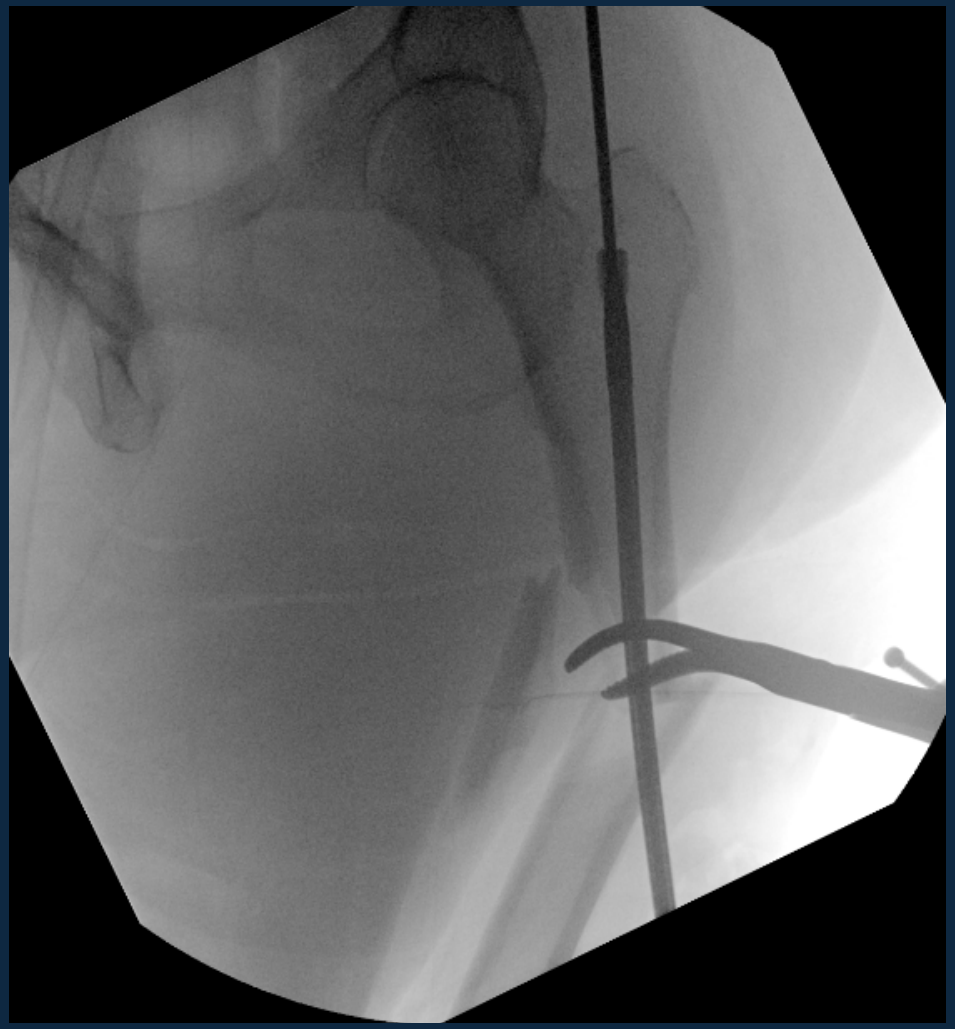
Case 4

Problems

- Atypical characteristics
  - Risk of delayed vs nonunion
  - Contralateral risk

Case 4

OR

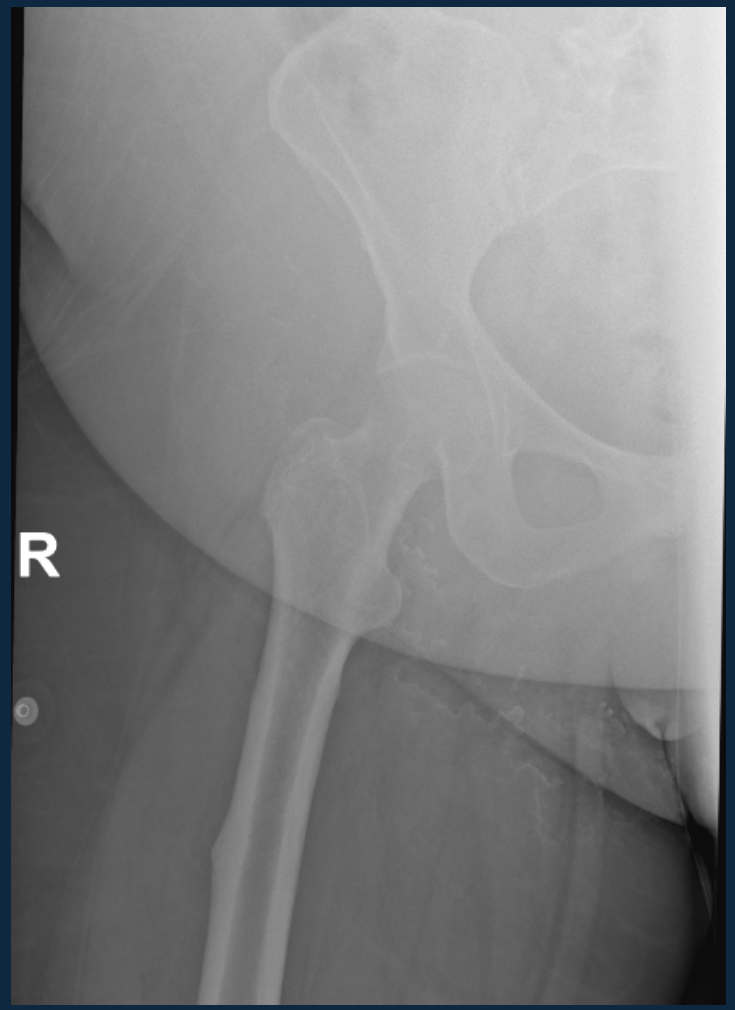


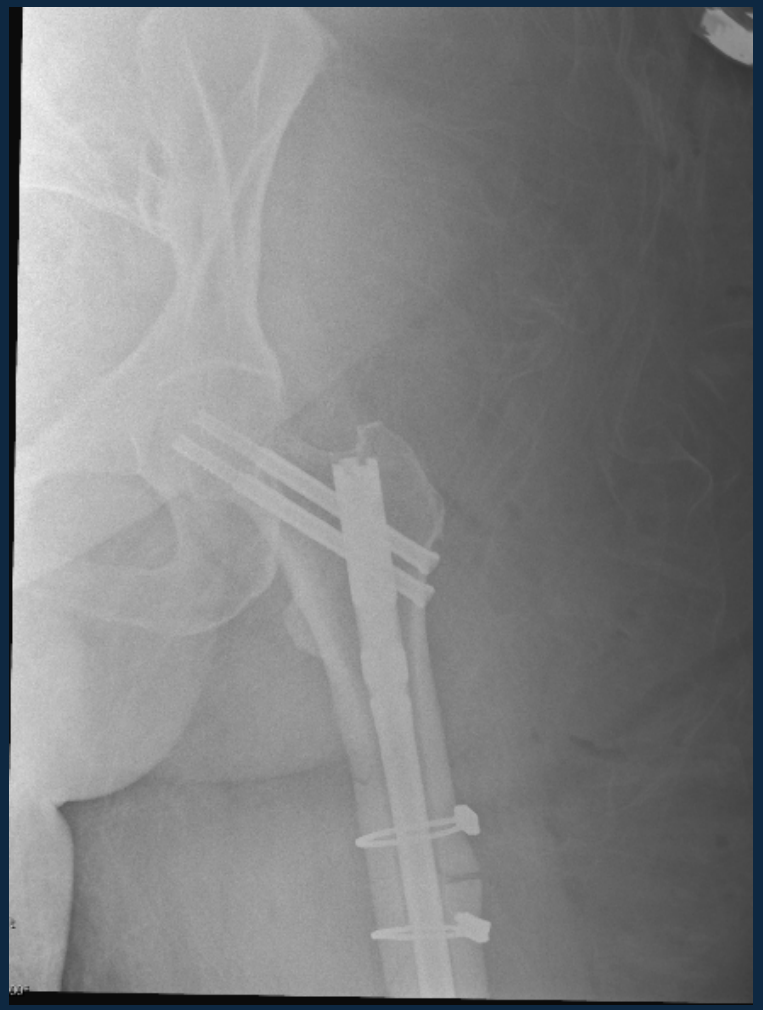
Case 4

OR

Case 4

OR





Case 4

Left thigh pain?

Fracture line visible?

Case 4

3 months