

Periprosthetic Hip Fractures

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Objectives

- Define periprosthetic and peri-implant fractures
- Accurately classify periprosthetic fractures at the hip
- Describe treatment strategies for periprosthetic and peri-implant fractures

Definitions

- Periprosthetic fracture
 - A fracture about a prosthesis (e.g. arthroplasty stem)
- Peri-implant fracture
 - A fracture adjacent to a surgical implant (e.g. plate, medullary nail)



Periprosthetic Fractures of the “Hip”

- Proximal Femoral Periprosthetic
 - Interprosthetic
- Acetabular Periprosthetic
- Proximal Femoral Peri-Implant

Periprosthetic Fractures of the Proximal Femur

- Occur around hip arthroplasty stems and/or cement mantles
- Incidence varies, 0.1-18%¹
- Etiology - bimodal distribution:
 - Elderly: Low energy MOI (fall from standing height)
 - Young: High-energy trauma (sport, MVC, etc; <10% reported cases²)

Periprosthetic Fractures of the Proximal Femur

- Risk factors:
 - Demographics:
 - Increased age, female sex, osteoporosis, inflammatory arthropathy, altered bony morphology
 - Surgical:
 - Press-fit stem – 1.2-5.4% incidence³
 - Anterior approach – 2.5-10% incidence⁴
 - Long-stem implants
 - Impaction grafting^{1,3}

Periprosthetic Fractures of the Proximal Femur

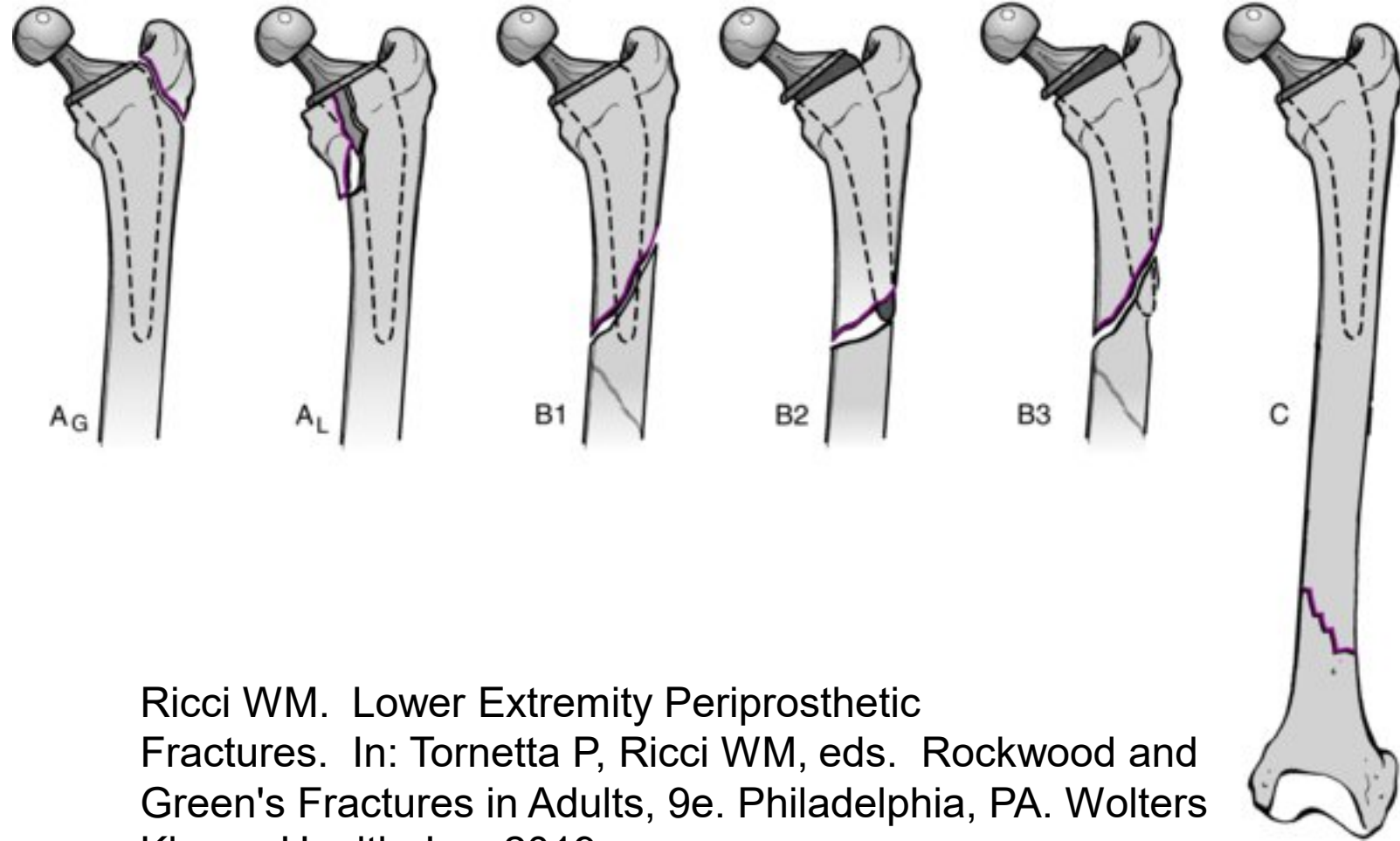
- 30-day mortality around 3% in multiple series
- Mortality higher when revision performed for fracture than for other reasons

Classification

- Early systems classify by anatomic region
- AAOS, 1990
 - Does not consider implant stability
- Kelley, 1994
 - Considers stem stability
- Poor utility

Classification

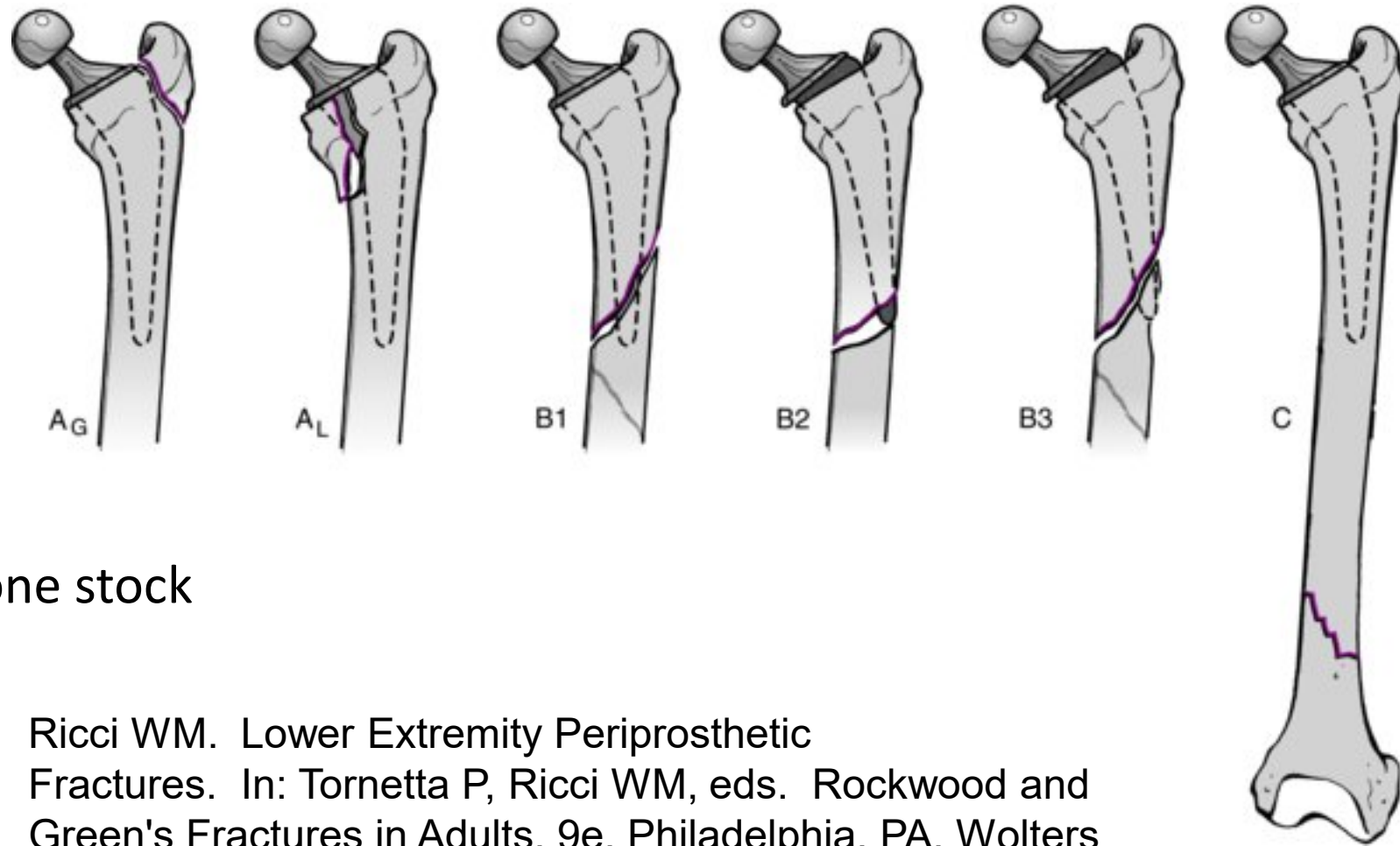
- Vancouver Classification
- Intraoperative vs postoperative
- Suggests treatment strategy
- Improved postop outcomes after adoption



Ricci WM. Lower Extremity Periprosthetic Fractures. In: Tornetta P, Ricci WM, eds. Rockwood and Green's Fractures in Adults, 9e. Philadelphia, PA. Wolters Kluwer Health, Inc; 2019

Vancouver Classification

- A – trochanteric
 - G, greater
 - L, lesser
- B – involving stem
 - 1, Well-fixed prosthesis
 - 2, Loose prosthesis
 - 3, Loose prosthesis, poor bone stock
- C – well below stem



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Intraoperative Fractures

- Incidence approx 1% primary THA, 7.8% revision THA¹
- Uncemented > Cemented stems
 - 2-7x increased rate of fx compared to cemented stems
- Risk factors:
 - Stem morphology²
 - Bone morphology³
 - Approach⁴
 - Female sex
 - Increased age
 - H/o prior hip surgery or revision THA

Intraoperative Fractures

- Vancouver Classification for Intraoperative Femur Fractures¹

| | Metaphyseal | | | Diaphyseal | | | Distal to Stem | | |
|---------------------|----------------------|-------------------|-----------------------|----------------------|-------------------|-----------------------|----------------------|-------------------|-----------------------|
| Classification | A1 | A2 | A3 | B1 | B2 | B3 | C1 | C2 | C3 |
| Fracture morphology | Cortical perforation | Undisplaced crack | Displaced or unstable | Cortical perforation | Undisplaced crack | Displaced or unstable | Cortical perforation | Undisplaced crack | Displaced or unstable |

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Intraoperative Fracture

| | Metaphyseal | | |
|--------------------------------------|--|---|---|
| Classification | A1 | A2 | A3 |
| Fracture morphology | Cortical perforation | Undisplaced crack | Displaced or unstable |
| Author's preferred treatment options | | | |
| Recognized fractures | Protected weight bearing or bone graft | Protected weight bearing or cerclage cables | ORIF with claw plate with conversion to long stem if implant unstable |
| Unrecognized fractures | Protected weight bearing | Protected weight bearing | ORIF with claw plate with revision to long stem if implant unstable |

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Intraoperative Fracture

| | Diaphyseal | | |
|------------------------|--|--|--|
| Classification | B1 | B2 | B3 |
| Fracture morphology | Cortical perforation | Undisplaced crack | Displaced or unstable |
| Author's preference | | | |
| Recognized fractures | Cortical strut with or without conversion to long stem implant | Lateral plate with conversion to long stem if implant unstable | Lateral plate with conversion to long stem if implant unstable |
| Unrecognized fractures | Cortical strut | Lateral plate with revision to long stem if implant unstable | Lateral plate with revision to long stem if implant unstable |

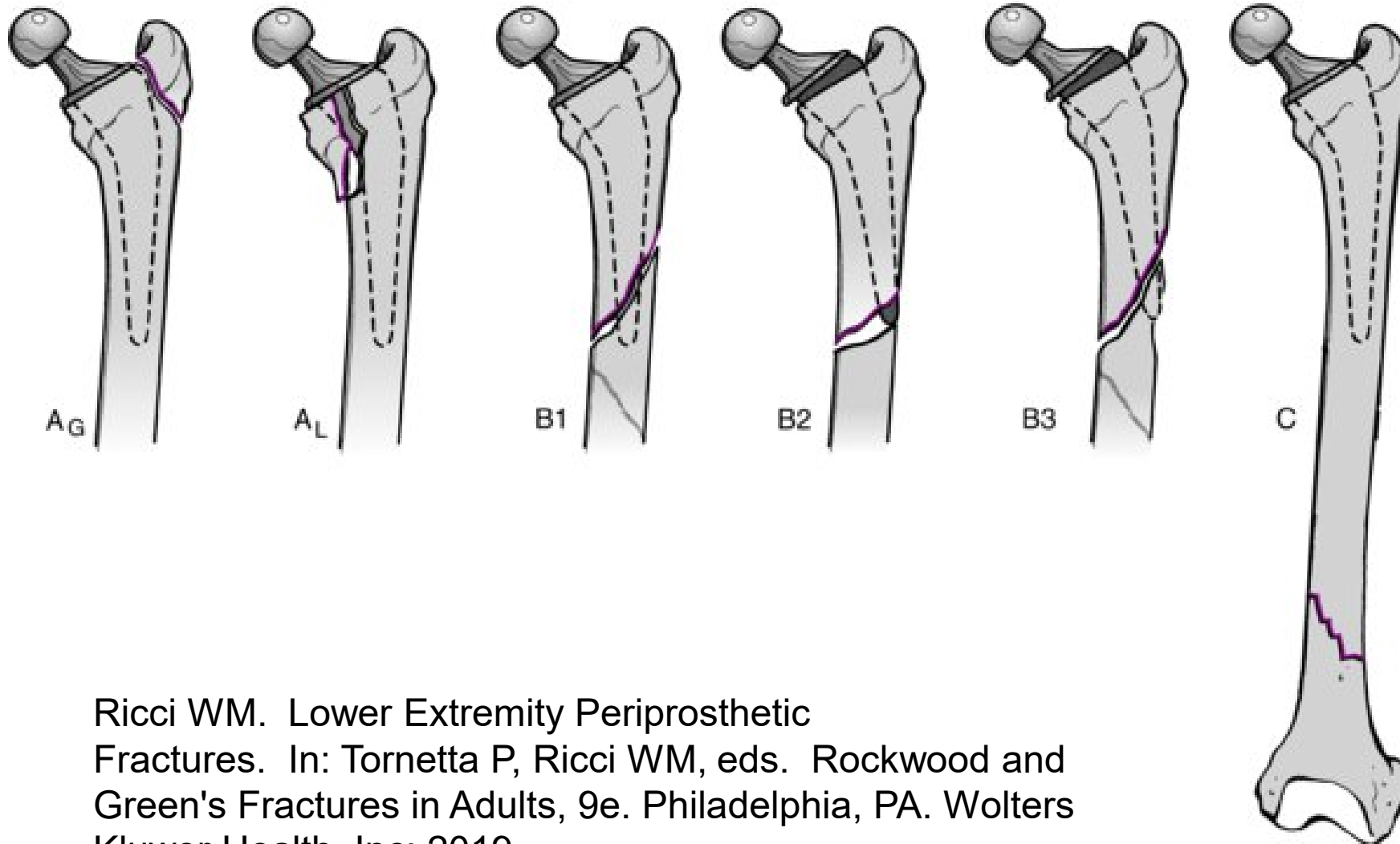
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Intraoperative Fracture

| | Distal to Stem | | |
|------------------------|----------------------|---|-----------------------|
| Classification | C1 | C2 | C3 |
| Fracture morphology | Cortical perforation | Undisplaced crack | Displaced or unstable |
| Author's preference | | | |
| Recognized fractures | Cortical strut | Lateral plate | Lateral plate |
| Unrecognized fractures | Cortical strut | Protected weight bearing or lateral plate | Lateral plate |

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Vancouver Classification – Postoperative



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Initial Evaluation

History

- PMH – critical to assess pt functionality
- Premorbid hip function
 - Pain, instability, weakness
 - **Mid-thigh pain, start-up pain, progressive limb shortening – stem loosening**
- RED FLAGS FOR INFECTION
 - History of wound-healing complications or delayed wound healing
 - Any hx of postop antibiotic therapy
 - Pain
 - Fever
 - Draining sinus

Physical

- May be limited by pain
- Note location of prior incision
- Leg length discrepancy
- Skin/soft tissue condition
- Neuromotor exam

Radiographic Workup

- XR
 - Standard AP/lat of affected hip and full femur
 - Low AP pelvis
 - Implant positioning
 - Polyethylene wear, osteolysis
 - PRIOR XR
- CT/MRI
 - Rarely indicated



Treatment Principles

- Nonoperative management is uncommon
 - Stable patterns
 - Poor surgical candidates
- Be prepared for several possible scenarios
 - Familiarized with extensile approaches, osteotomies
 - Ensure multiple implant options are available in-house

Treatment Principles

- Obtain intraoperative tissue cultures, even if preoperative risk of infection was low
- Postop early mobility is goal, but may require protected WB 6-12 wks until radiographic evidence of healing

Preop Planning

- Obtain index op report
 - Implant system used, any intraoperative abnormalities, etc
- Obtain postop, pre-morbid XR
 - Look for evidence of subsidence, malpositioning, etc
- Template
 - Consider including multiple systems or bail-out options
- Speak to the rep
 - Ensure all necessary equipment and systems are available in-house

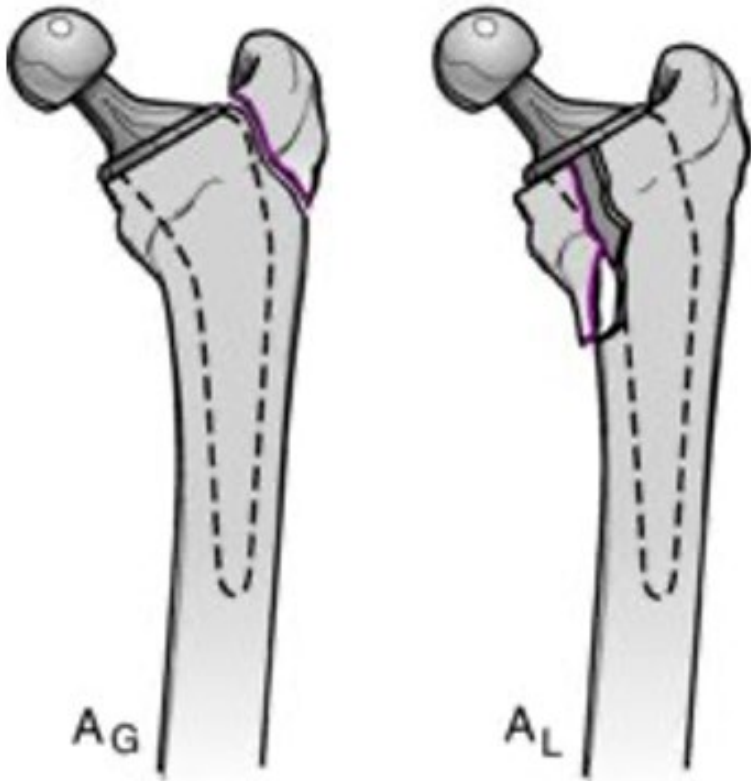
Timing

- Increased mortality with surgical delay beyond 72 hours
- Work expeditiously to ensure the optimal
 - Surgeon
 - Implant availability
 - Team

Postop

- GOAL – WBAT for all fractures
 - May not be possible due to fixation, bone quality, implants etc
 - Alternative strategies – dual plating, nail/plate etc emerging
- Additional protocols (abduction, posterior hip) per surgeon preference
- Scant evidence in periprosthetic “hip” fractures

Vancouver A



- A_L
 - observation for true LT
 - Cerclage + revision for large medial fragment
- A_G
 - observation if small
 - Internal fixation for large fragments

Example: AG

- Displaced trochanteric fragment reduced and fixed with claw plate

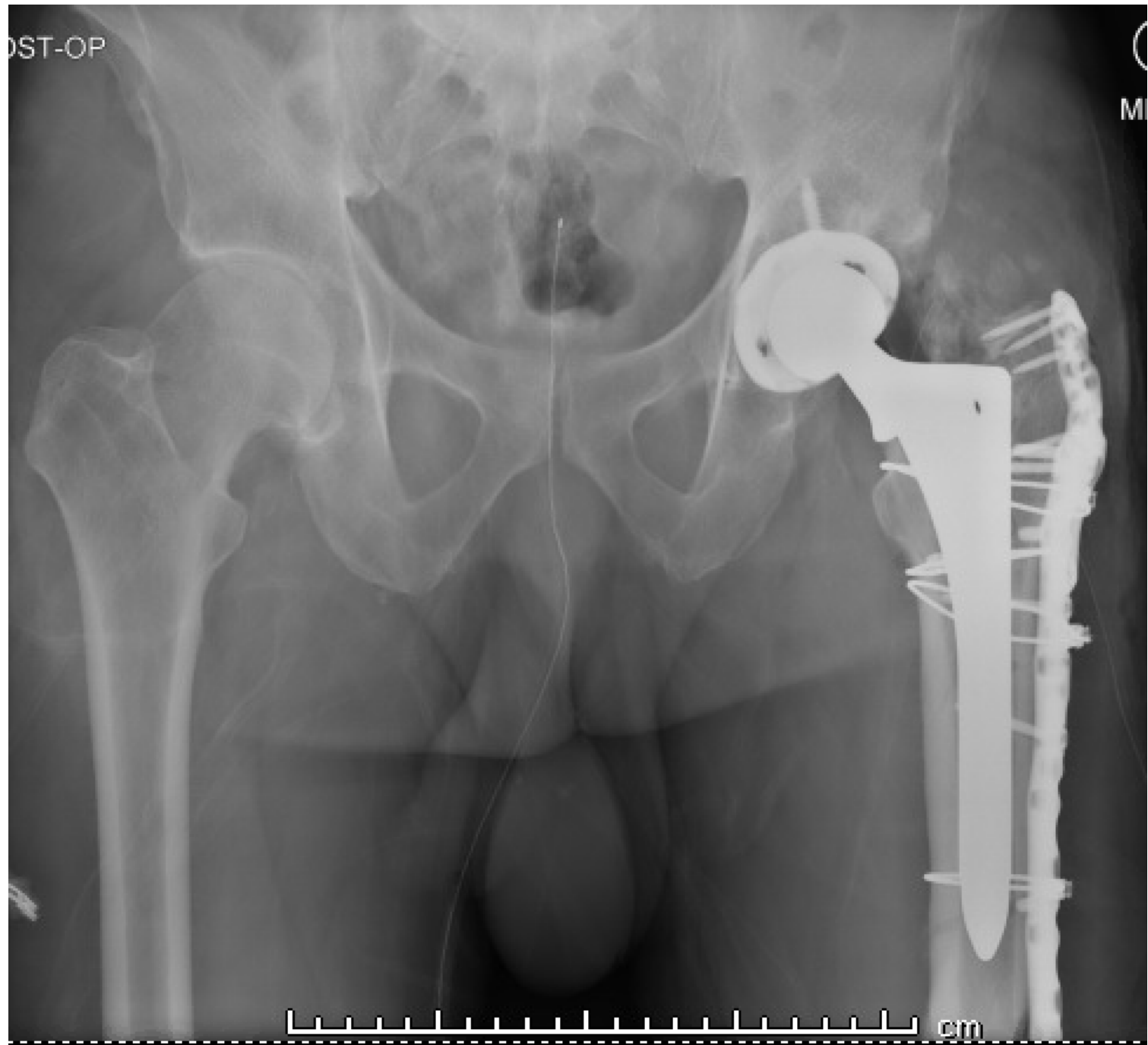


Example: A_L



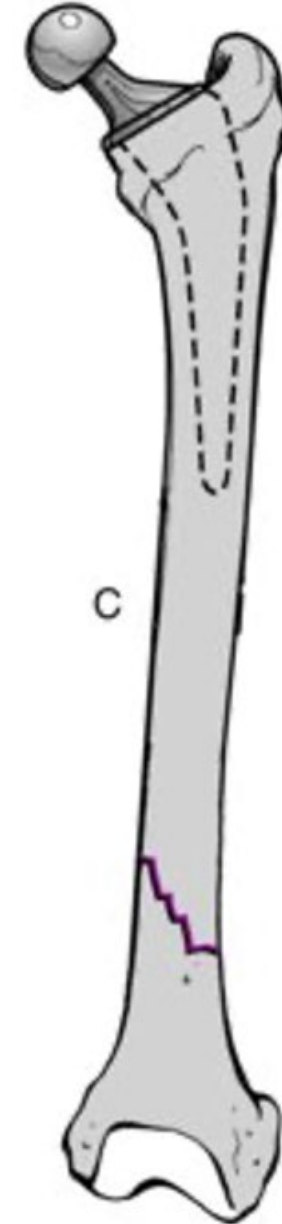
Example: A_L

- Cerclage of fracture
- Prosthesis revision
- Plate spanning entire femur

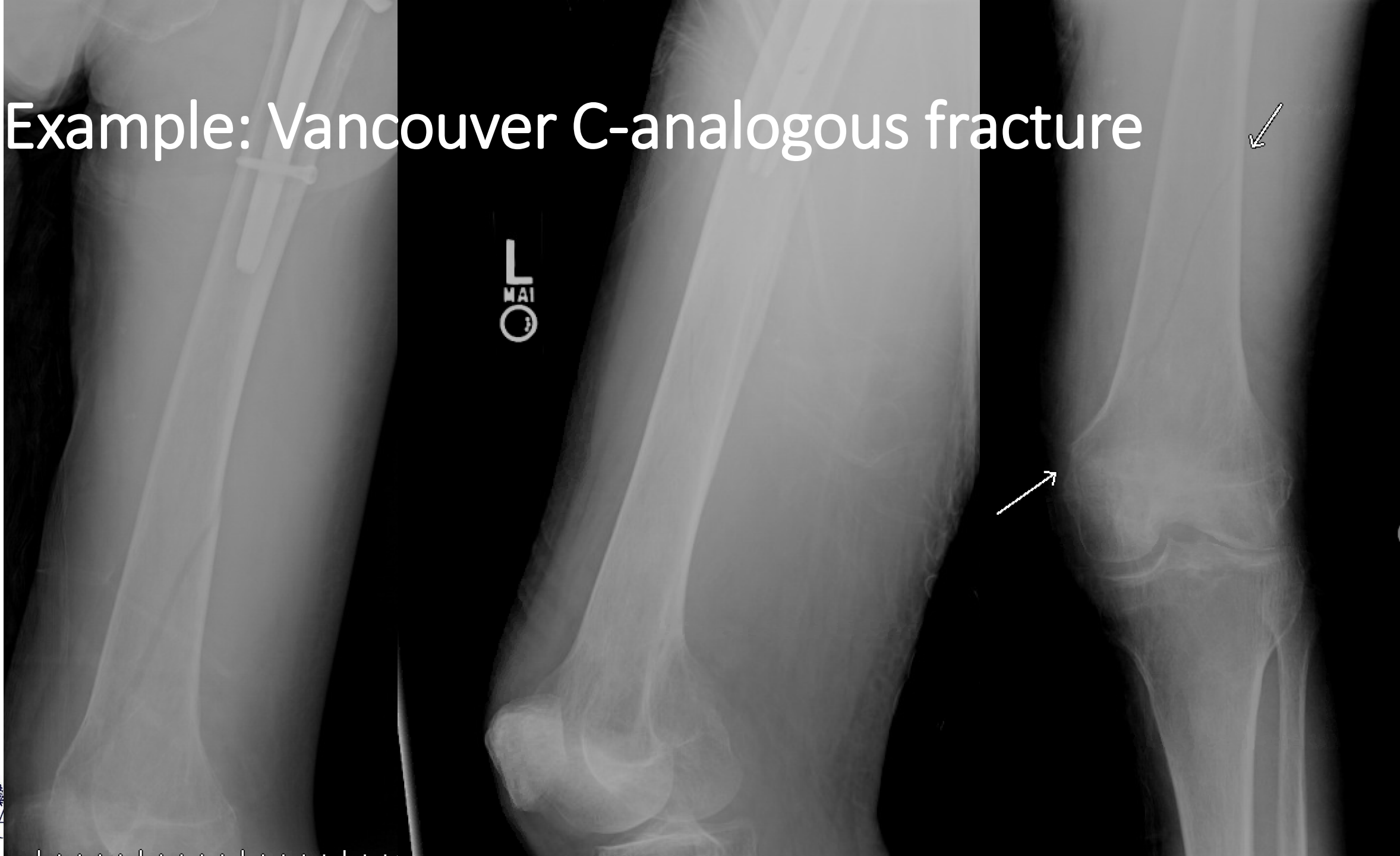


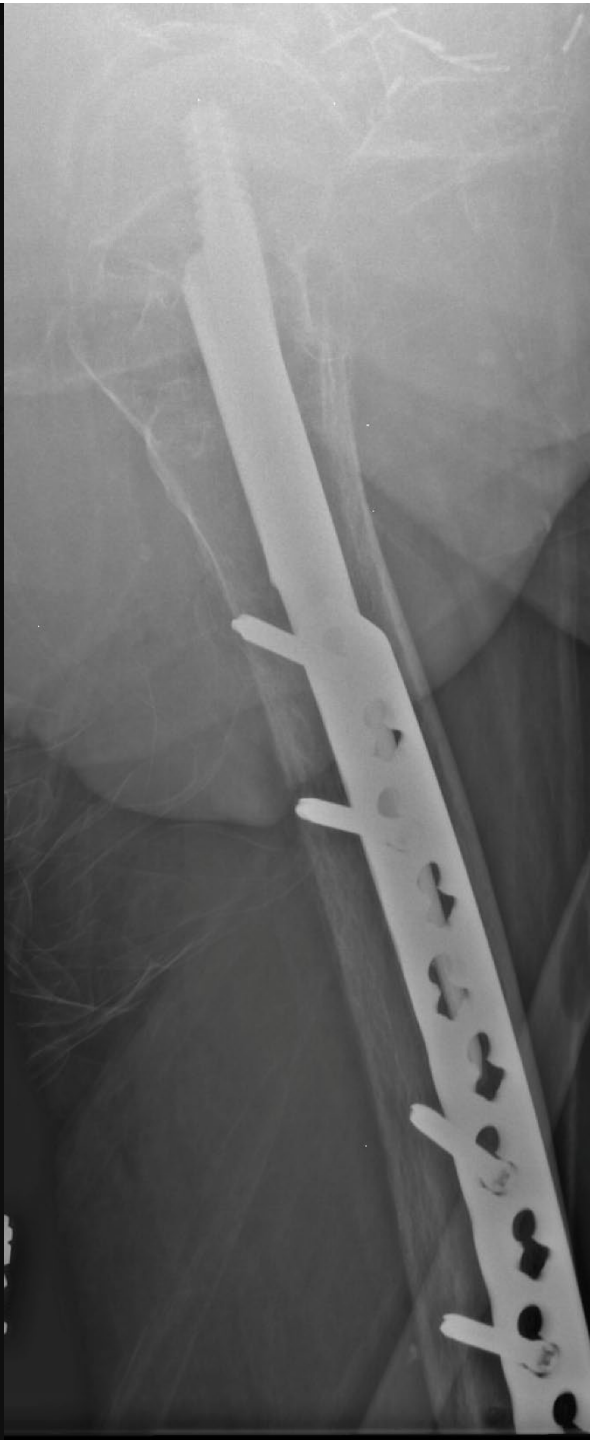
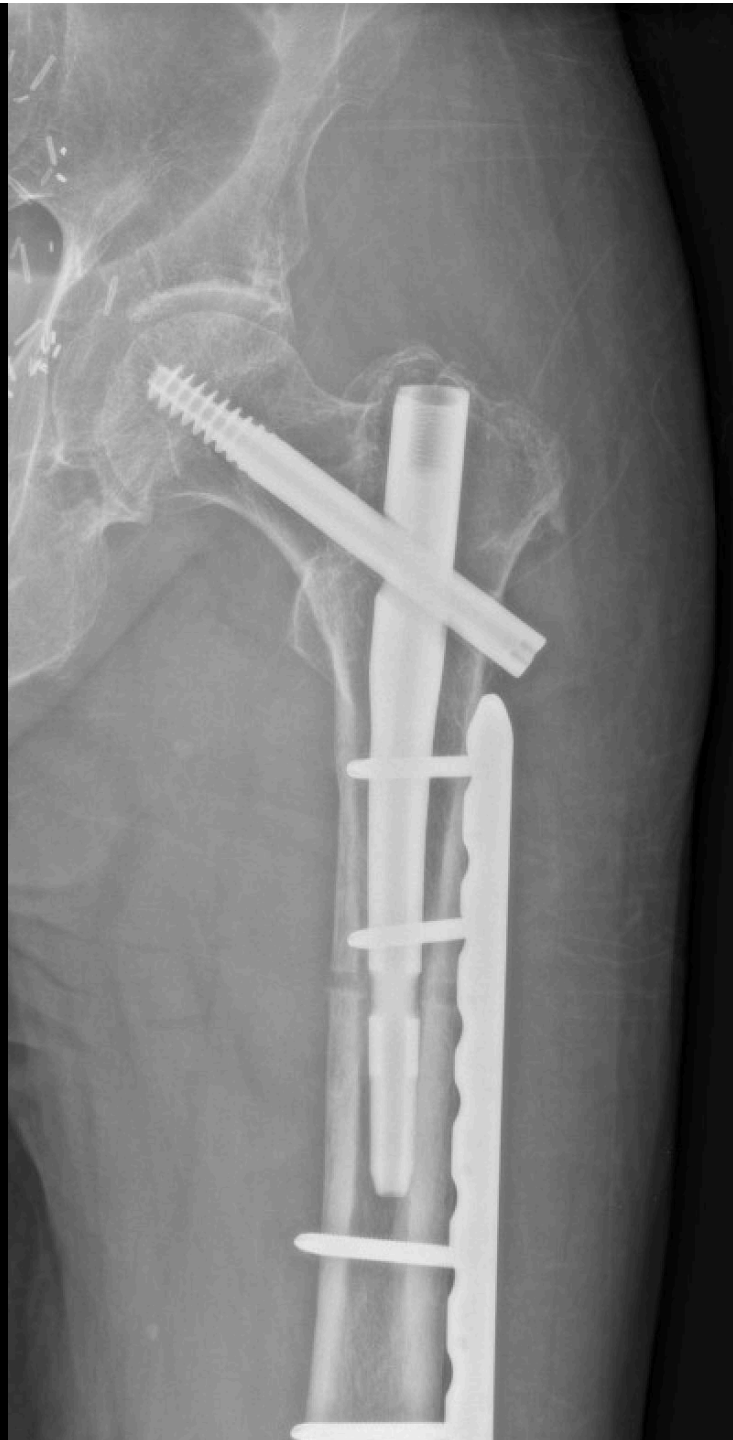
Vancouver C

- Fix the fracture
- Don't create new problems
 - Overlap implants
 - No stress risers
- Plate the whole bone!!

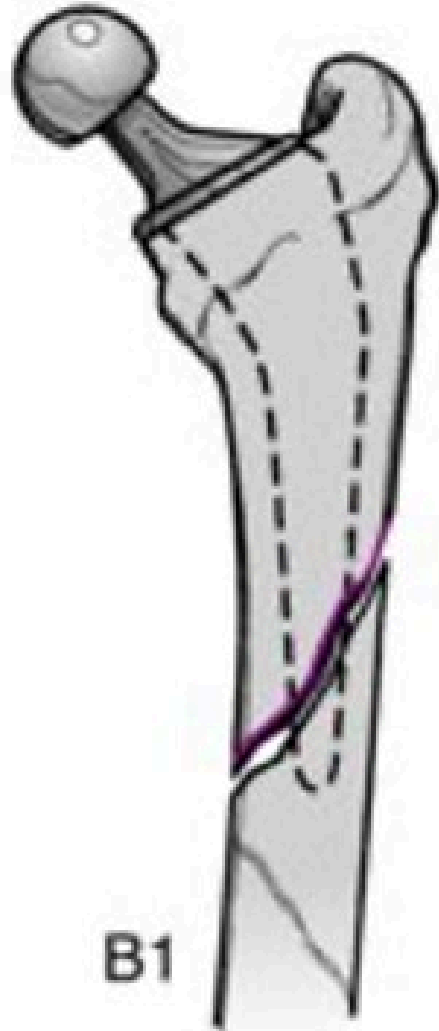


Example: Vancouver C-analogous fracture



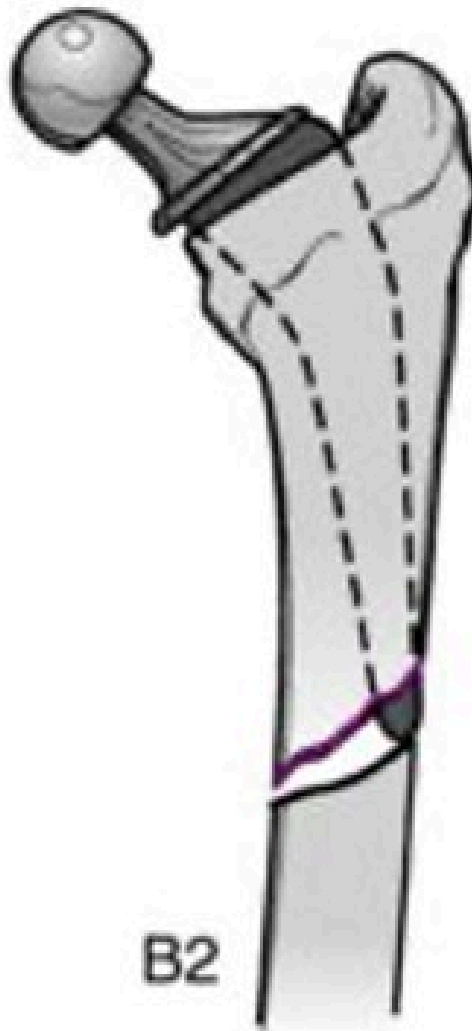


Vancouver B



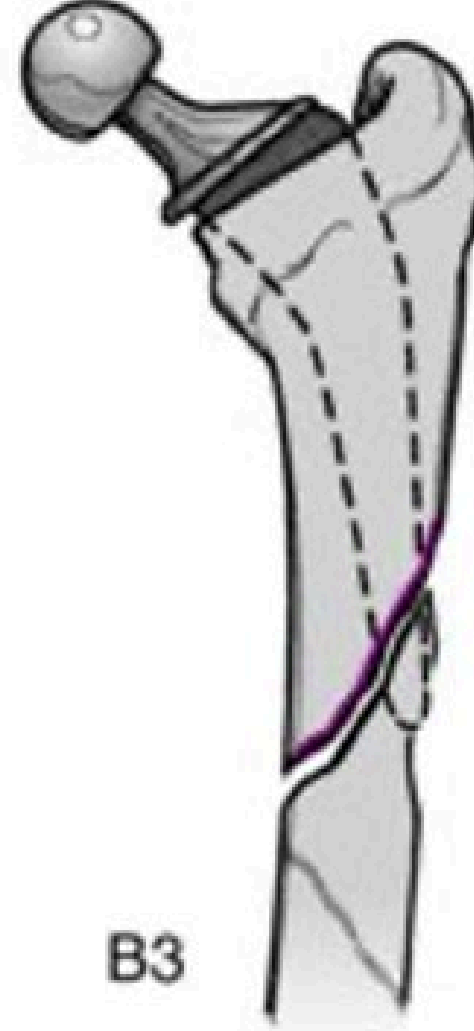
B1

STABLE IMPLANT



B2

LOOSE IMPLANT



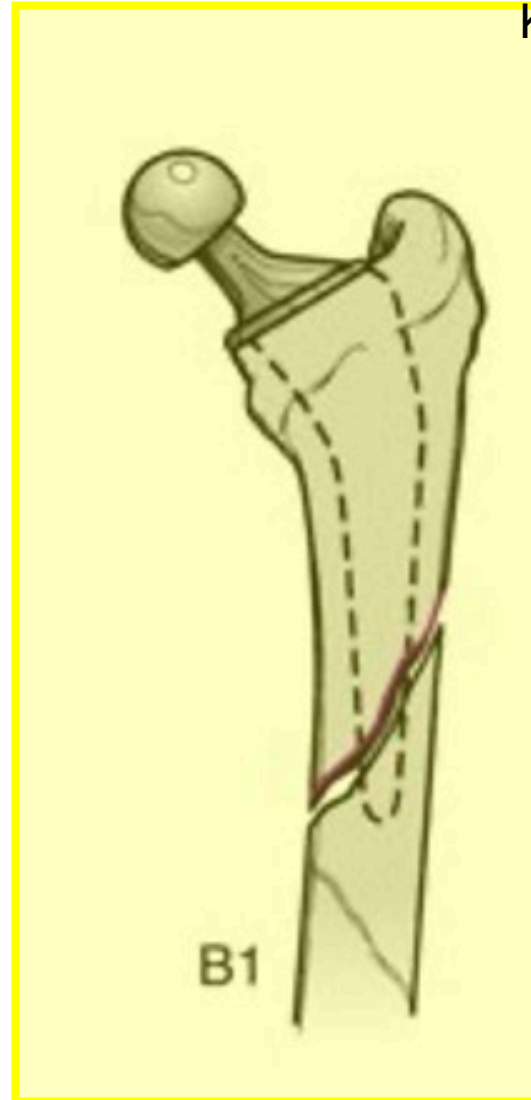
B3

INSUFFICIENT BONE STOCK

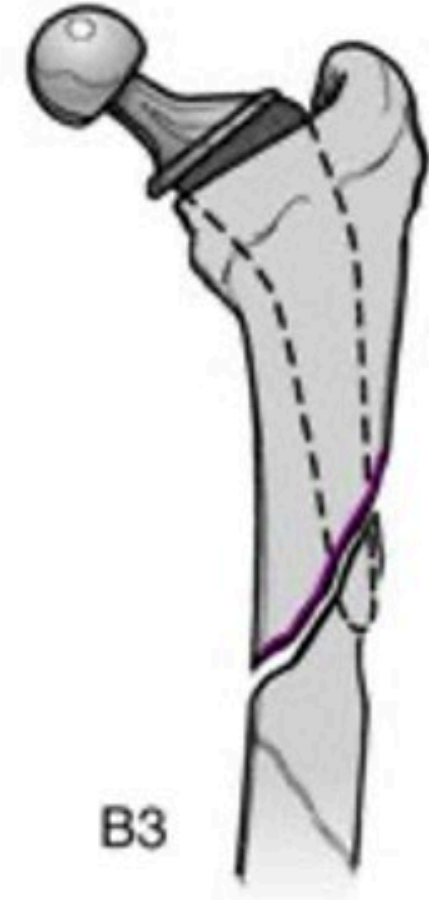
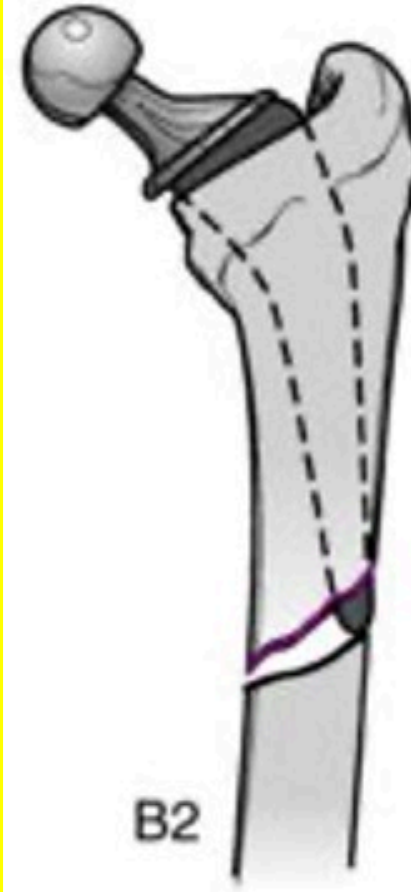
Vancouver B

INTERNAL FIXATION

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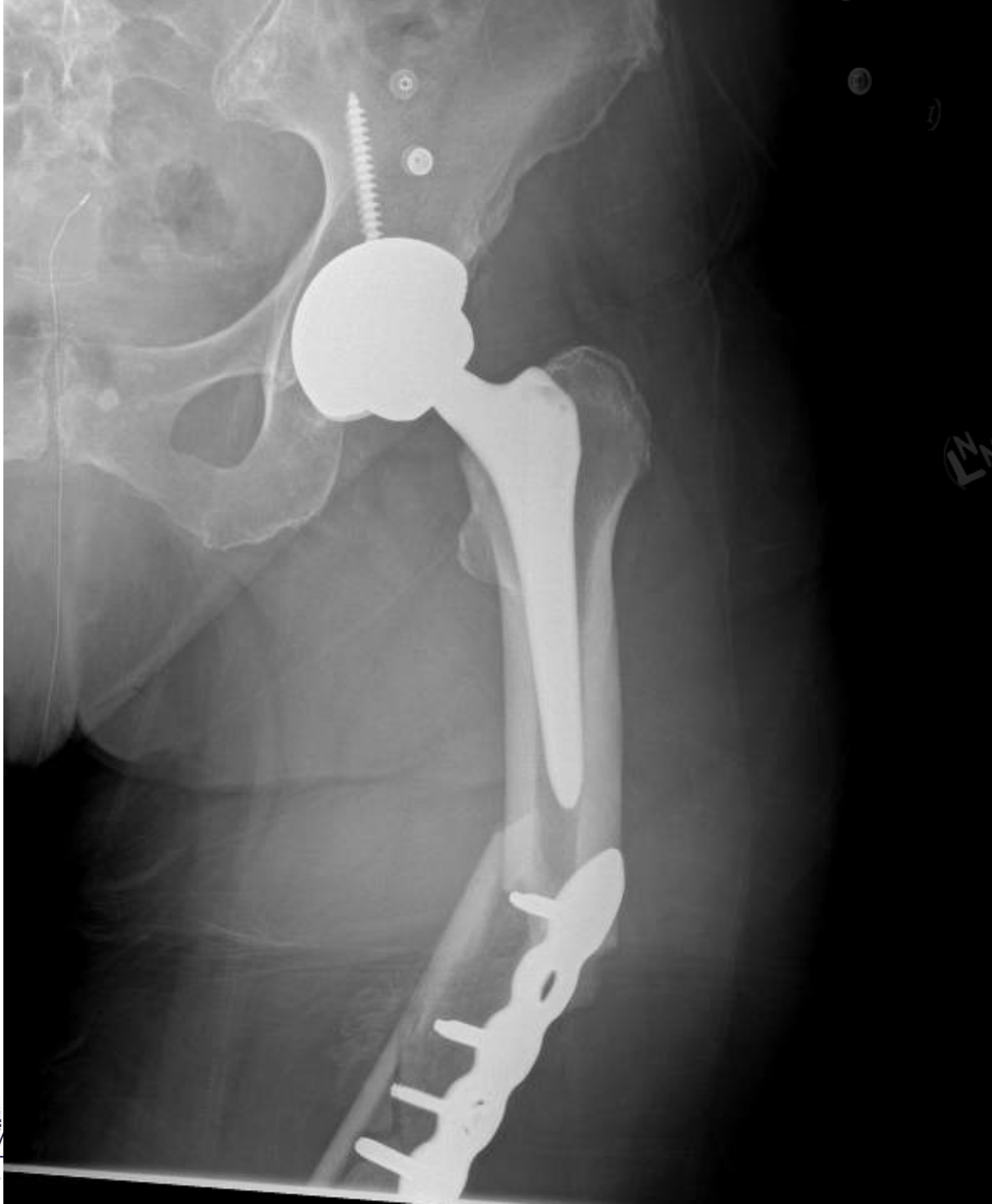


STABLE IMPLANT



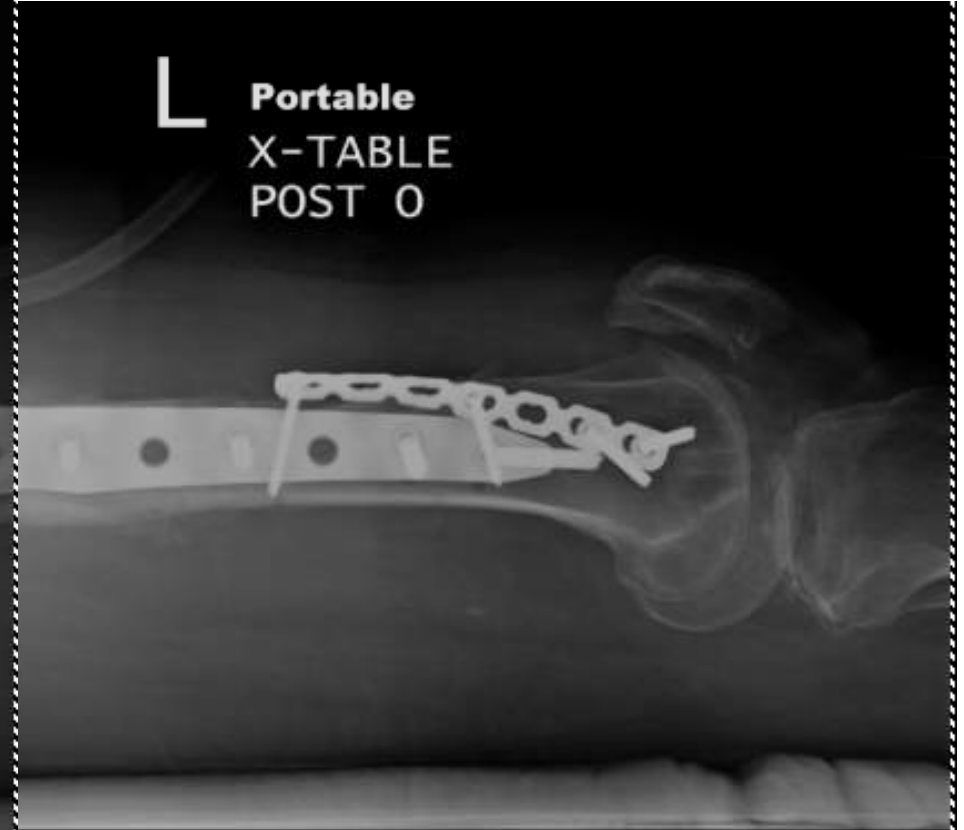
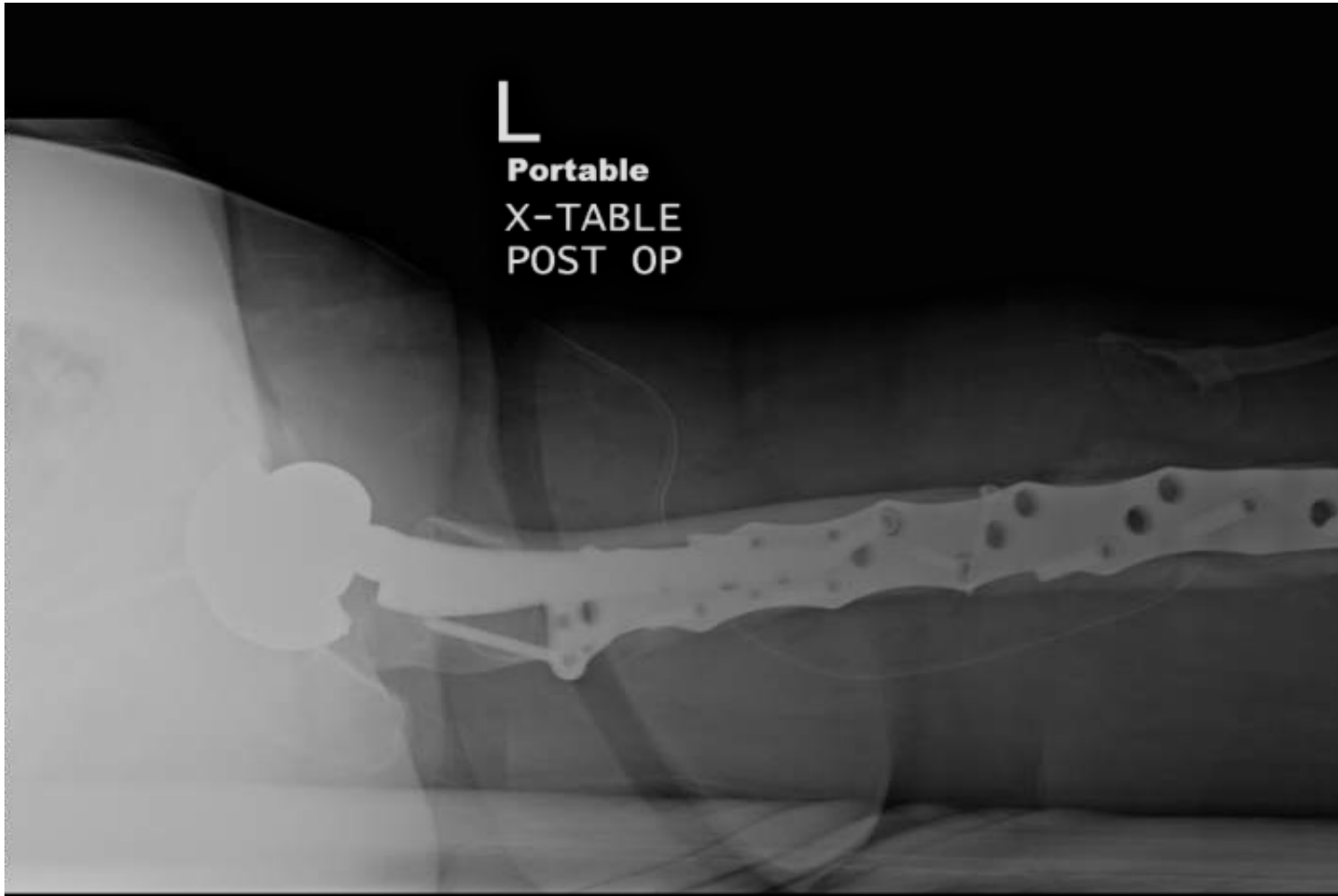
Vancouver B1

- Don't forget basic osteosynthesis principles
- Choose absolute or relative stability and create it
- Don't disturb biology whenever possible
- Test stem intraoperatively and be prepared to revise







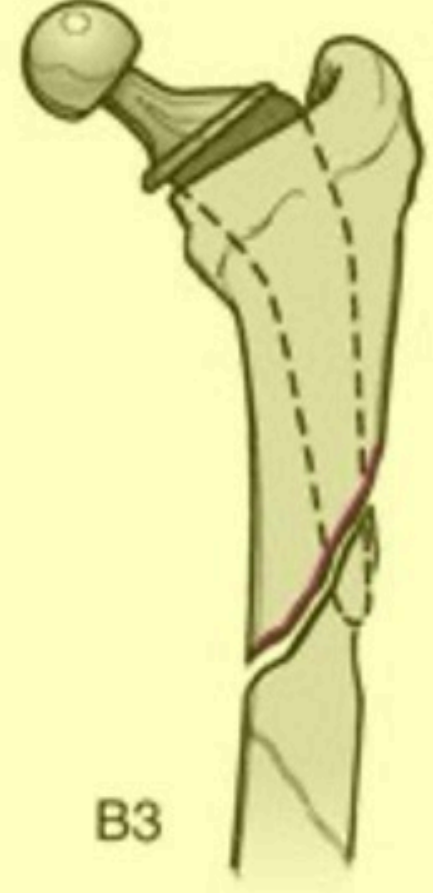
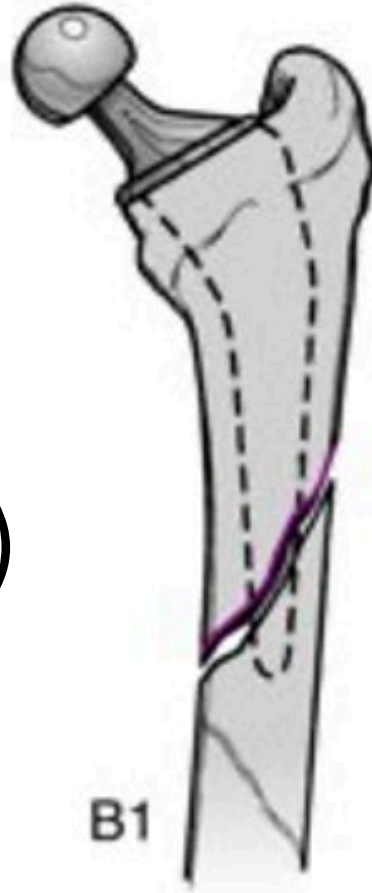




Vancouver B

REVISION ARTHROPLASTY

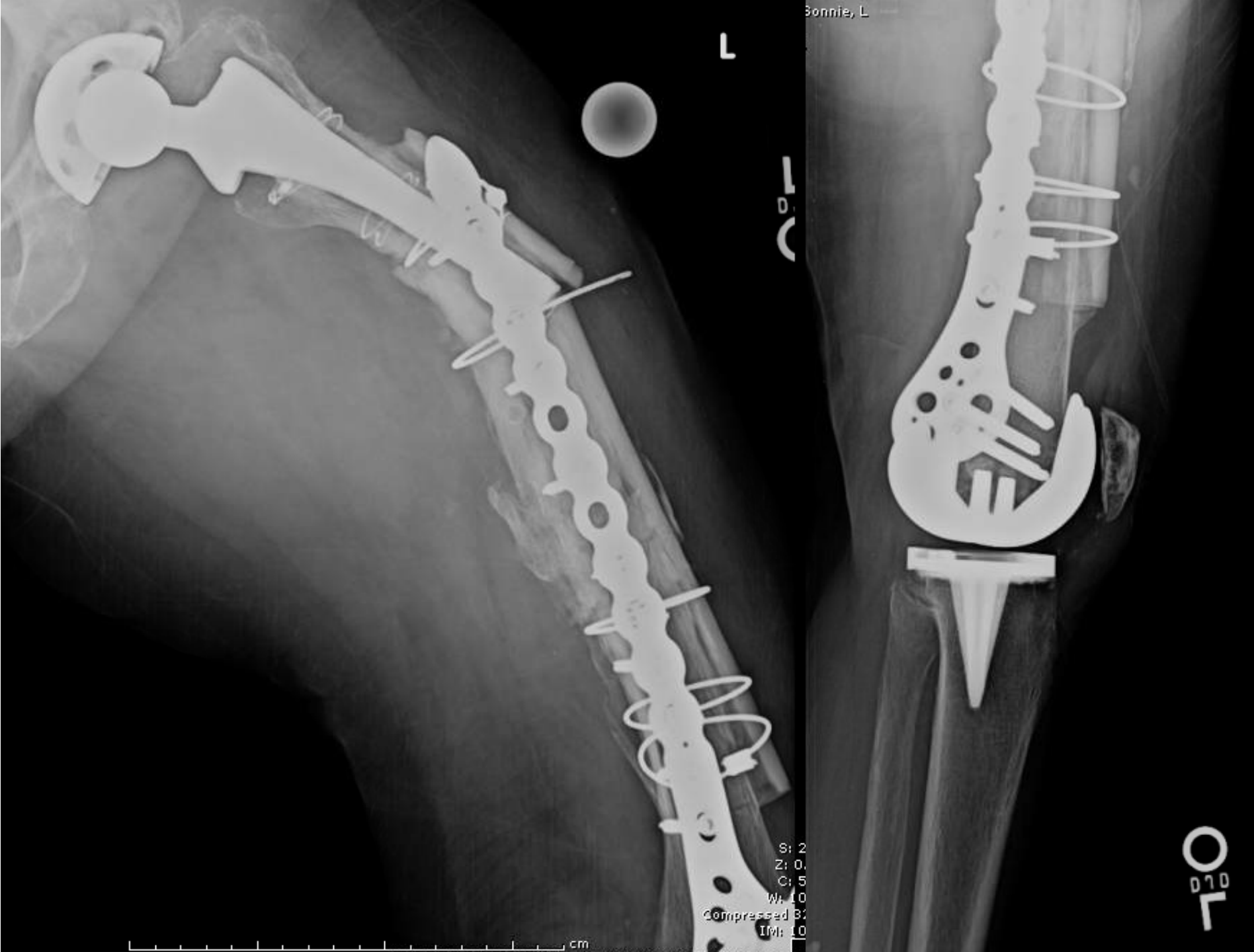
(± INTERNAL FIXATION)



Vancouver B2/3

- Bypass fractures by at least 2 cortical diameters
 - Biomechanical data from canine models without fixation
- Don't forget basic osteosynthesis principles
- Create a durable, stable construct













Fixation Mechanics

- Cerclage useful for re-creating tube or when fixation cannot be placed
- Be judicious
- Screws are biomechanically superior to cables
 - Need some **BI** cortical screws
 - Numerous proprietary options exist to facilitate this

Allograft Struts

- Should be reserved for when there is bone loss
- Inferior to internal fixation with plates/screws for simple patterns
- Increases infection risk and time to union in meta-analyses¹

Periprosthetic Acetabular Fractures

- Historical intraoperative fracture rate low (0.3% in Mayo series)
 - Rate up to 8.4% based on CT scans
- Postoperative fracture rate very low (0.07% in Mayo series)



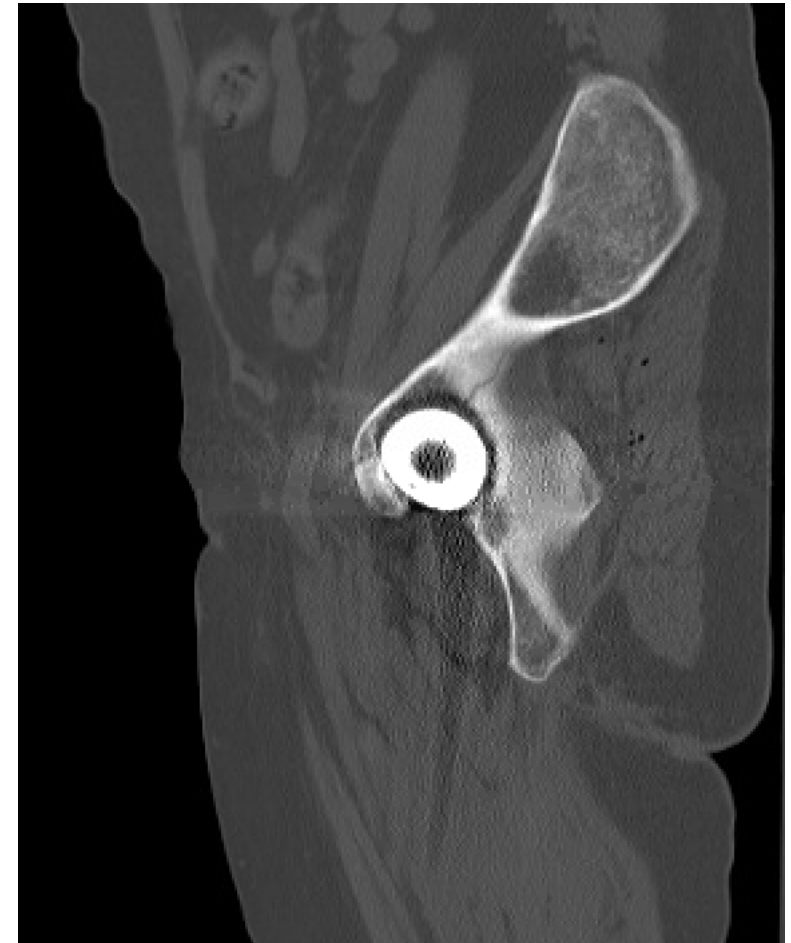
Classification

- Peterson and Lewallen (1996)
- Type I: Component position unchanged, no pain with hip motion
- Type II: Radiographic loosening or significant hip pain

Treatment

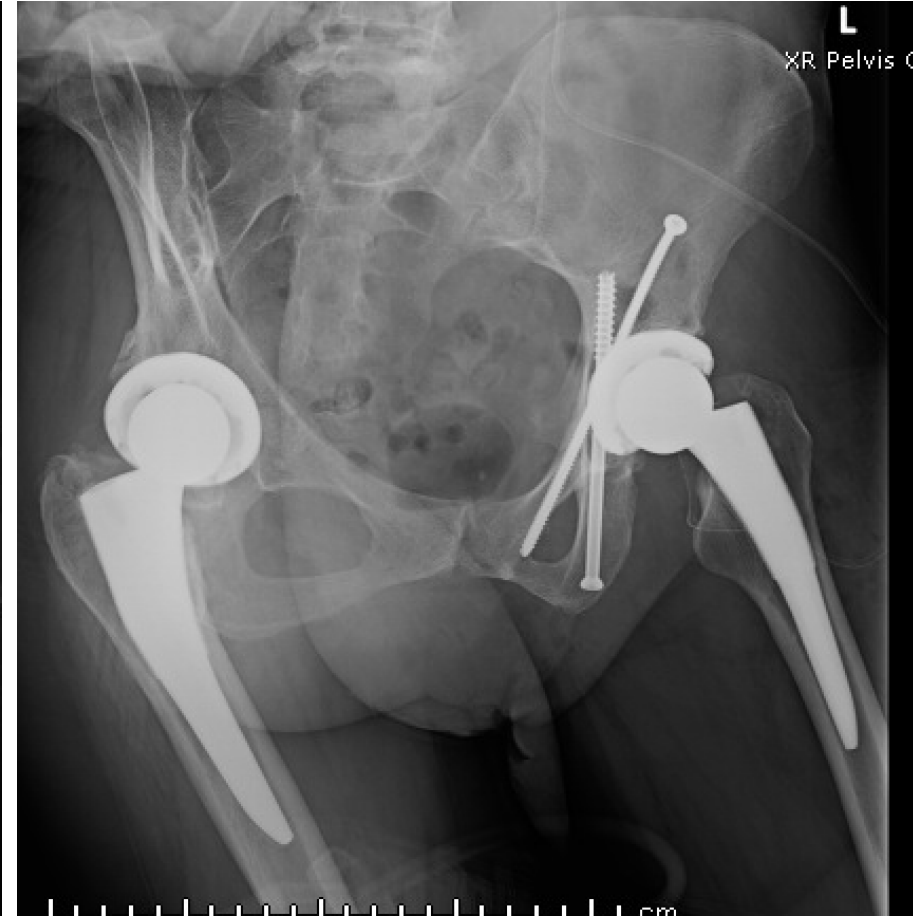
- Stable cup
 - Intraop – augment with screws
 - Postop – limited weightbearing
- Unstable cup
 - Revision of cup +/- ORIF of acetabular fracture

Example: Stable Cup

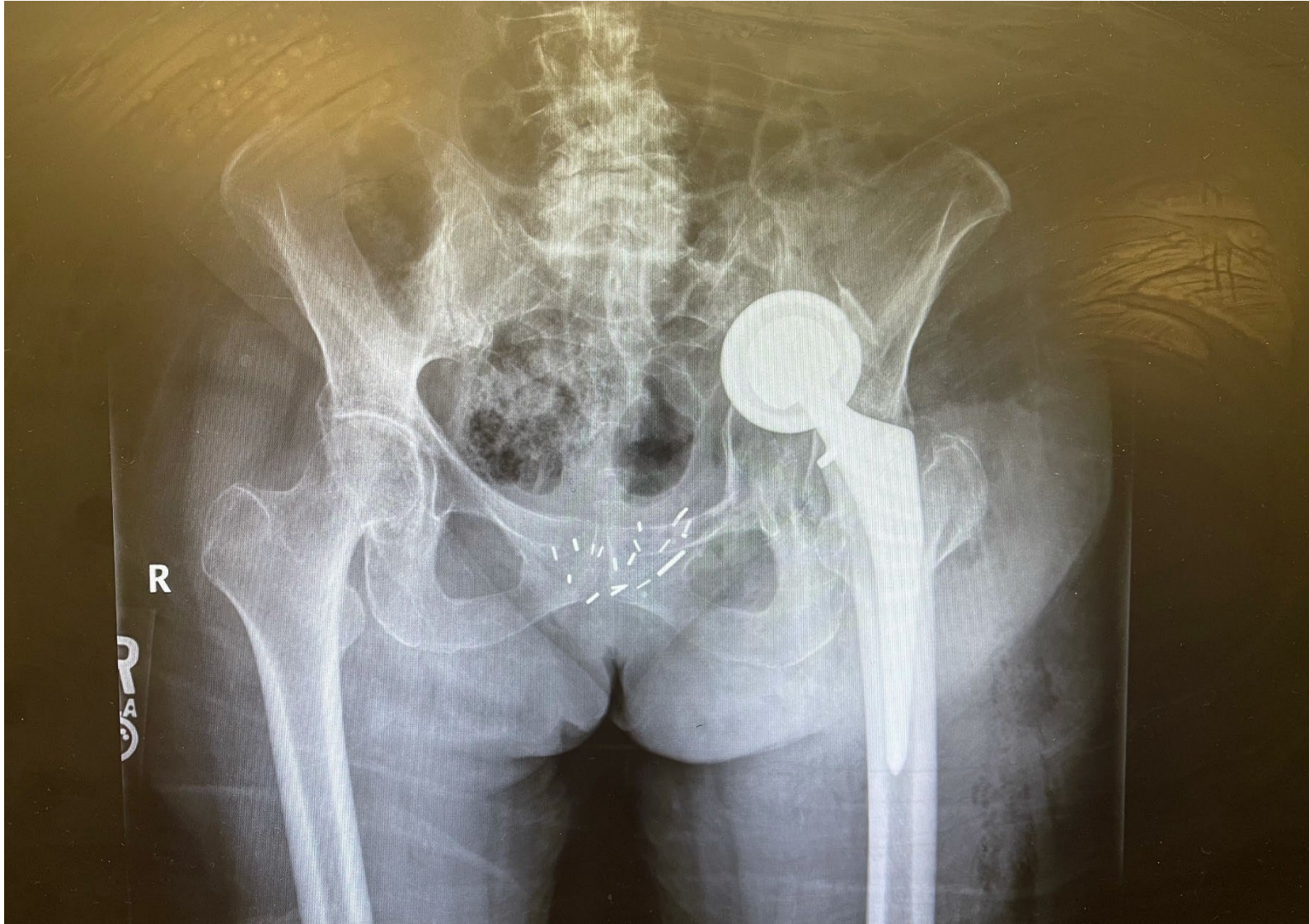




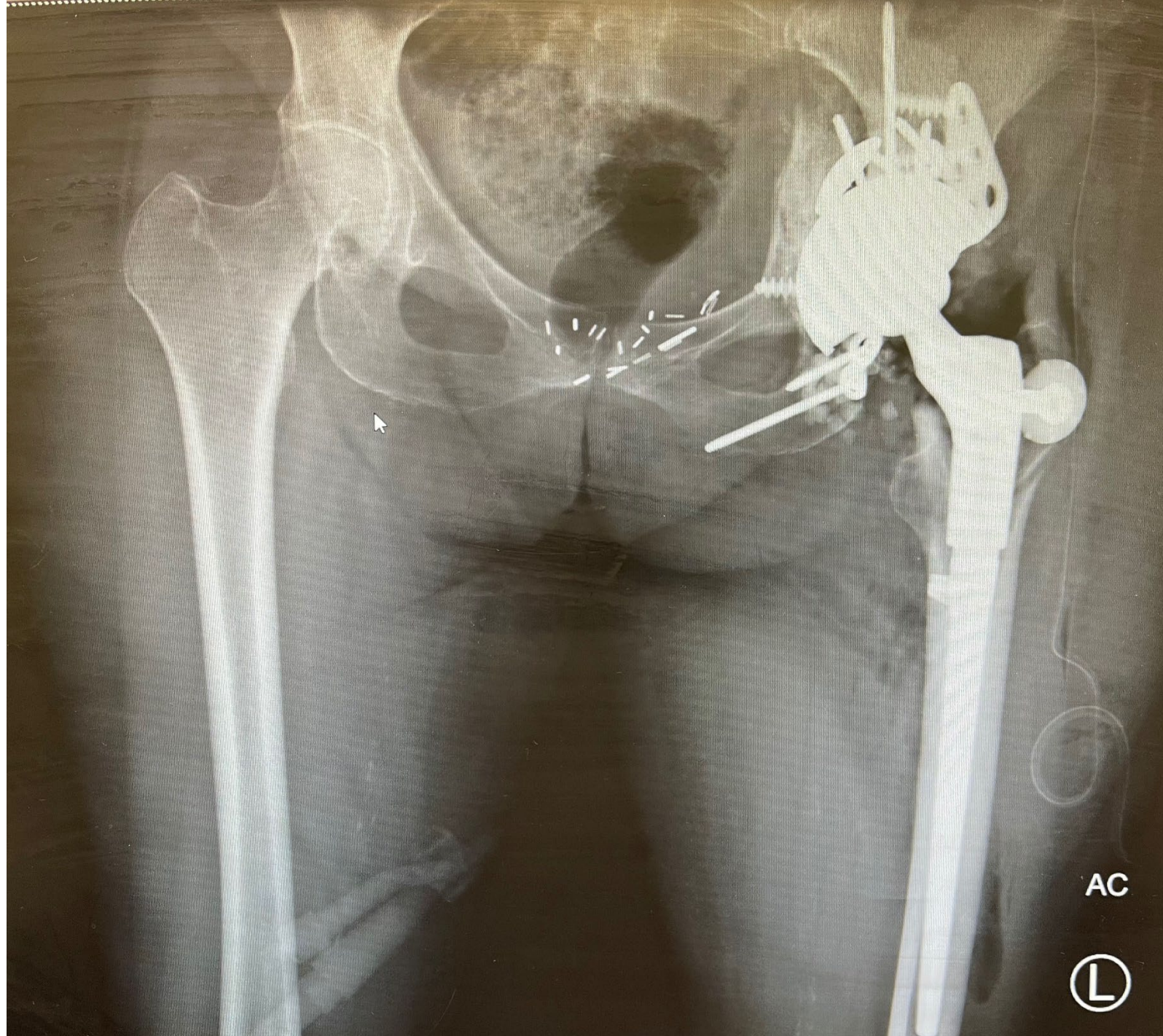




Example: Unstable Cup



- Prosthesis revised
- ORIF of posterior column
- Flanged cup with fixation into anterior and posterior columns

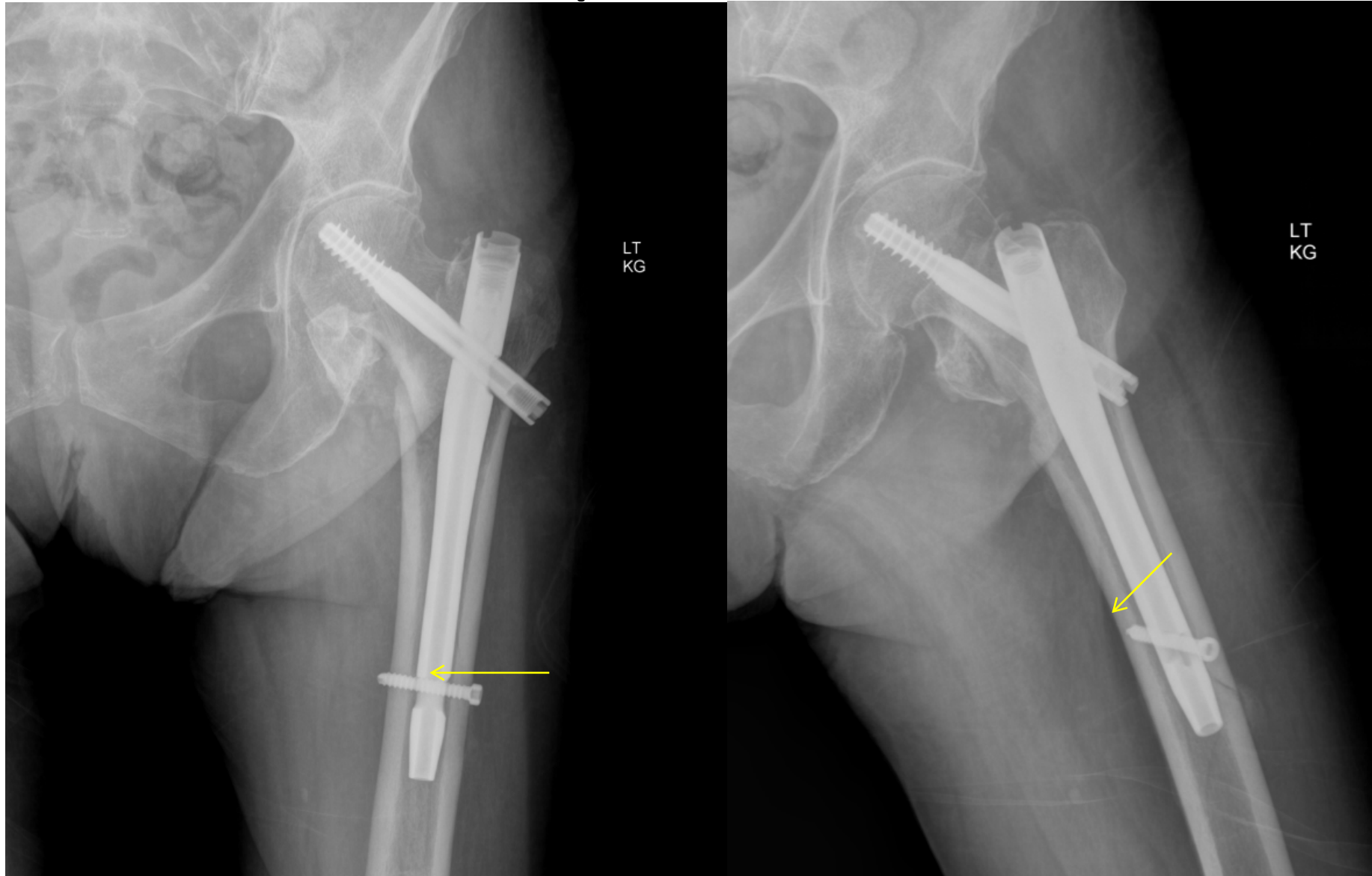


Peri-Implant Fractures

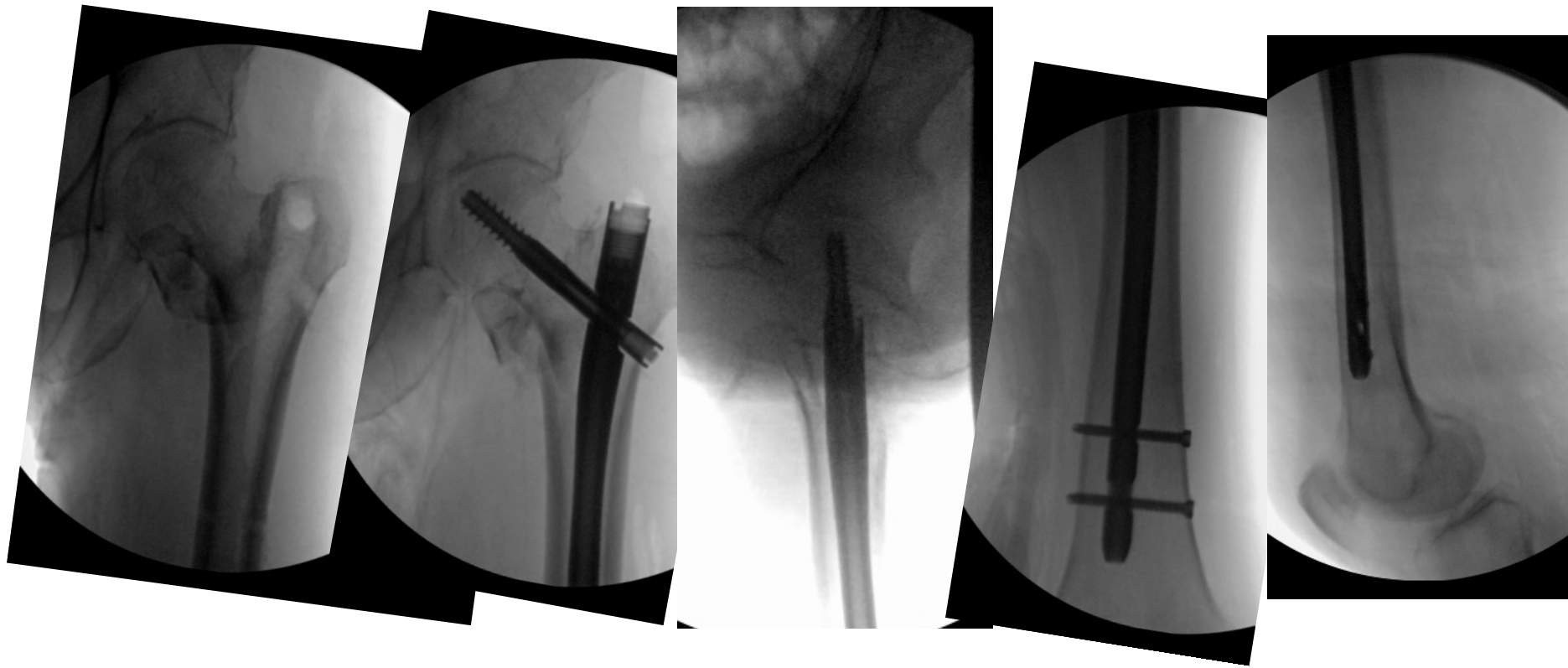
- Treatment algorithm determined by 2 questions:
 - How is the fracture optimally treated?
 - Is the initial fracture healed?
- Prioritize optimal treatment of new fracture
 - Especially when prior fracture is healed
- If prior fracture not healed, adjust accordingly
 - Two fractures, two treatments

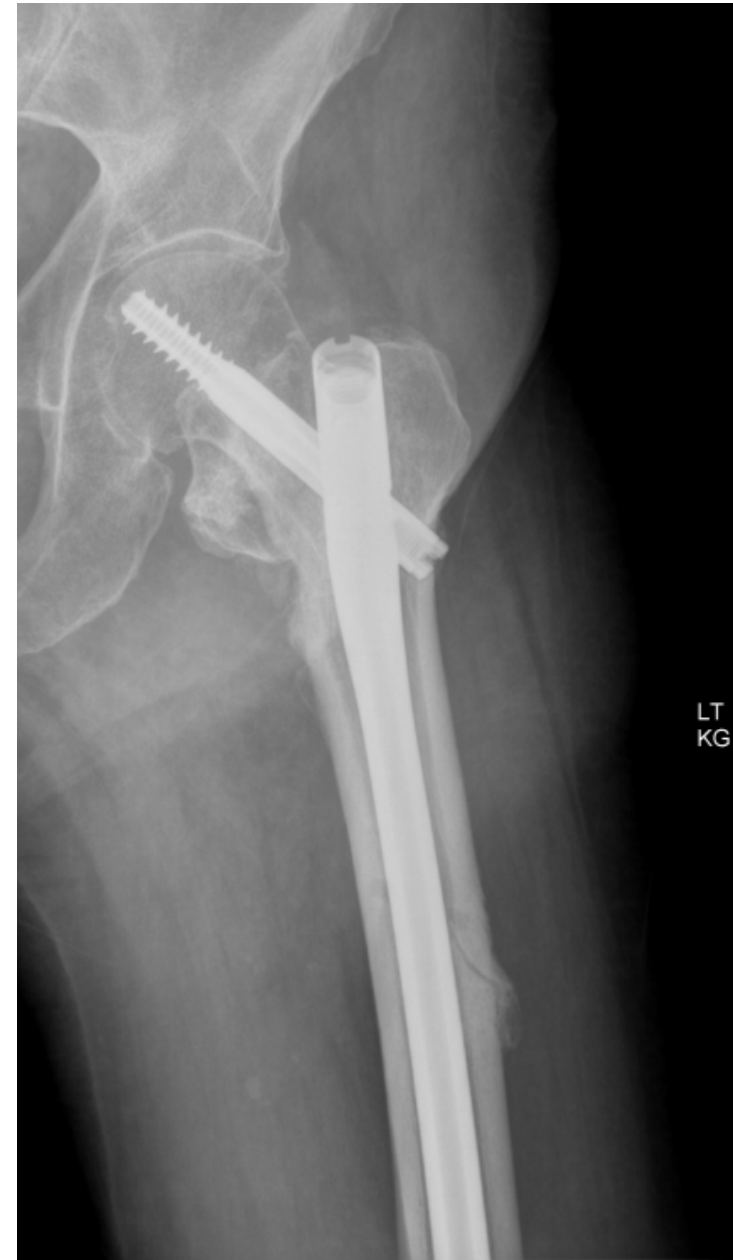
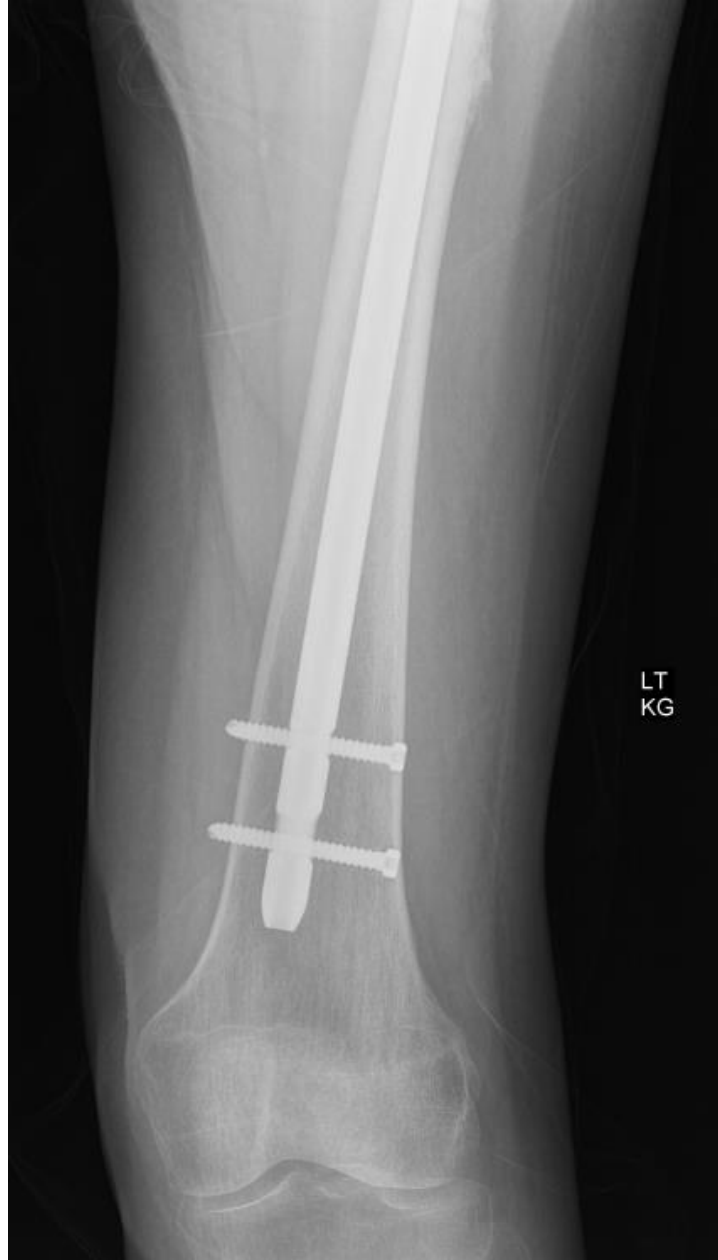
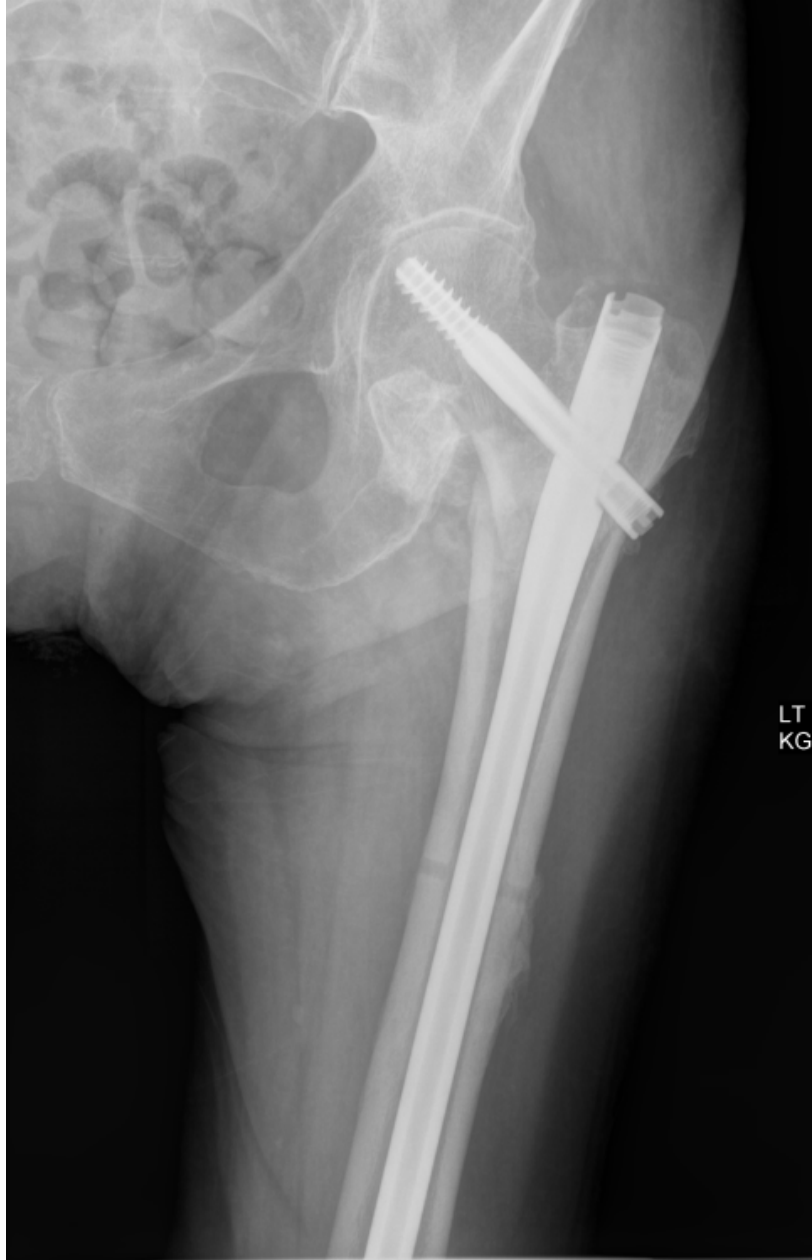


6 weeks, still w c/o pain 9/10



Re-admit





Summary

- Periprosthetic and peri-implant fractures are unique
- Periprosthetic fractures at the hip can be reliably classified
- Revision arthroplasty is necessary if the prosthesis is unstable