Periprosthetic Fractures: Evaluation and Management

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OrthoCarolina Hip and Knee Center
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Epidemic on the Rise

- THA / TKA rates increasing
- Life expectancy increasing
- Osteoporosis
- Osteolysis
- Uncemented stems
- Constrained revision implants

Outline

- Periprosthetic Fractures of the Hip
  - Evaluation
  - Treatment
- Periprosthetic Fractures of the Knee
  - Evaluation
  - Treatment
- Cases

Problem

- Usually elderly
- Poor bone quality
- Femoral stem blocks proximal fixation
- No endosteal blood supply if cemented stem
- High stress adjacent to femoral stem
- Cable fixation inadequate

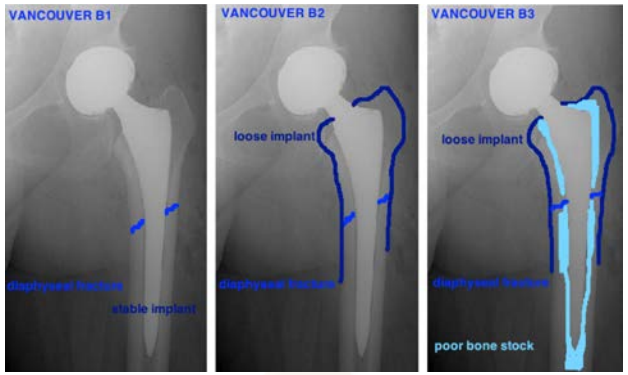
Periprosthetic Fractures of the Hip

Classification

- Vancouver Classification
  - Duncan et al, 1995
- Important Factors
  - LOCATION
  - FIXATION OF STEM
  - BONE QUALITY
- Other factors
  - Age
  - General health

Vancouver Classification

- Type A
  - Trochanteric
- Type B
  - Shaft Fracture around stem
    - B1 implant stable
    - B2 implant unstable
    - B3 implant unstable / bone deficiency
- Type C
  - Shaft Fracture below stem



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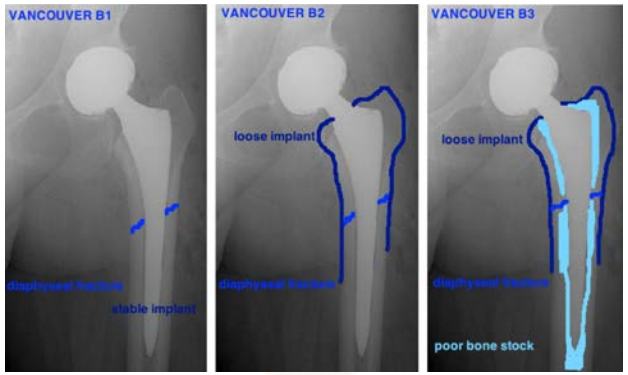

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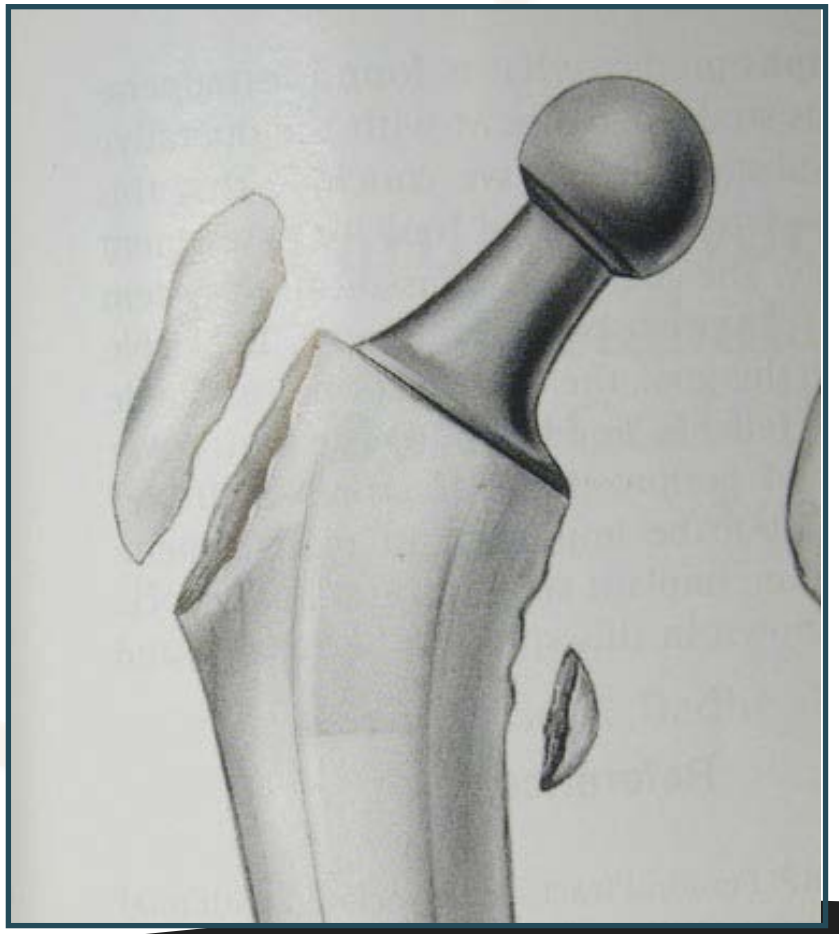
Vancouver Classification

- Type A
  - “Proximal” to the prosthesis
  - Greater or Lesser trochanter

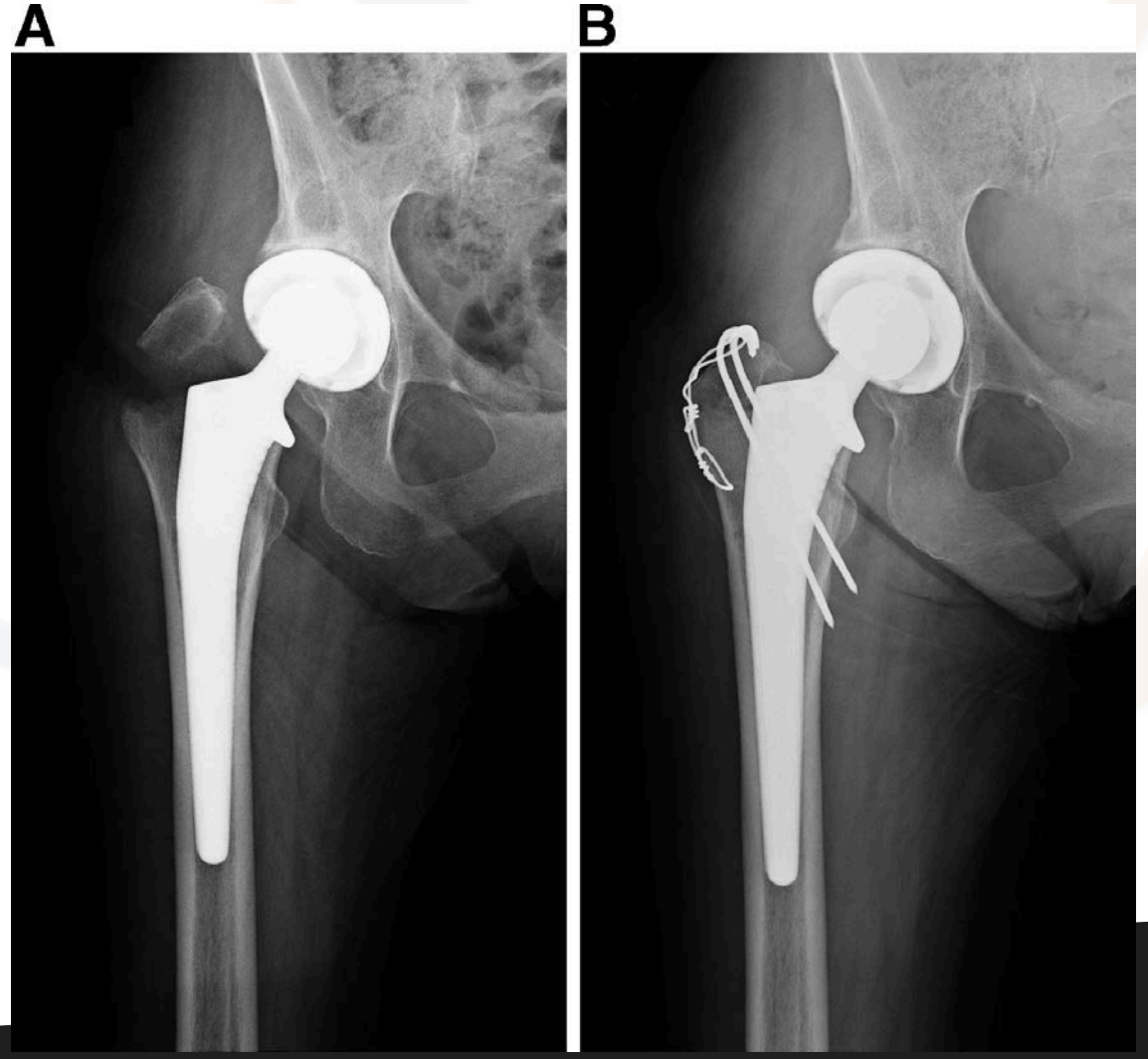


Brady et al, Orthop Clinics 1999

Type A: Trochanteric

- Lesser Trochanter
  - Conservative treatment
- Greater Trochanter
  - Nondisplaced – follow / observe closely
  - Displaced - ORIF
- Osteolysis
  - deal with osteolysis source

Type A: Trochanteric



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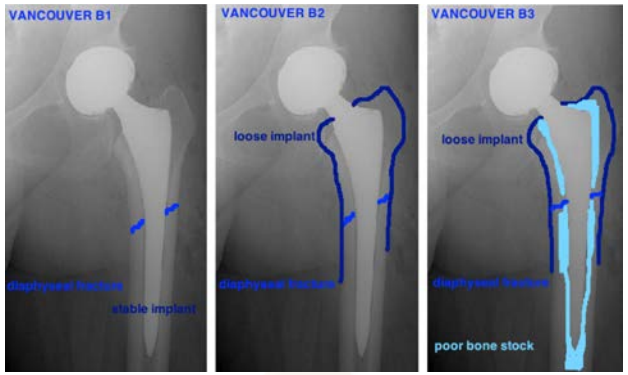
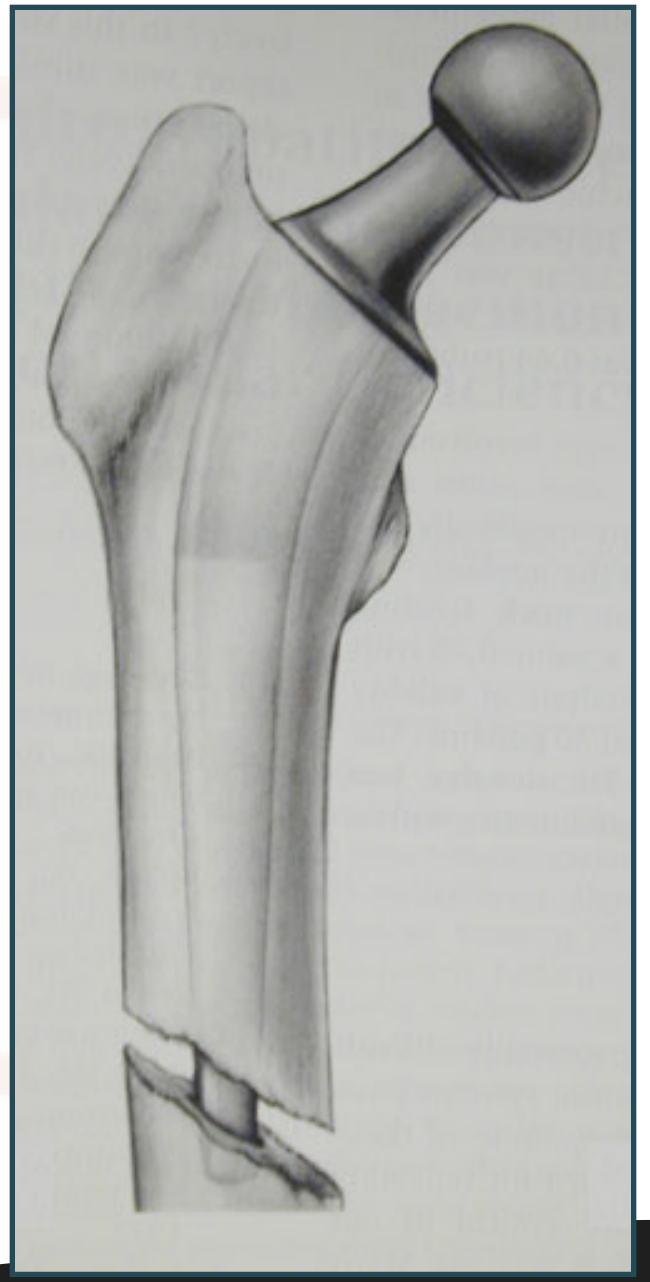


Type B1

- “Around” the prosthesis
- Stem is well fixed
- Uncommon



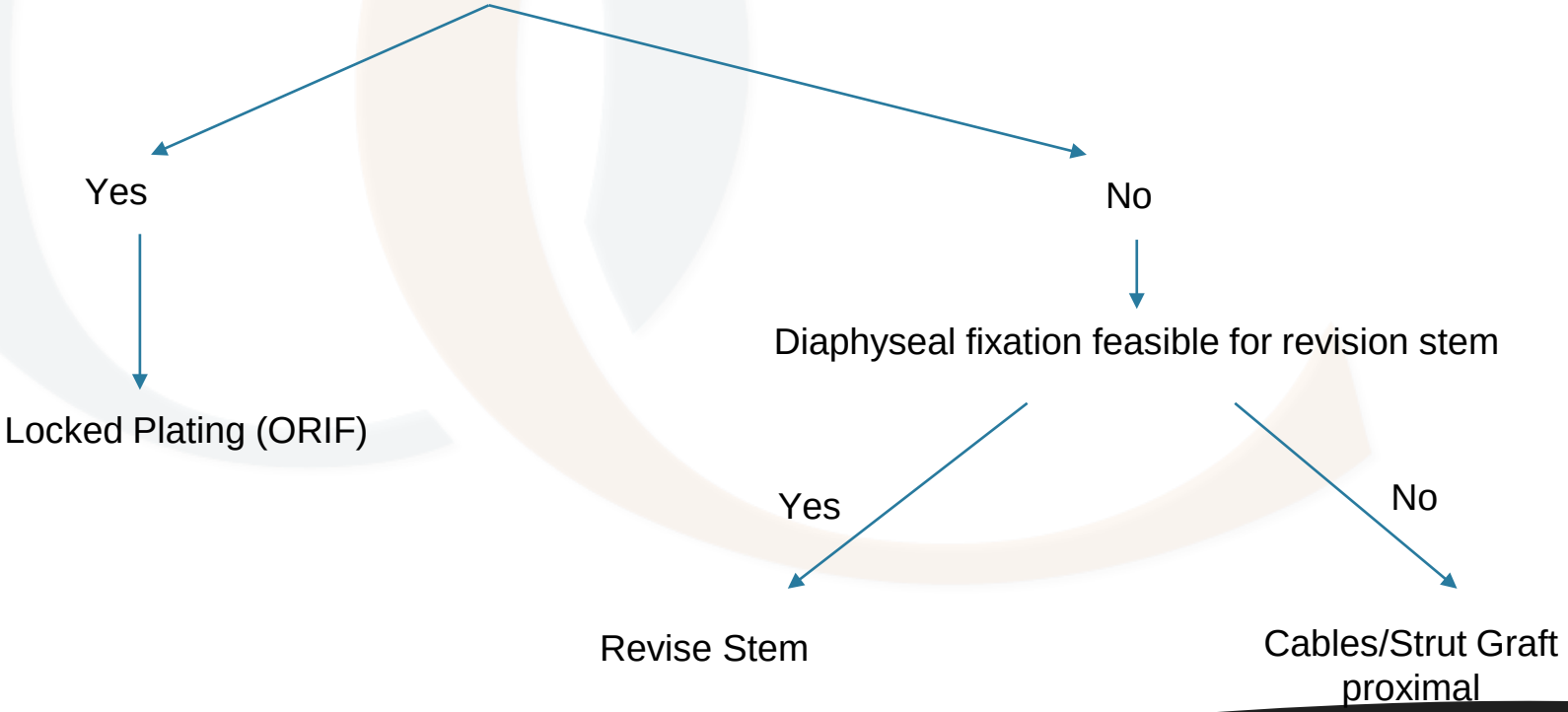
Reproduced from Brady et al, Orthop Clinics 1999

Type B1- Management

- Question 1:
  - Is the femoral component stable? (B1 vs. B2)
    - Review old XR if available
    - Has the stem moved?
  - Evaluate implant – bone interface
  - Evaluate implant-cement interface

Type B1- Management

- Question 2:
  - Can I obtain proximal screw fixation?



Case Example

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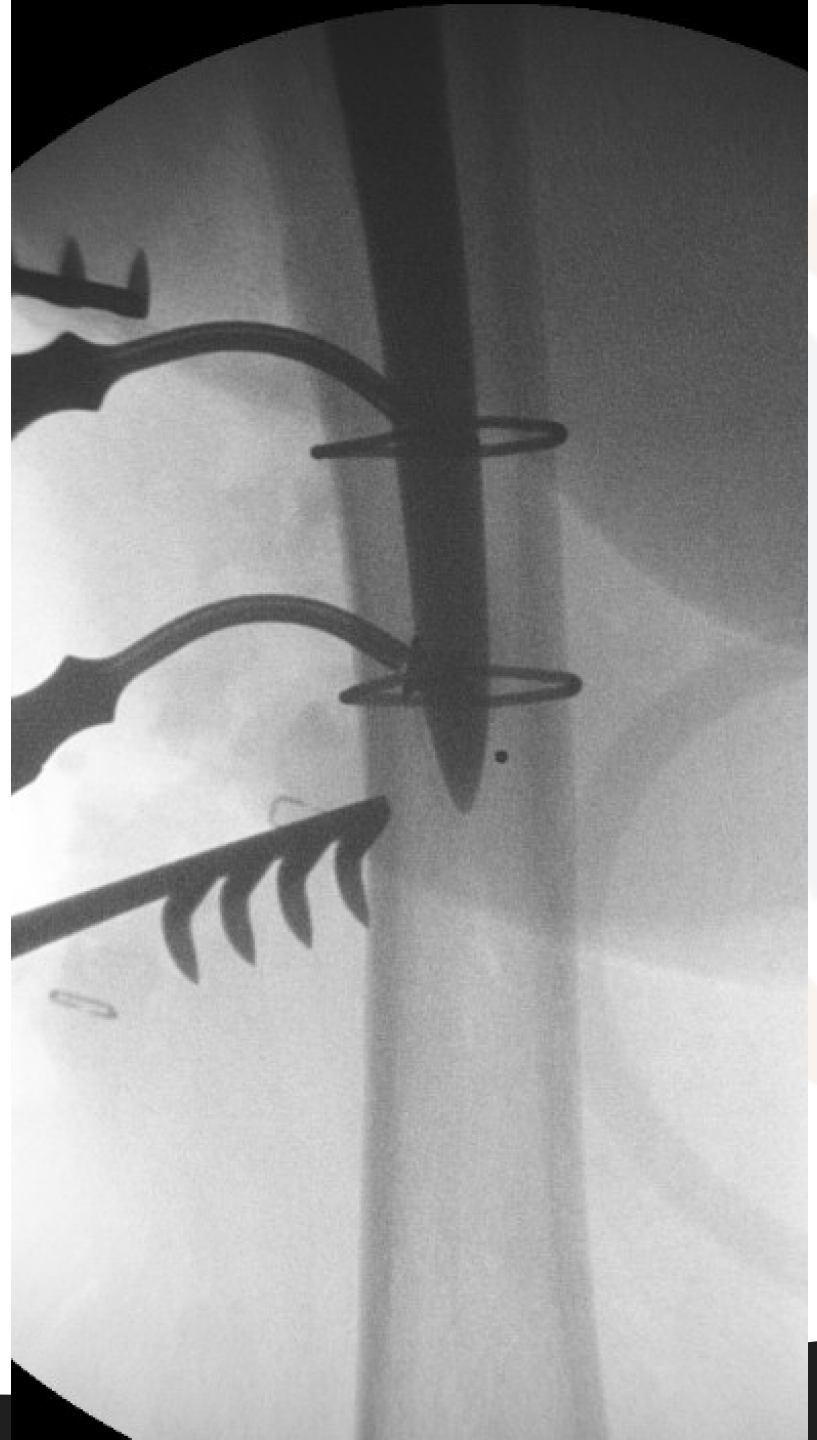

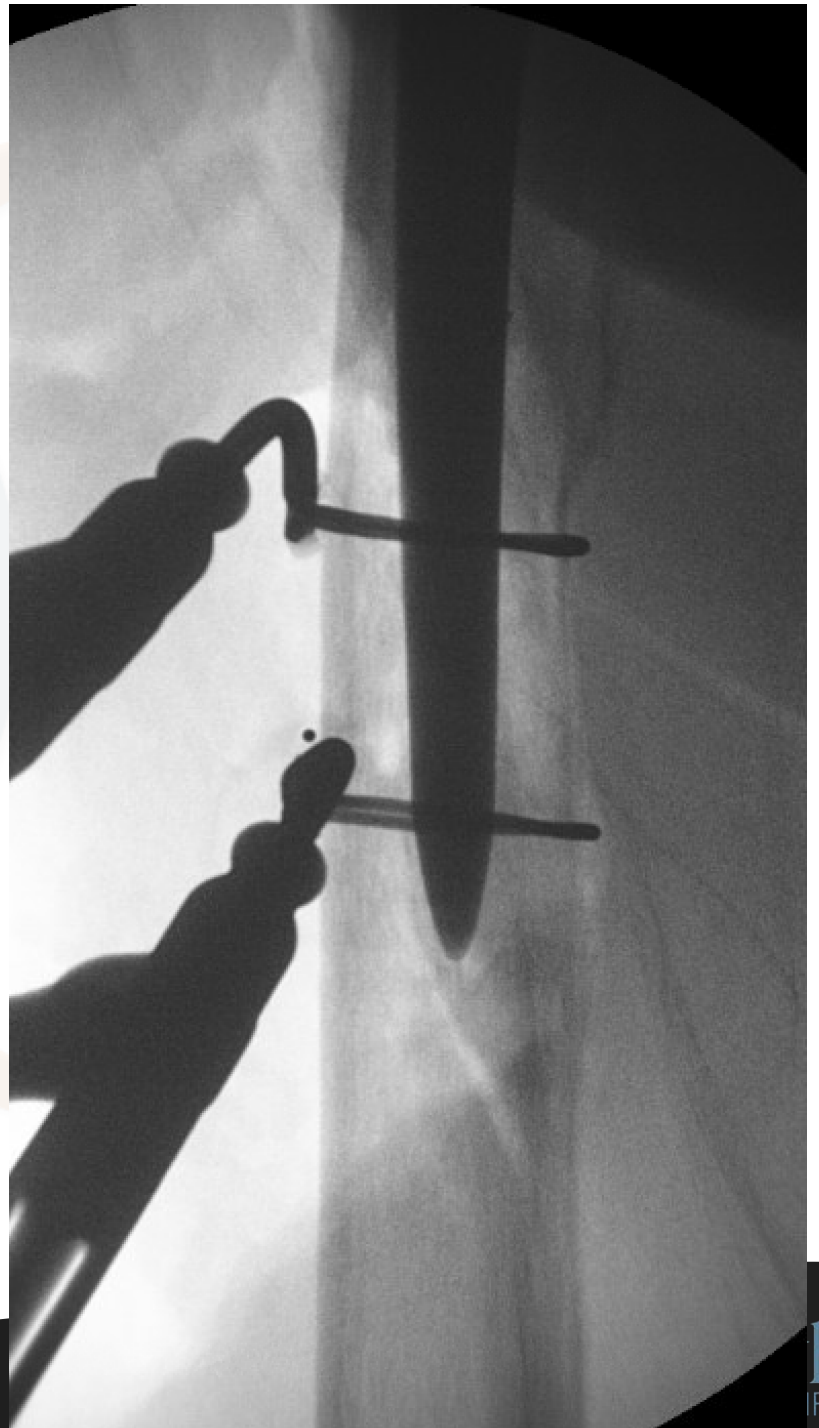

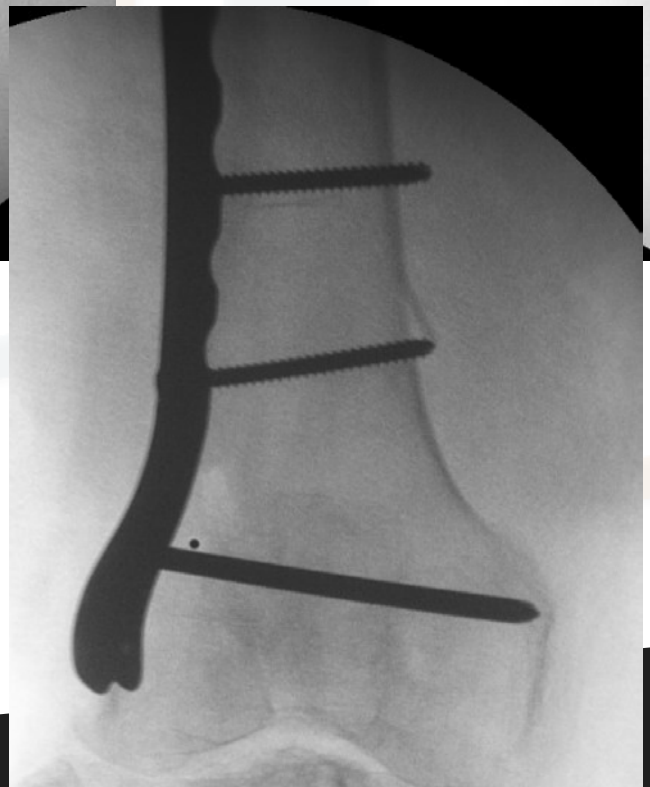

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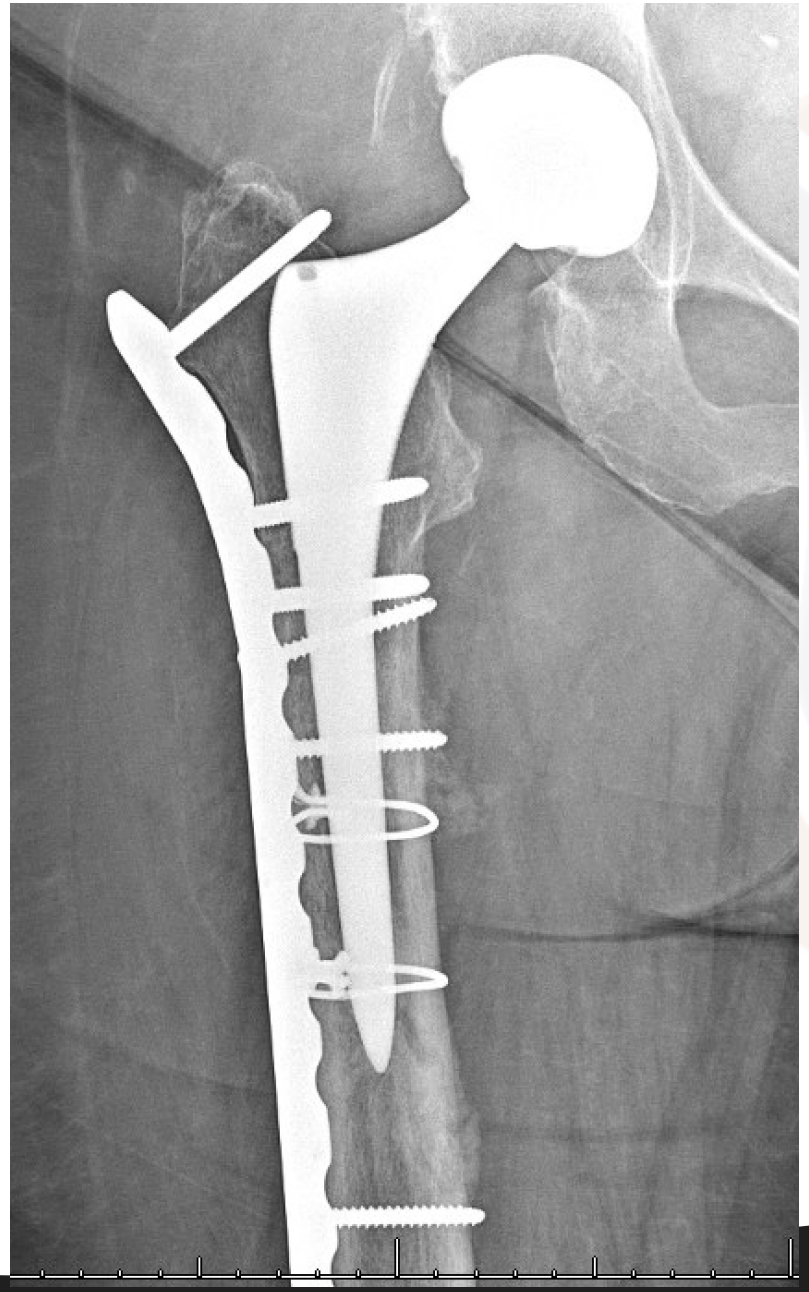
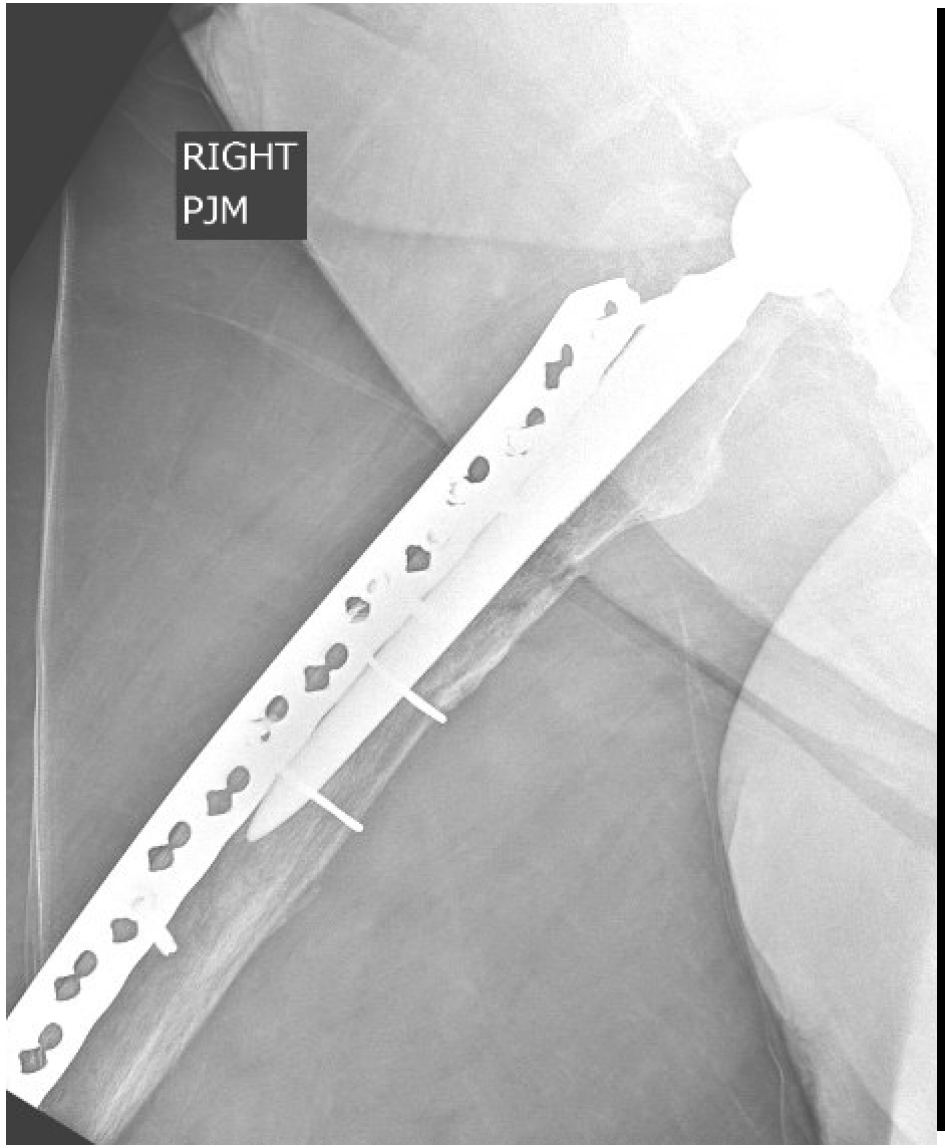
HIP AND KNEE CENTER




RIGHT
PJM


RIGHT PJM

Vancouver Classification

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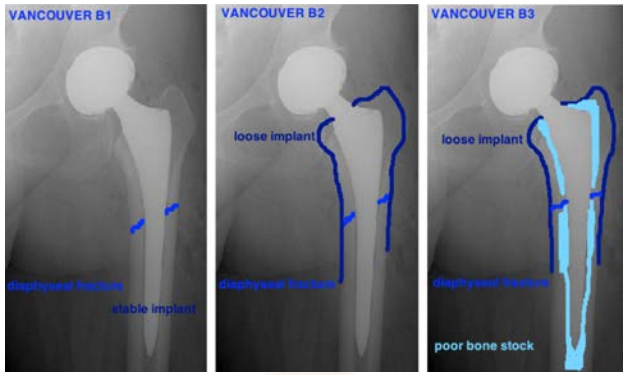

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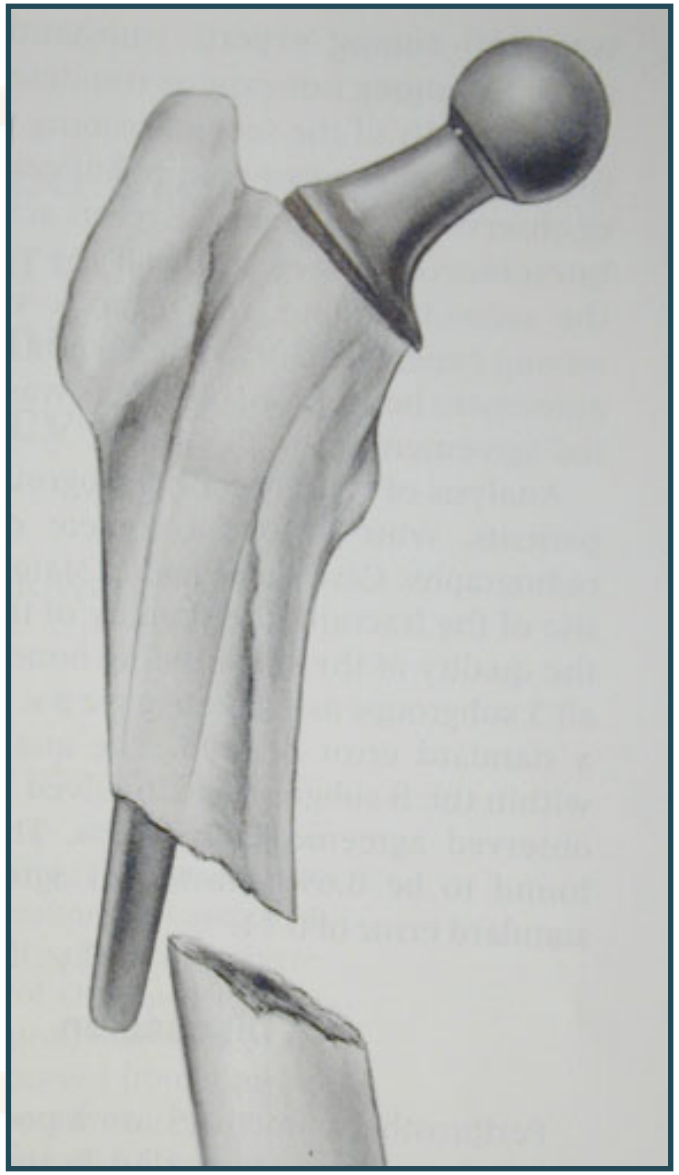
Type B2

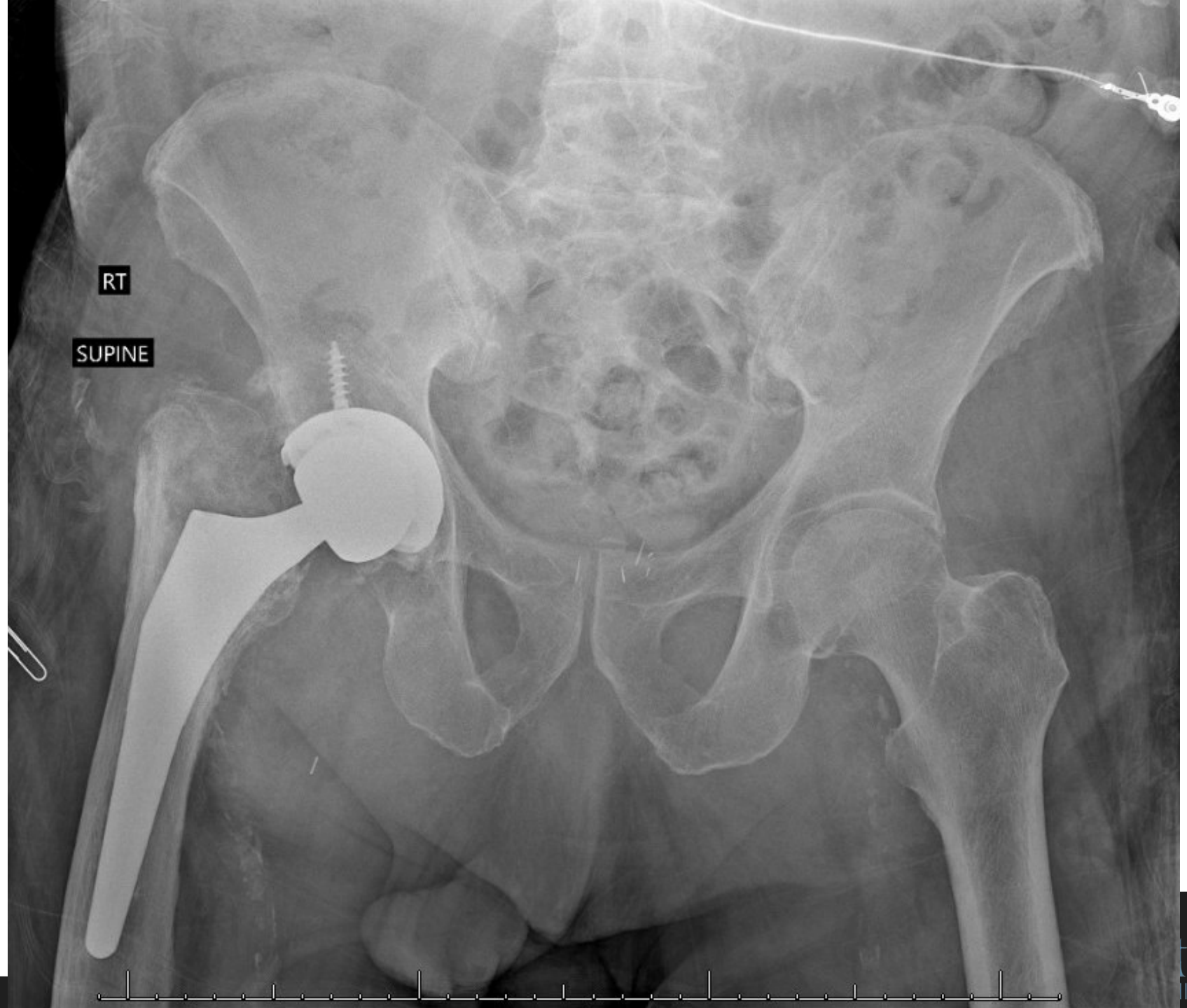
- “Around” the prosthesis
- Stem is loose
- Most common



Reproduced from Brady et al, Orthop Clinics 1999

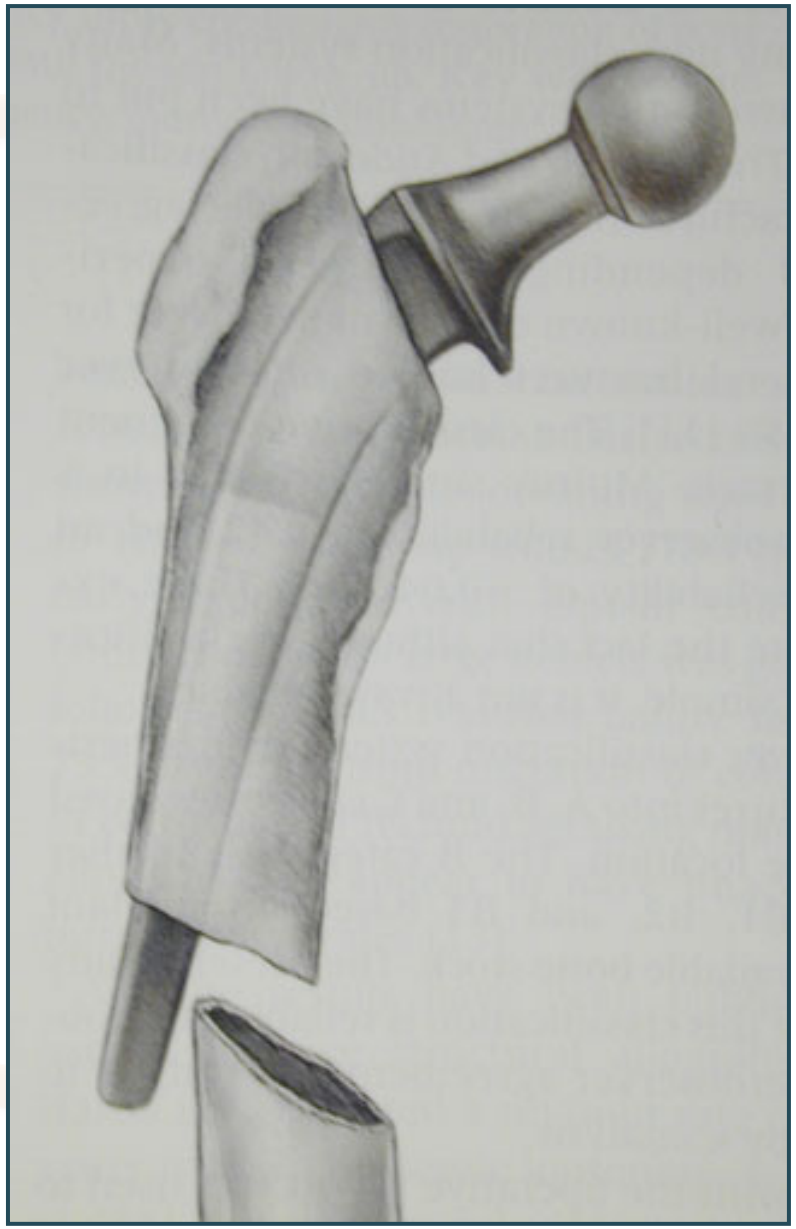
B2 Principles

- Loose femoral stem
- Work through fracture for stem removal
- Cables or unicortical plate fixation
- Obtain diaphyseal fixation
- Stem must bypass fracture by >2X diaphyseal diameter



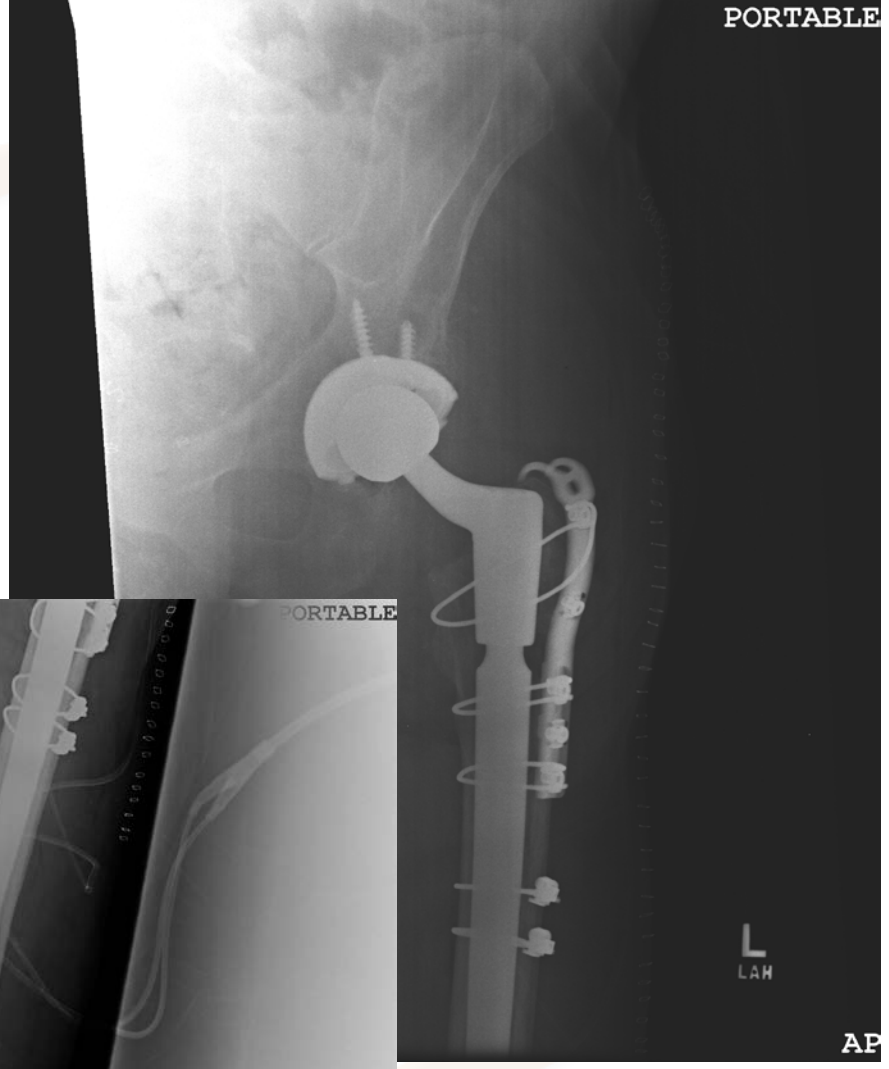
Type B3

- “Around” the prosthesis
- Stem is loose
- Poor bone stock



Reproduced from Brady et al, Orthop Clinics 1999


L
CD


PORTABLE
L
LAH
AP


PORTABLE
L
LAH
AP

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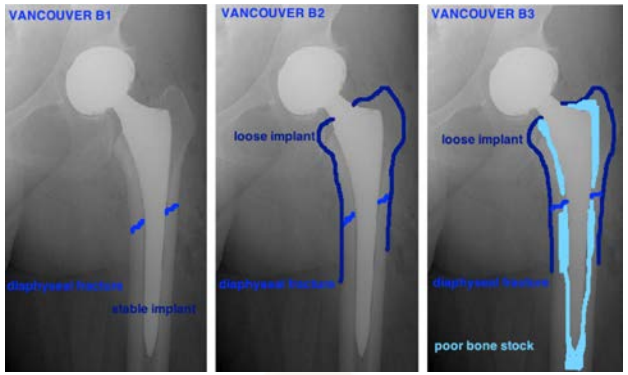
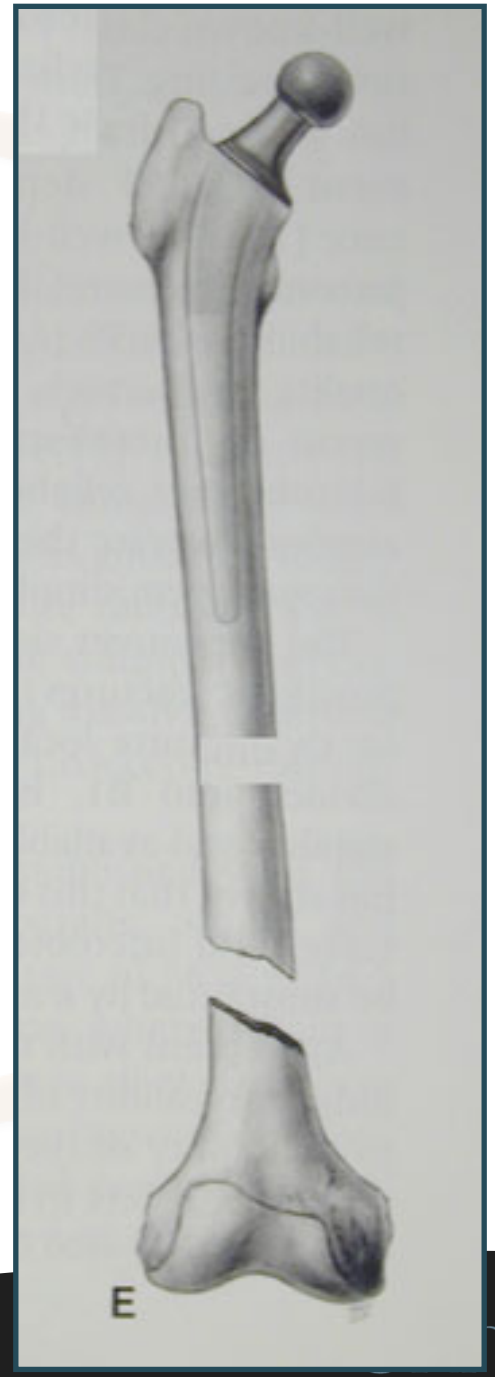


Type C

- Distal to the prosthesis
- Fracture treated in “isolation”



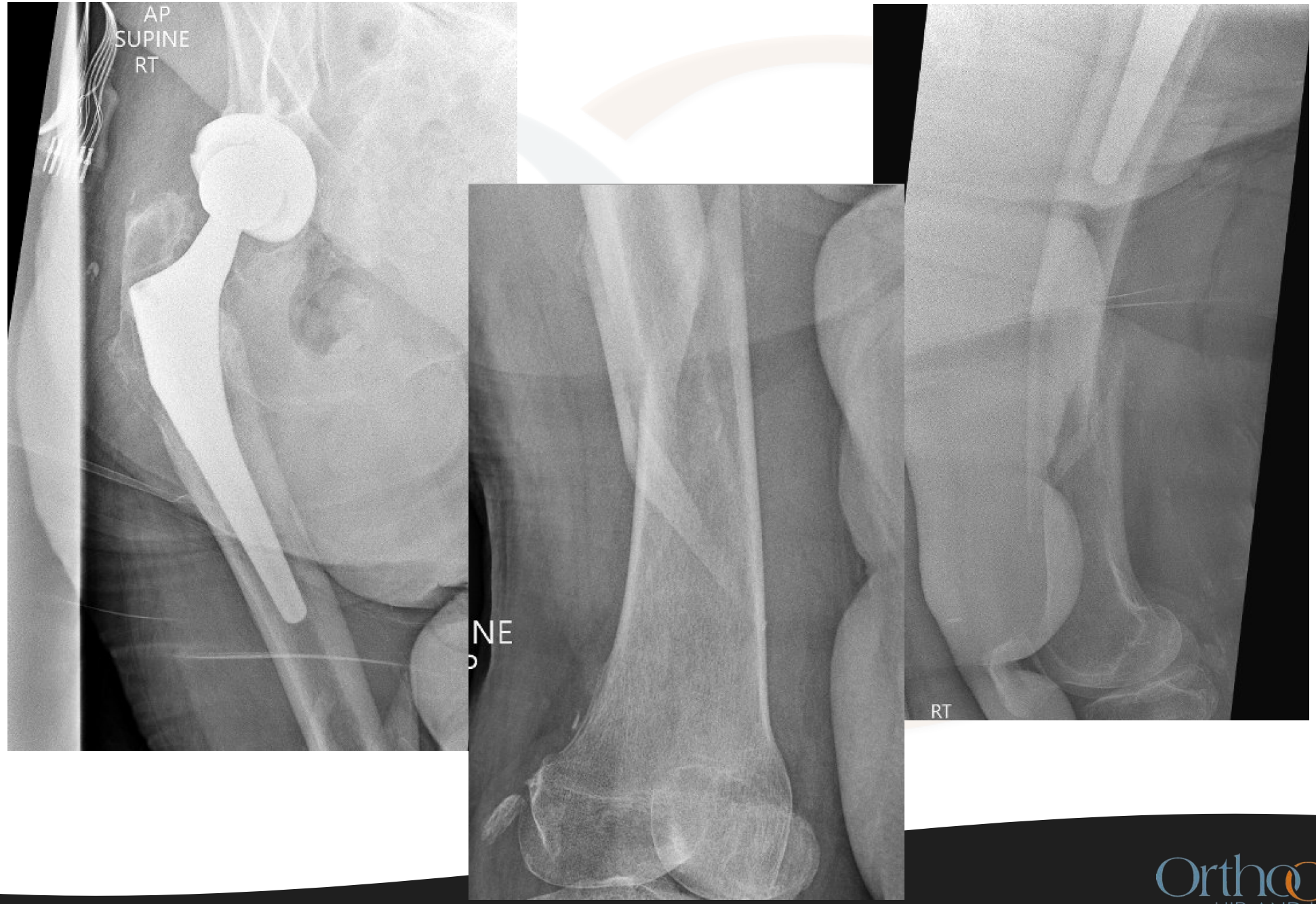
Reproduced from Brady et al, Orthop Clinics 1999

Type C

- Stem is stable / fx distal
- Span entire femur (overlap femoral stem)
- Locking plate construct
- Preserve vascularity - screws better than cables


RT
X TABLE


PACU
Port Supine
R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SUPINE
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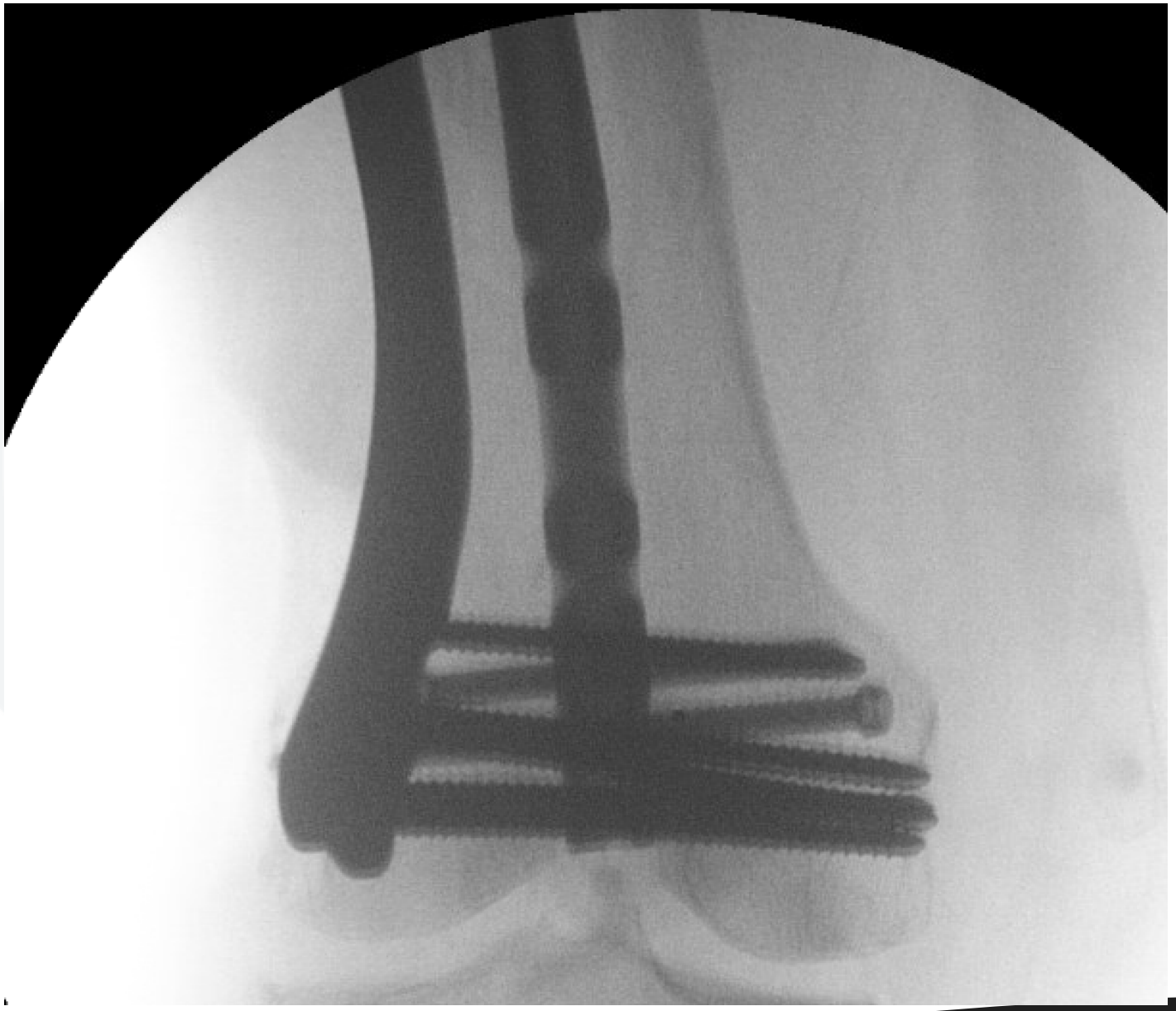


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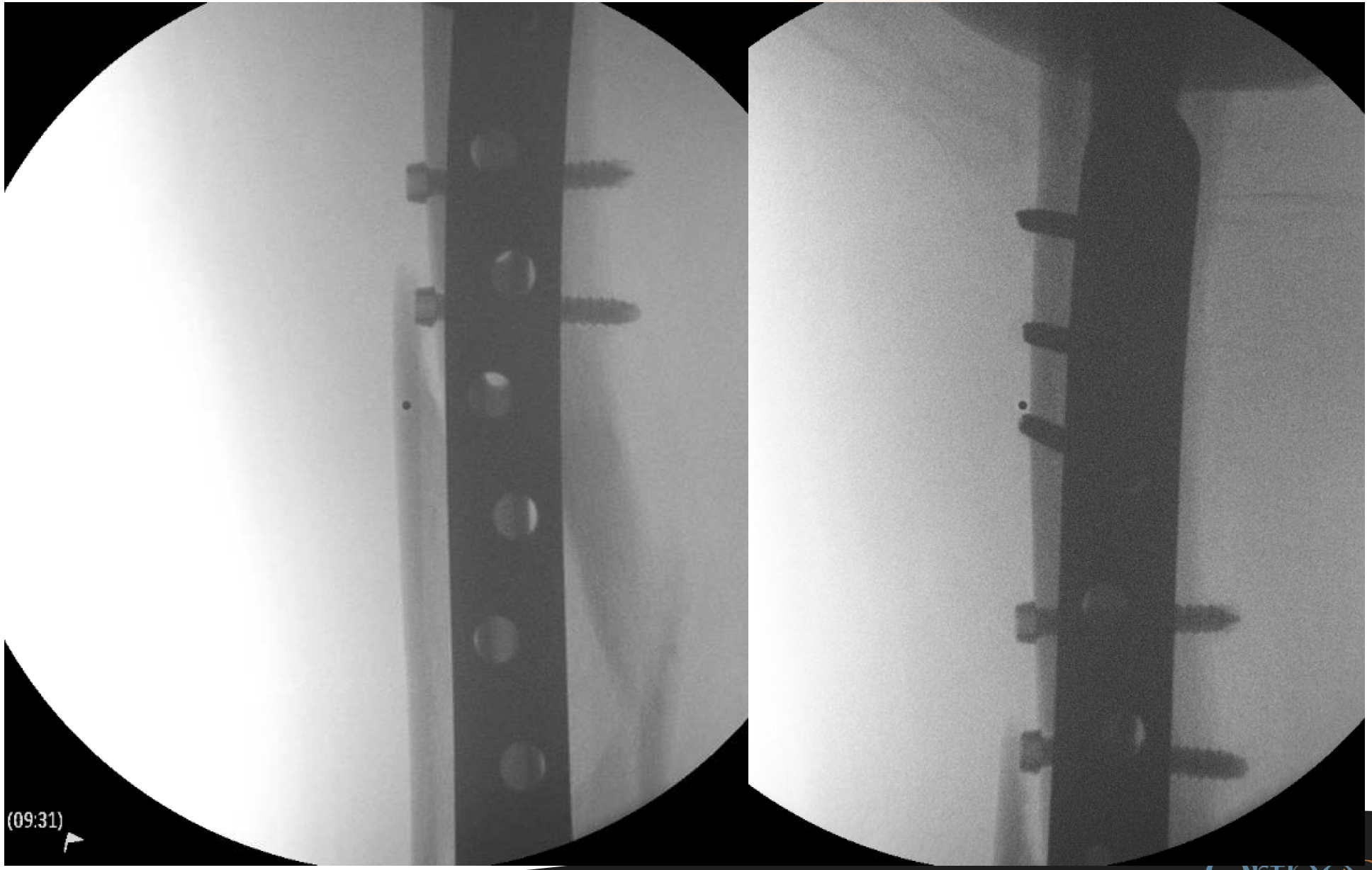
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Vascular Supply

PRESERVE VASCULAR SUPPLY

Priorities

- Fracture Union
- Stable Joint Replacement
- Return to Function

Summary

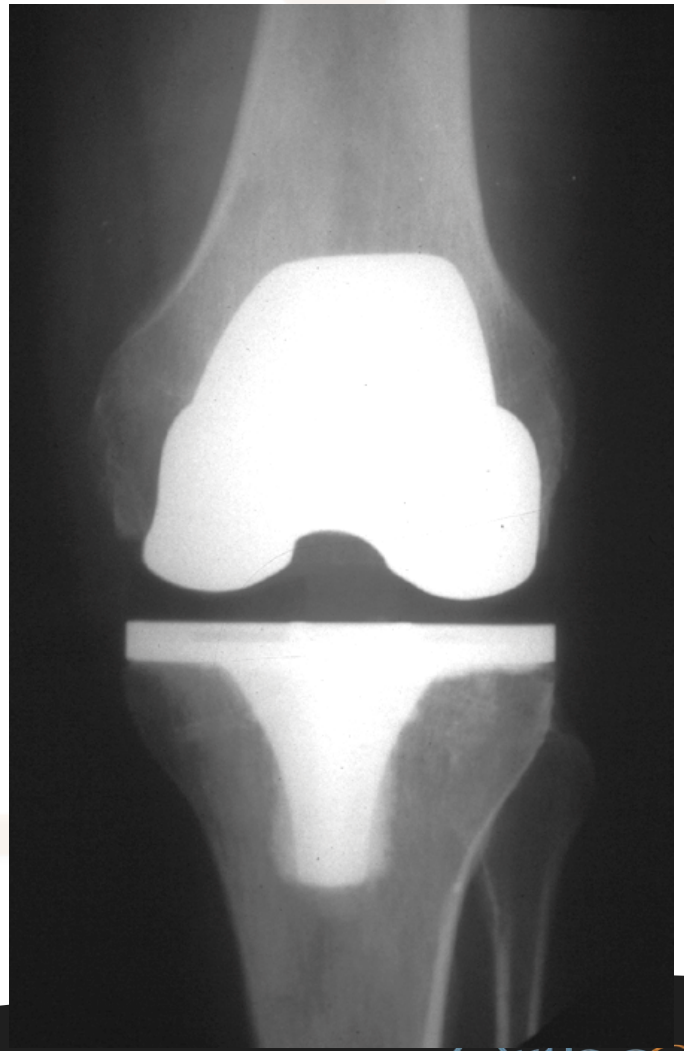
- Periprosthetic hip fractures are challenging
- Frequency is increasing
- Have an organized approach to treatment
- Must establish stability of implant
- PRESERVATION OF VASCULARITY IS PARAMOUNT

Periprosthetic Fractures of the Knee

Scope

- # TKA's increasing exponentially
- Approximately 300,000 TKA's done annually
- Volume of TKA will double by the year 2030

• *AAOS Projection*



Scope

- Prevalence of periprosthetic knee fractures → 2.8%
  - Mayo Clinic Registry – 19,810 primary and revision TKA
    - 2.3% following primary TKA
    - 6.3% following revision TKA

Scope

- 2.8% prevalence in a procedure performed 300,000 times annually
  - 300,000 X 3% 9,000/year
- Growing elderly population
- Osteoporosis

TKA Periprosthetic Fracture

- Periprosthetic Femur fractures
- Periprosthetic Tibial fractures
- Patella fractures

TKA Periprosthetic Fracture

- **Periprosthetic Femur fractures**
- Periprosthetic Tibial fractures
- Patella fractures

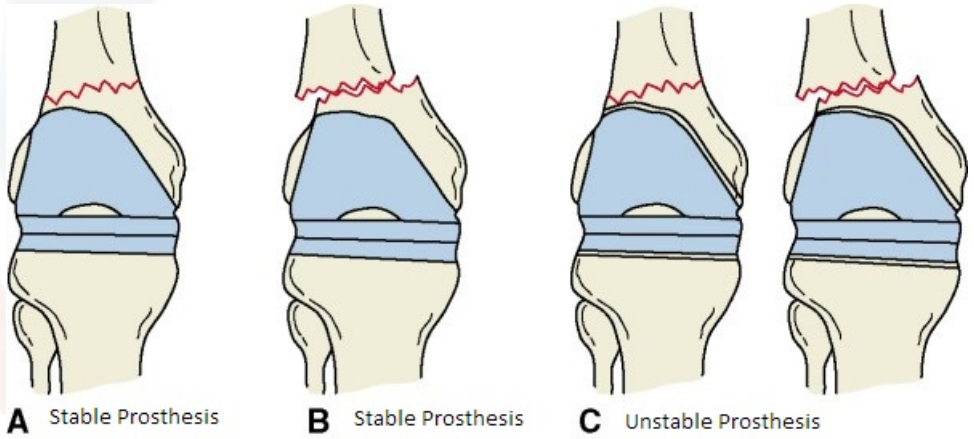
Risk Factors

Risk Factors:

- Intraoperative Iatrogenic (Anterior Notching, etc..)
- Osteoporosis
- Rheumatoid Arthritis
- Neurologic Impairment
- Osteolysis

Classification

- Type 1
  - Nondisplaced fracture
  - Prosthesis intact
- Type 2
  - Displaced Fracture
  - Prosthesis intact
- Type 3
  - Displaced or Nondisplaced
  - Prosthesis Loose



Lewis and Rorabeck (1997)

Goals of Treatment

- Fracture Union
- Maintain alignment
- Rapid mobilization
- Early ROM

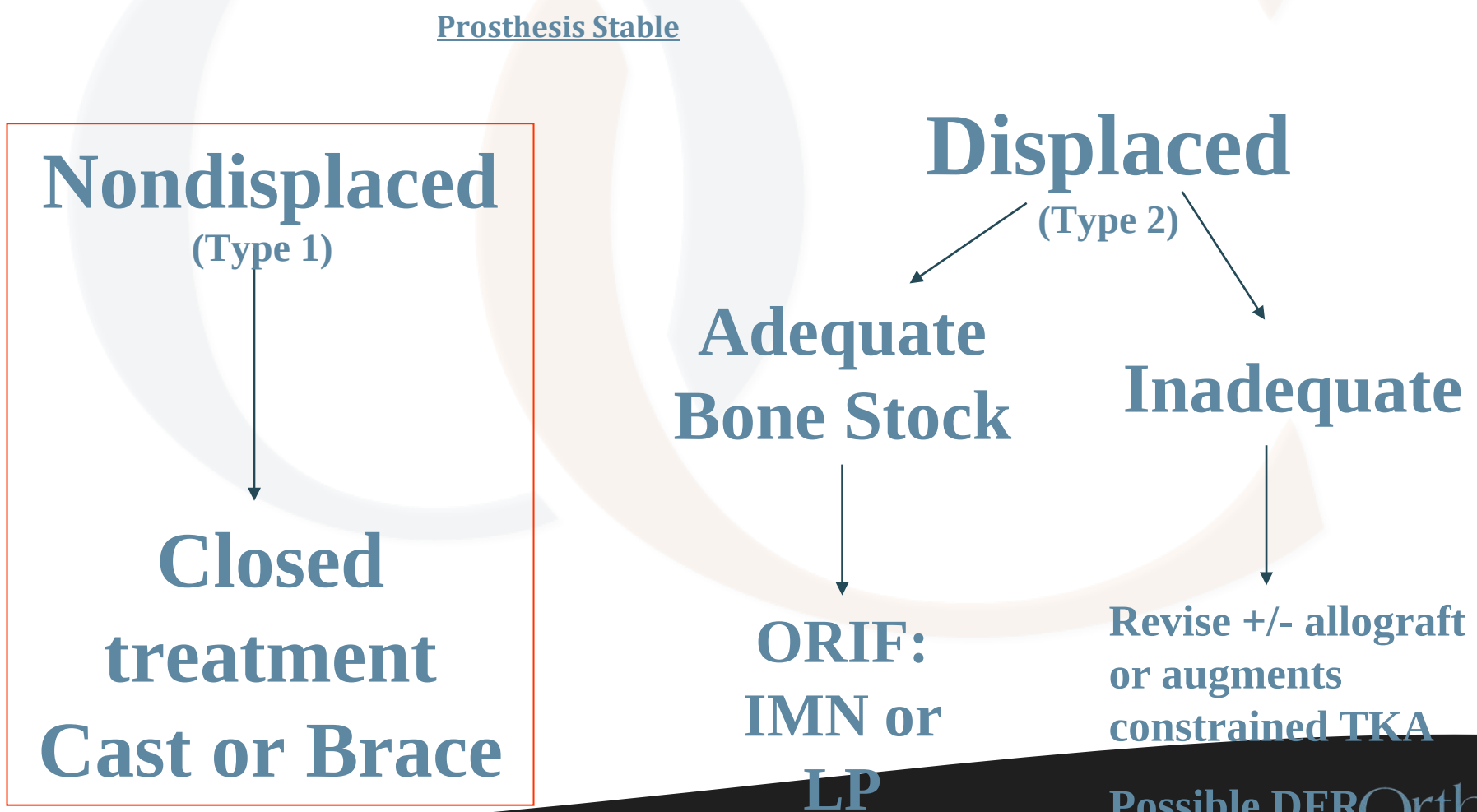
Management

3 questions that will affect management:

1. Is the Prosthesis Stable ?
2. Is the Fracture Displaced ?
3. Is the Bone Stock adequate for fixation?

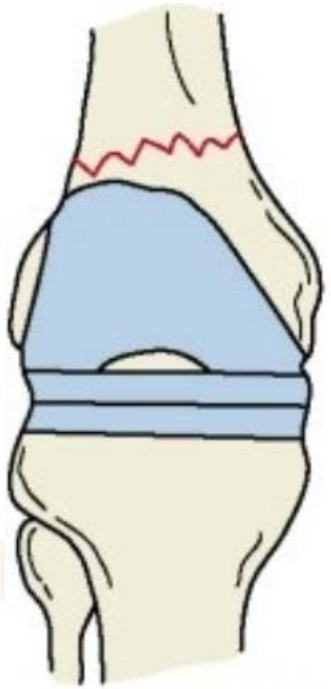
Question #1:
Is the femoral component stable?

Question #2:
Is the Fracture Displaced?



Type 1 (Nondisplaced Fractures)

- Rare
- Nonoperative
  - Type I fx only, medically infirm, elderly
  - Immobilization with Brace or cast
  - Protect NWB with crutches/walker
  - Close frequent follow-up
  - Early intervention if unstable/malalignment



A Stable Prosthesis

Type 1

THE JOURNAL OF ARTHROPLASTY

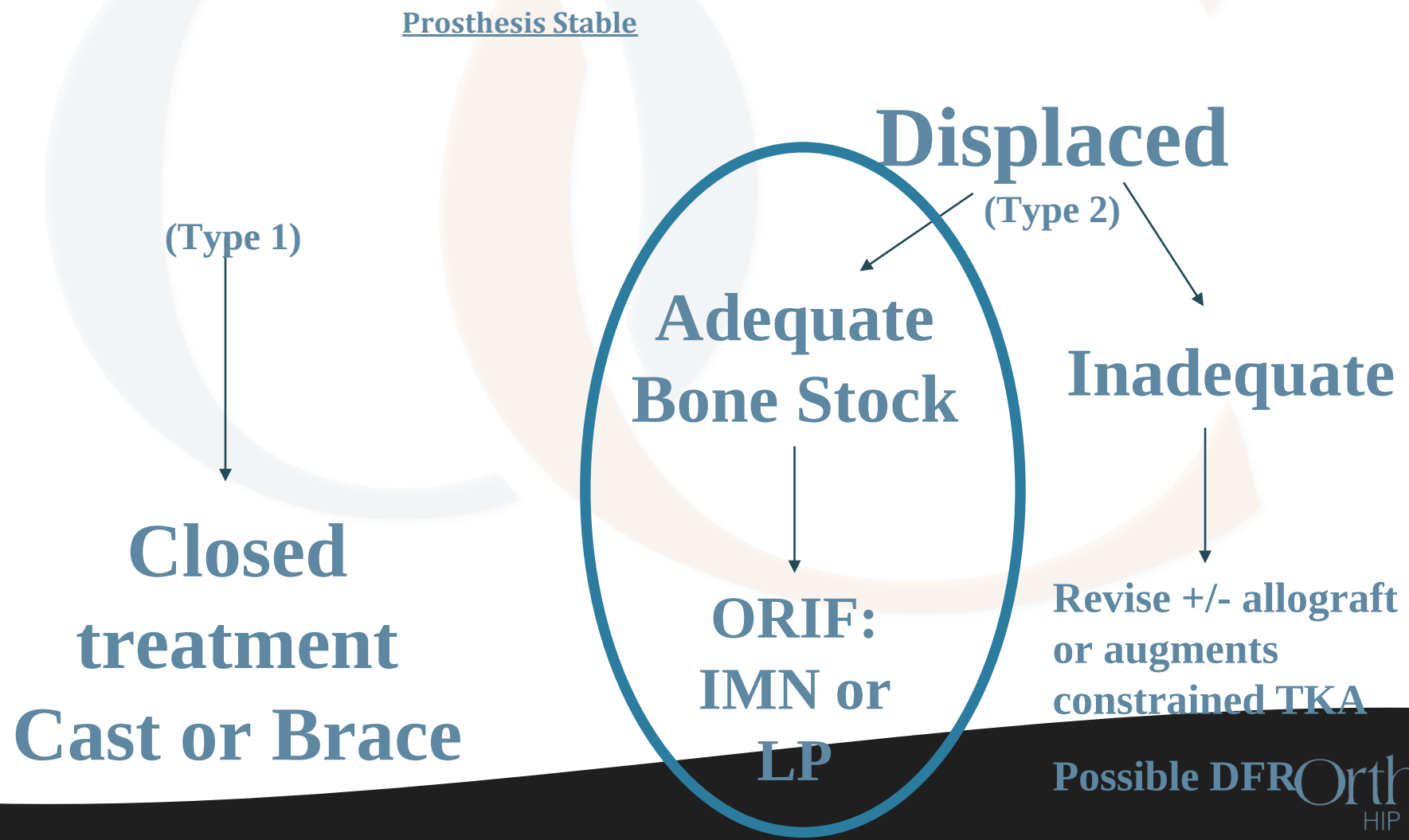
AAHKS AMERICAN ASSOCIATION OF HIP AND KNEE SURGEONS

Results: Nonoperative Treatment

- 195 combined cases in literature
- Union rate 65-100%
- Patient satisfaction 67-83%
- Risks/complications of bed rest & immobility

  - Chen et al, J Arthroplasty 1994

Type 2: Displaced Fracture/Implant Stable

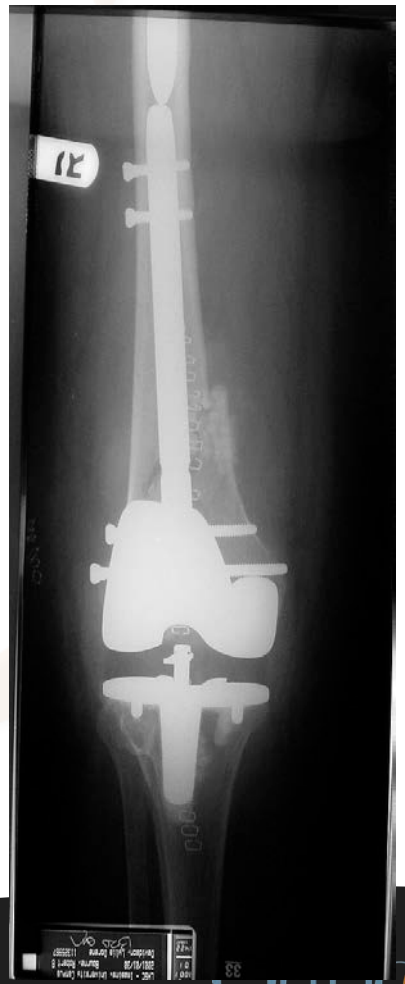


Type 2: Displaced Fracture/Implant Stable

Internal Fixation

What should I use?

- Plate/screws
- IM nail
- Locked plates
- Nail + plate



Retrograde IM Nails

Advantages:

- Soft tissue friendly
- Minimally invasive

Challenges:

- Marginal distal fixation (modern implants improving)
- PS Box
- Canal diameter considerations

Retrograde IM Nails

JOT
JOURNAL OF ORTHOPAEDIC TRAUMA

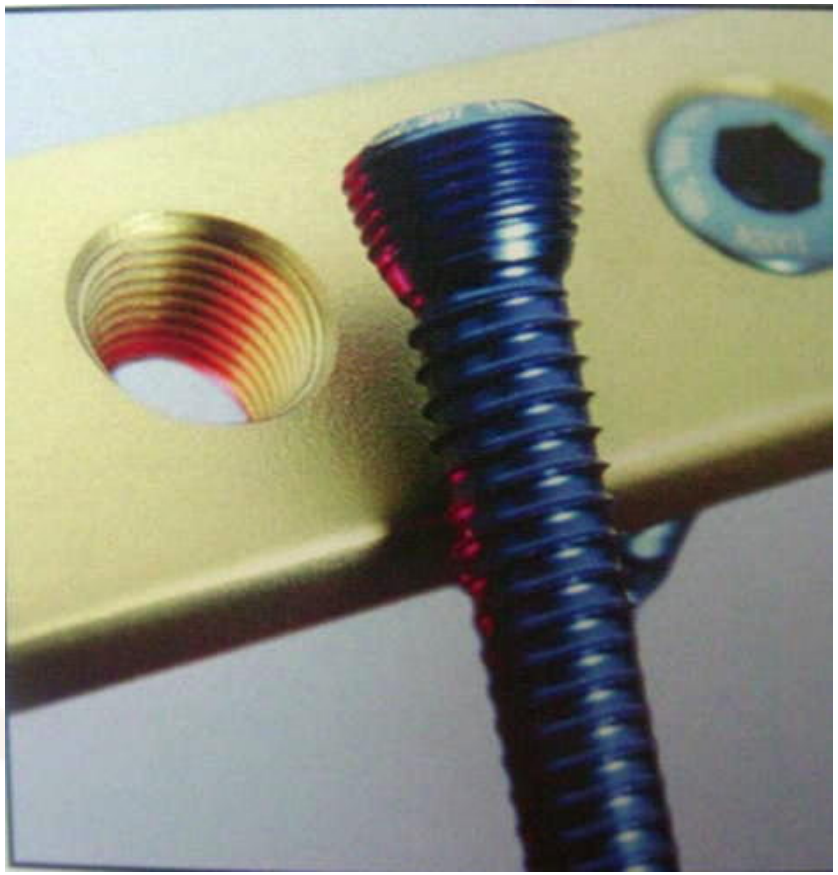
Current Indications:

- Fractures above CR design or Open Box PS
- Sufficient distal bone to allow minimum of 2.5 locking screws

- Gliatis et at JOT 2005
  - 10 of 10 unions at 3 months
  - One malunion

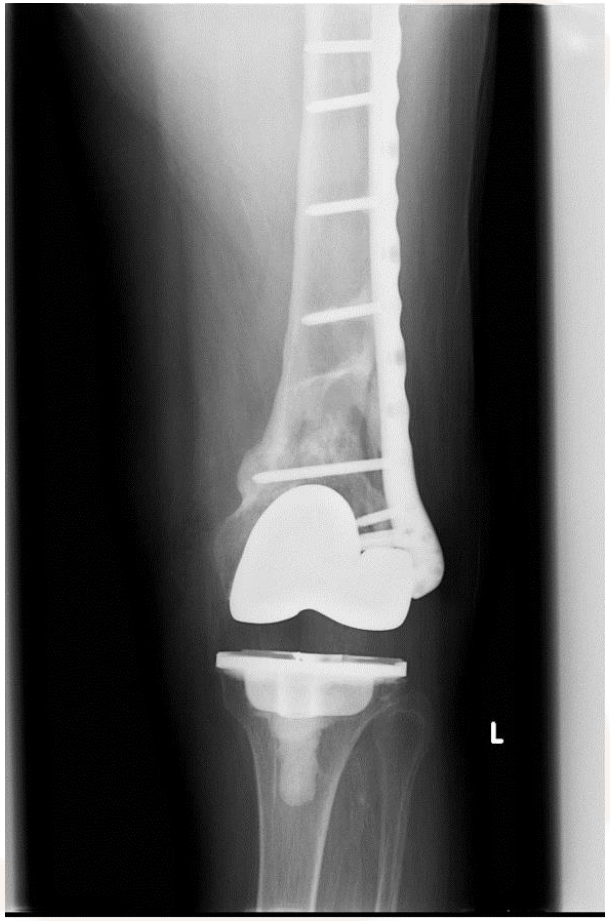
Locked Condylar Plates

- Fixed angle device
  - Stability in Coronal Plane
- Increased pull out strength
- Distal convergence of screws in condyle
- Hybrid Fixation
- Percutaneous Technique

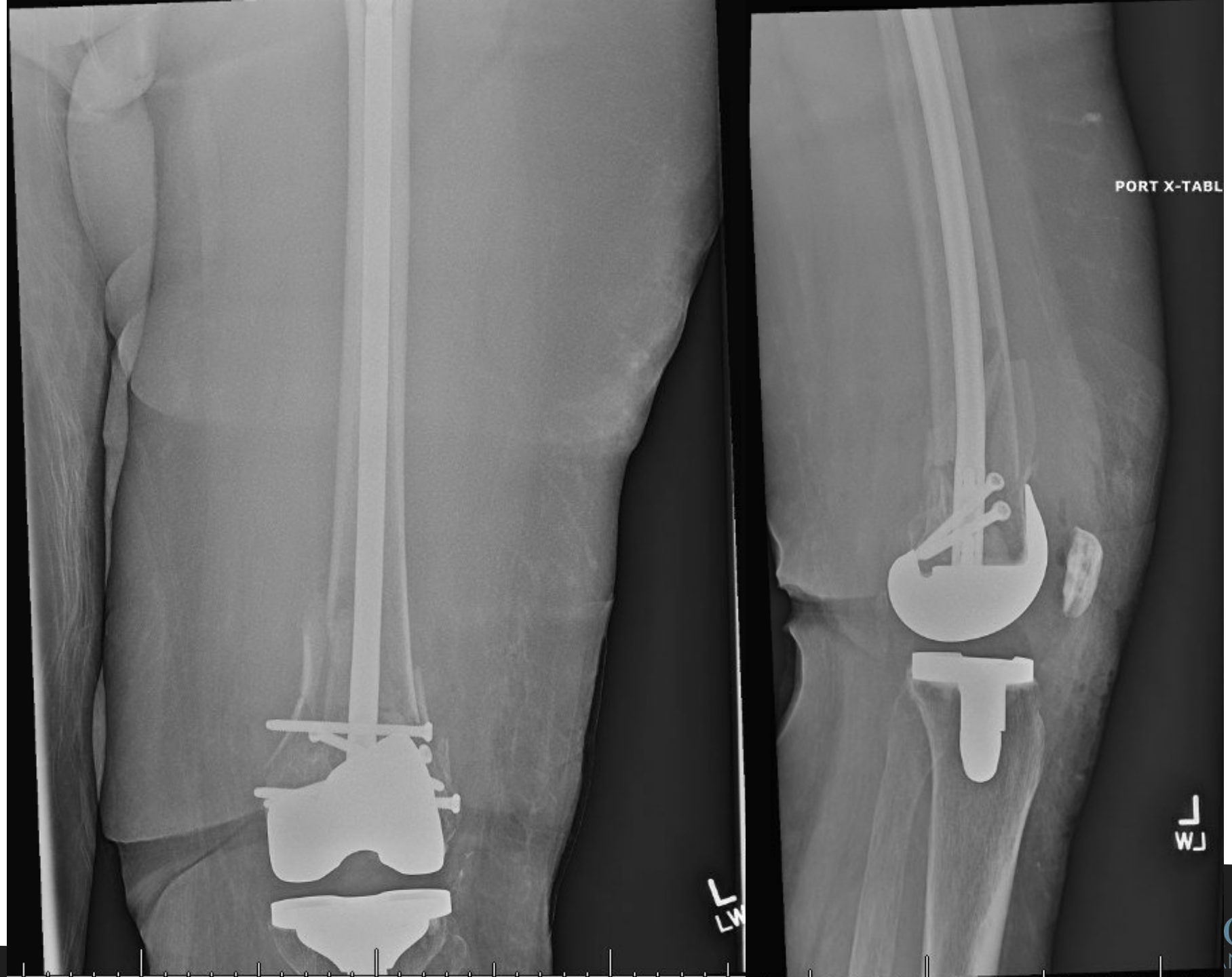


Locked Condylar Plating

- Locked condylar plating
  - Kregor et al, Injury, 2001
  - Fracture Union in 97%
  - 1 revision TKA



Case Example


PORT X-TABL

Case Example

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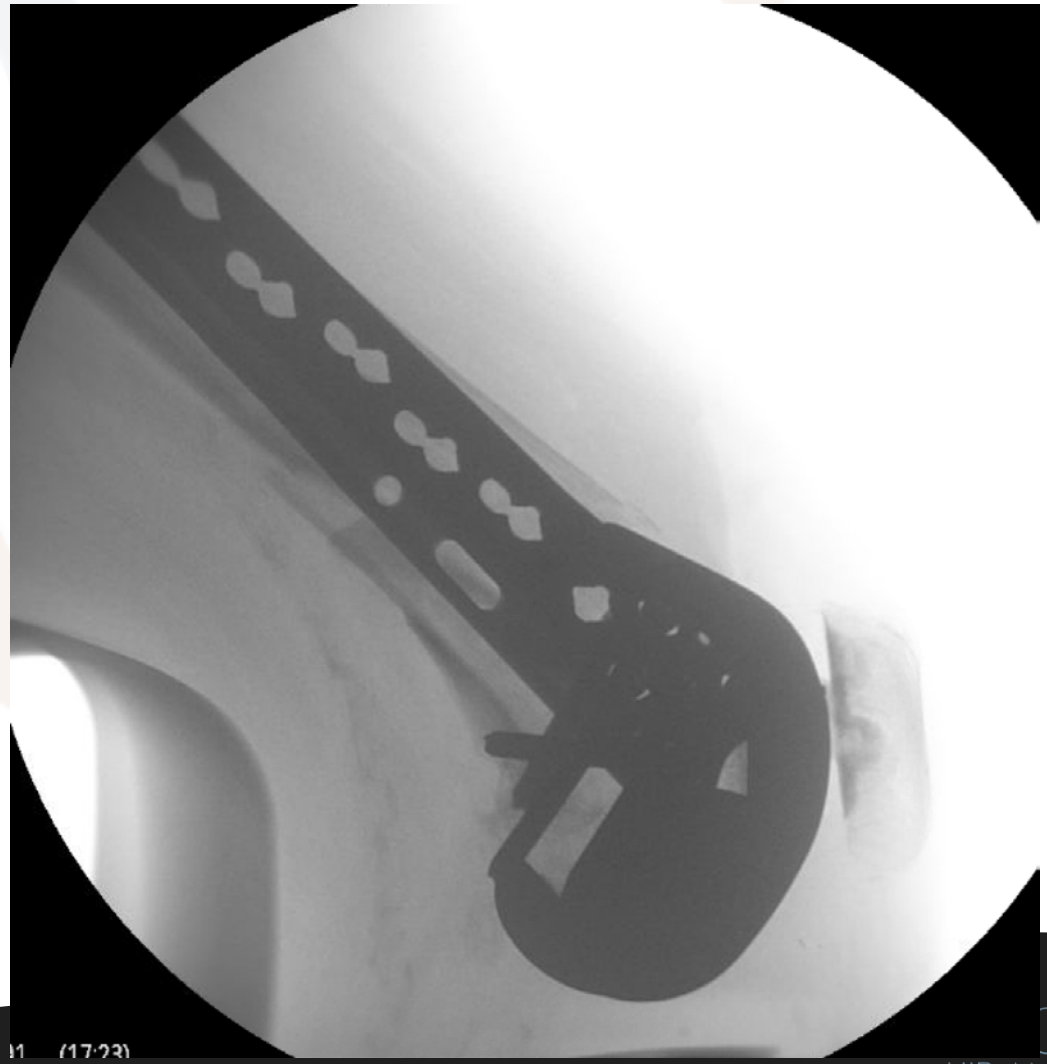
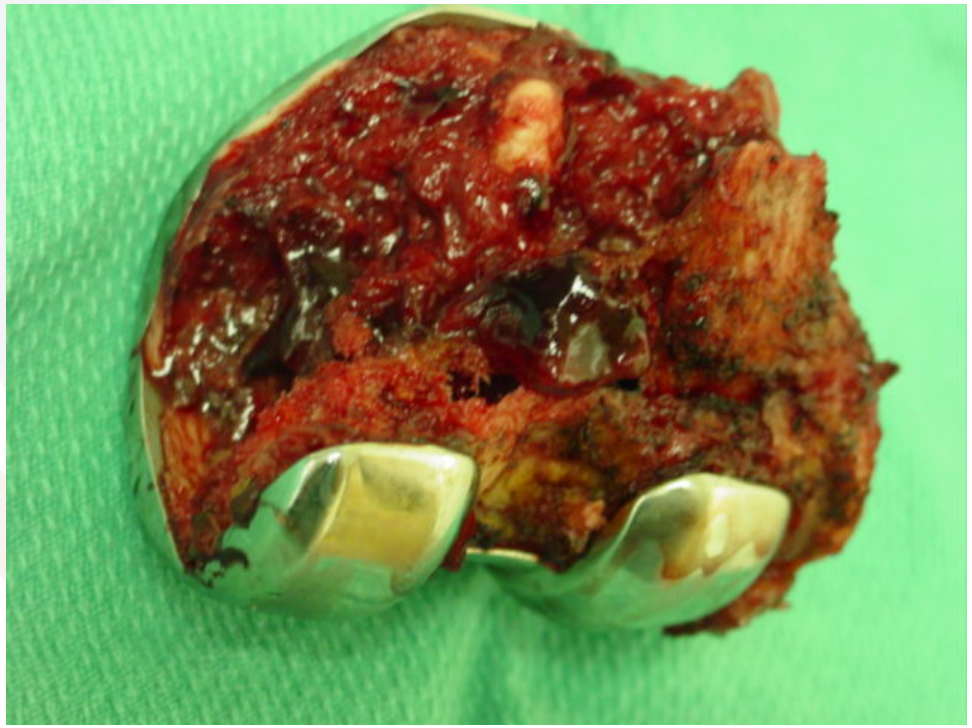


Revision TKA

- Type 2
  - Inadequate distal bone
- Type 3
  - Loose Component

Revision Options

- Long stem Revision Component with Fracture Augmentation
- Allograft Prosthetic Composite
- Distal Femoral Replacement



Long Stem Revision

Indications:

- Adequate bone stock with grossly loose component.
- Require Long Cemented vs Cementless Stems
- Use of augments or allografts

Long Stem Revision

- McLaren et al. CORR 1994
  24 of 25 satisfactory results in long stemmed revision

- Kress et al: JOA 1993
  100% union at 6 months

- Culp et al: CORR 1984
  Revision for acute fractures
    - earlier mobilization
    - better ROM
    - better functional outcome

Distal Femoral Replacement

- Primary treatment for many type II and III
- Salvage of failed ORIF
- Elderly patients with poor bone stock

Davilia et al JOT 2001

Freedman et al JOT 1995

- Early ambulation
- avg 99dg ROM
- All had extensor lag

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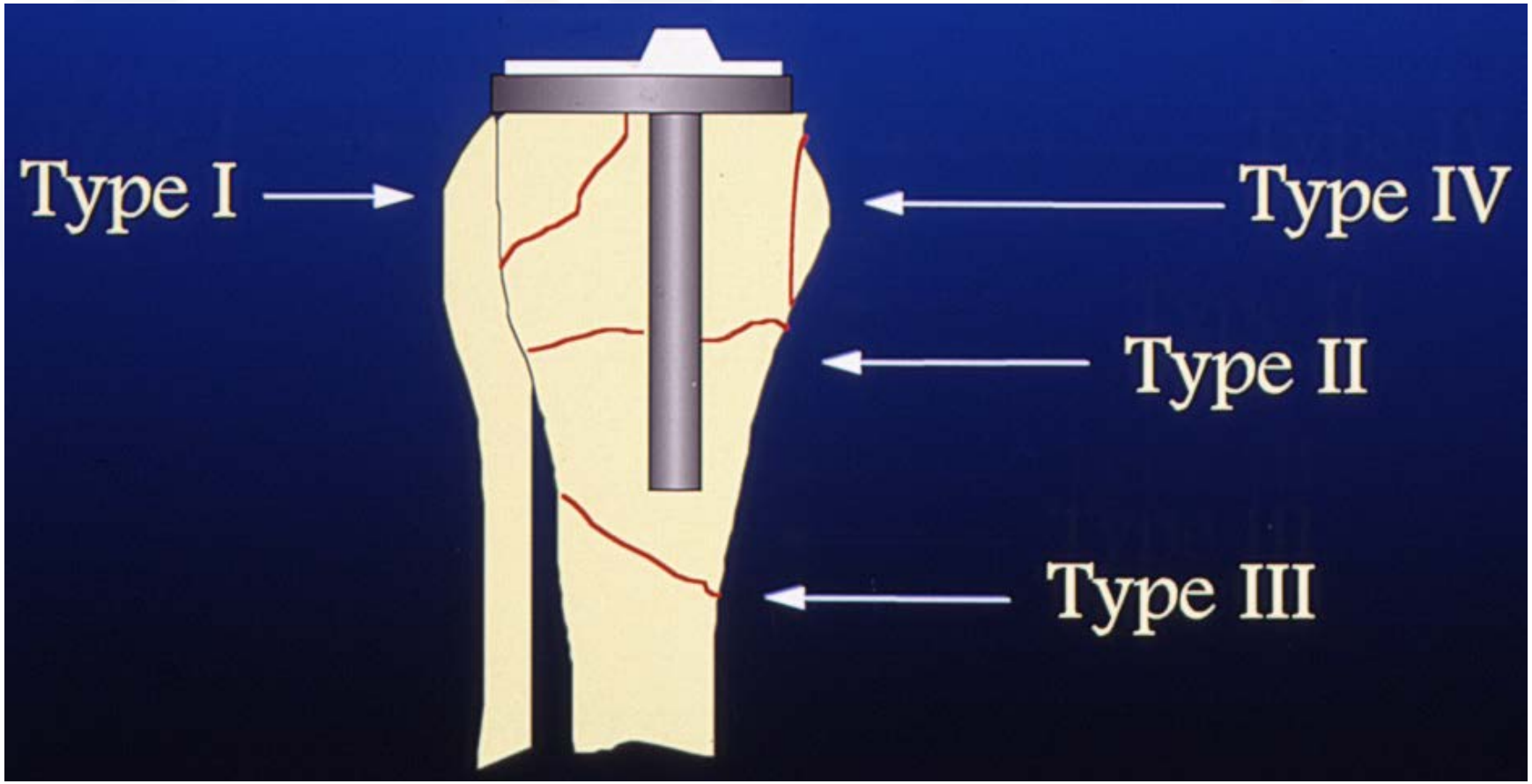
TKA Periprosthetic Fracture

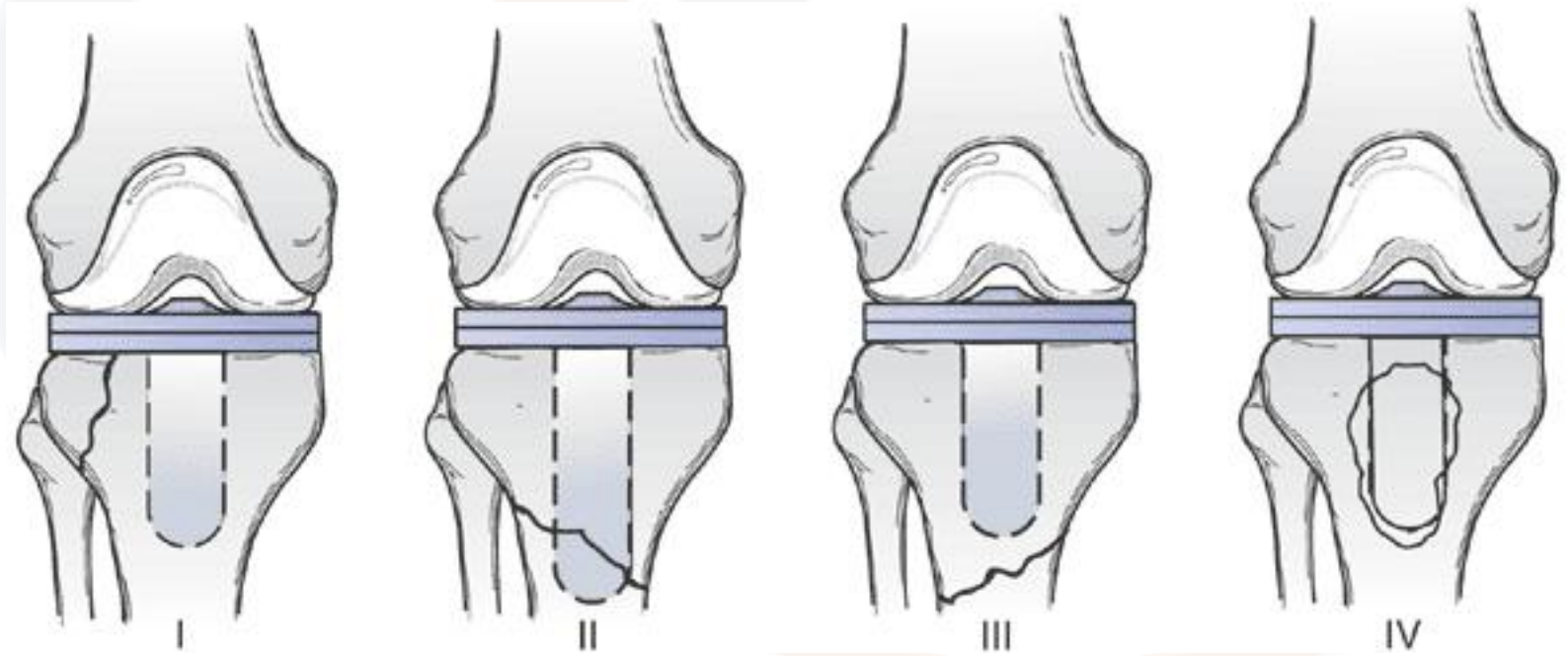
- Periprosthetic Femur fractures
- **Periprosthetic Tibial fractures**
- Patella fractures

Periprosthetic Tibial fractures



Felix et al, CORR 345:113-124, 1997

Periprosthetic Tibial fractures



Felix et al, CORR 345:113-124, 1997

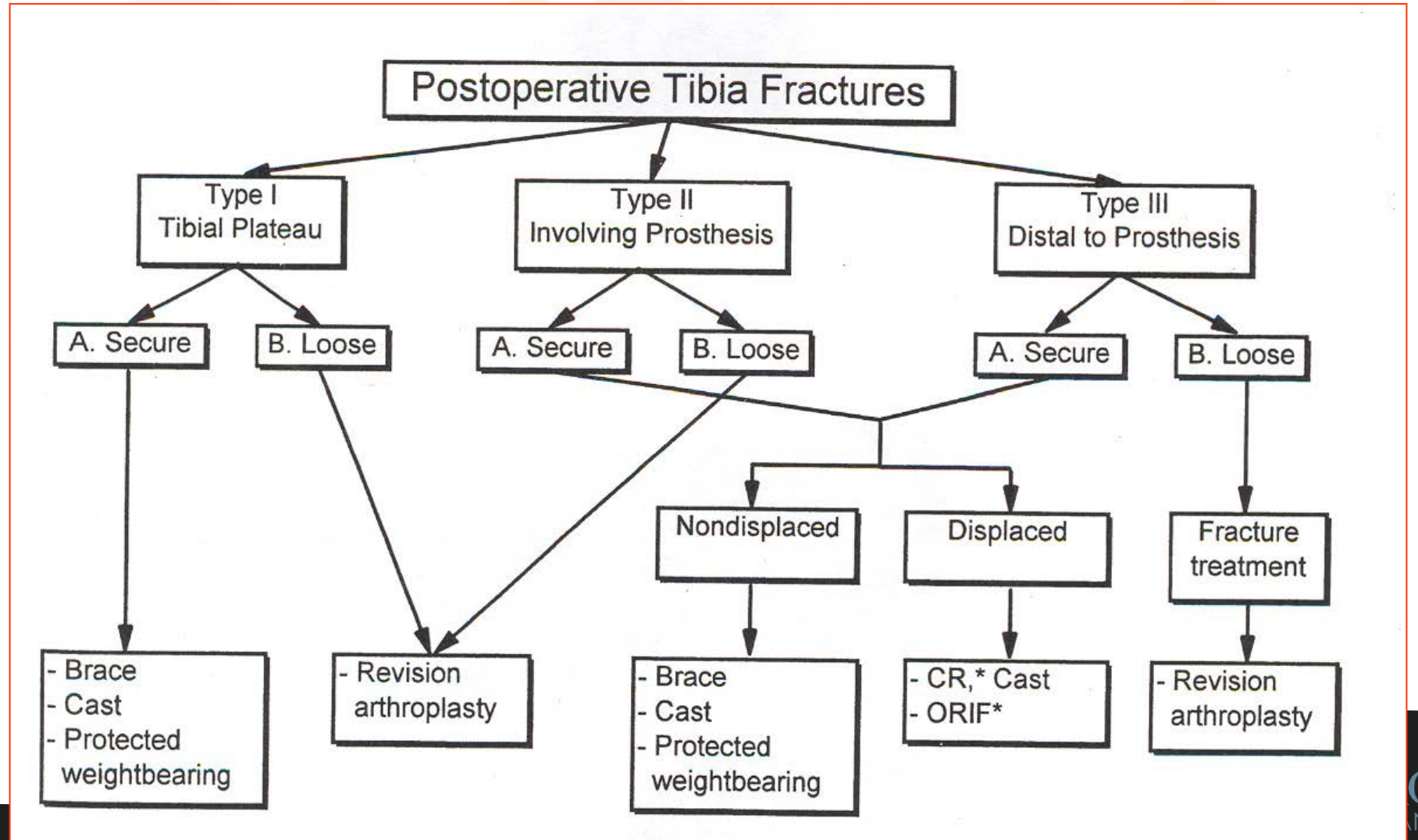
Periprosthetic Tibial Fractures

Classification

- Subtype A: Implant well fixed
- Subtype B: Implant loose
- Subtype C: Intraoperative

- Felix et al, CORR 345:113-134, 1997

Periprosthetic Tibial Fractures

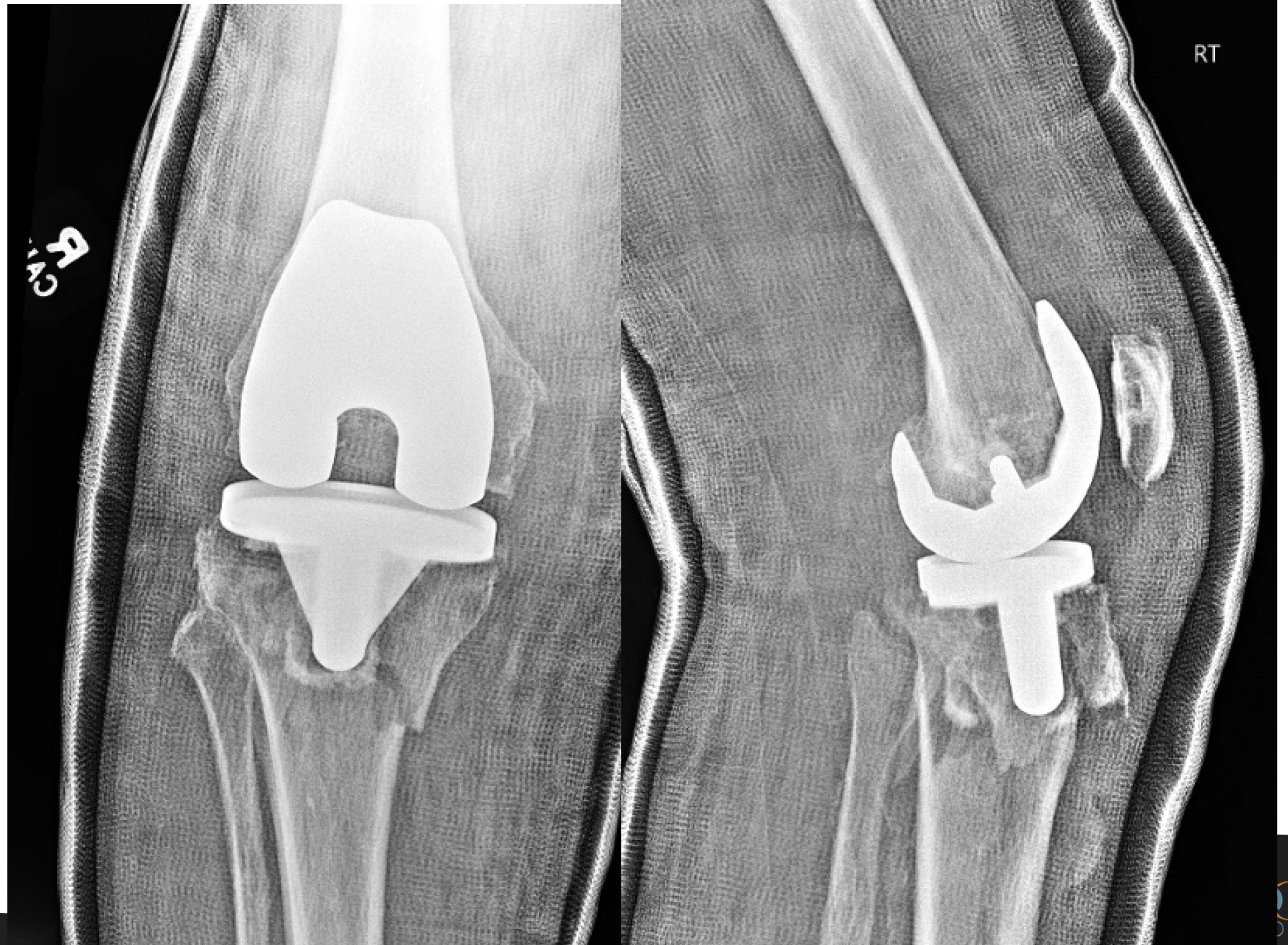


Periprosthetic Tibial Fractures

Recommendations

- Loose Implant
  - Revise
- Stable Implant/Non-displaced
  - Conservative
- Stable Implant/Displaced
  - ORIF/IMN


RT
X TABLE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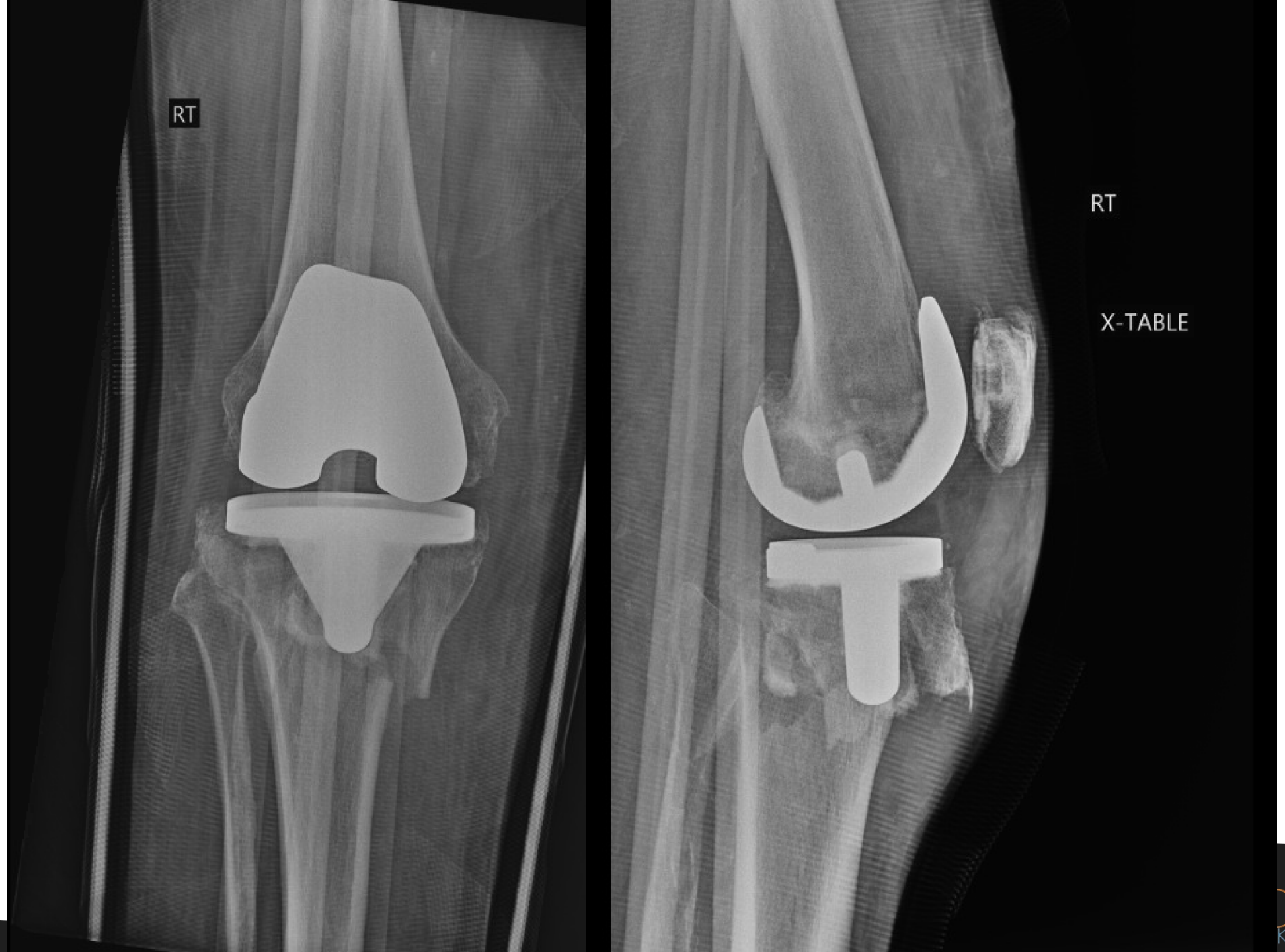
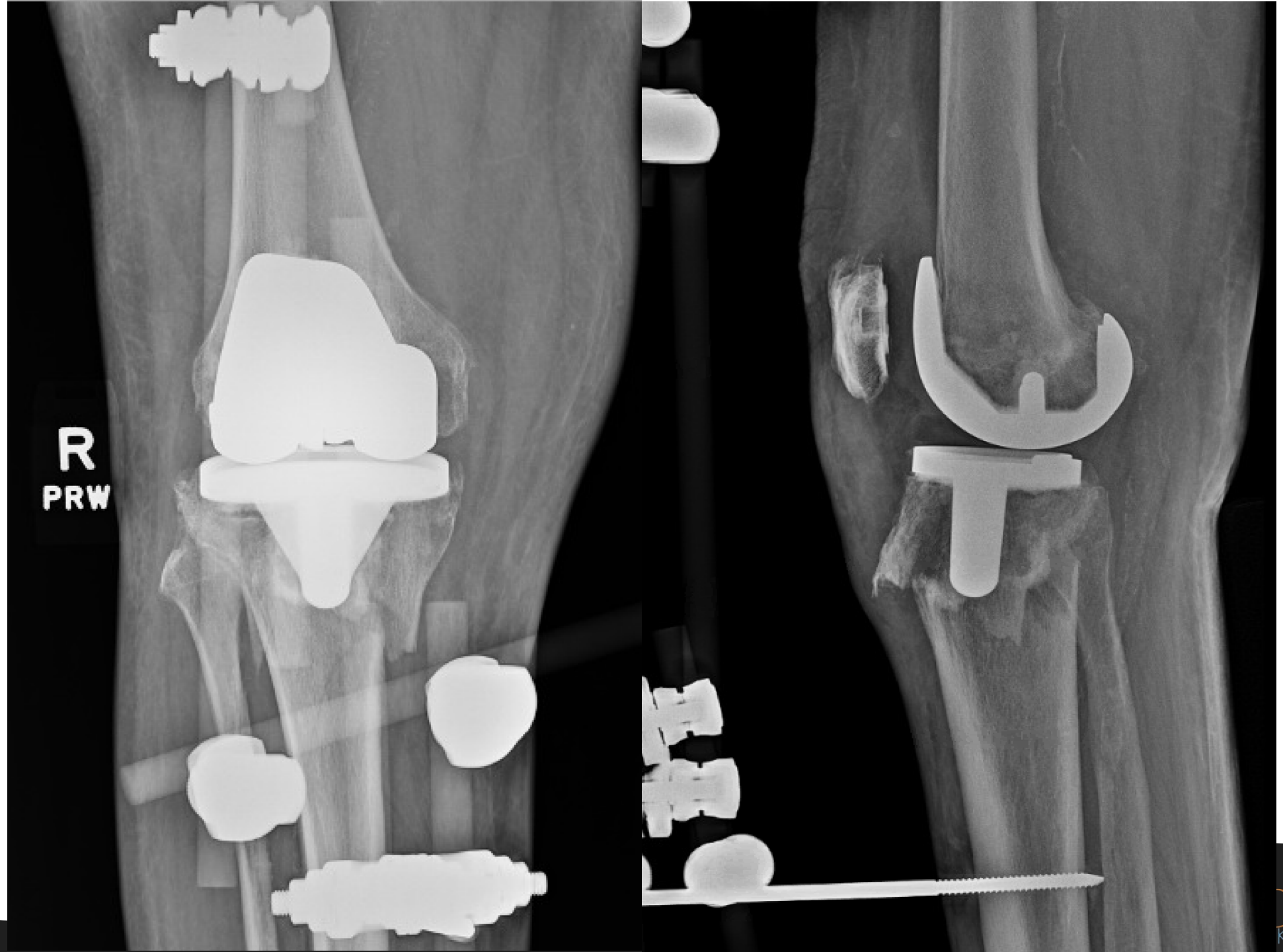


Carolina
KNEE CENTER



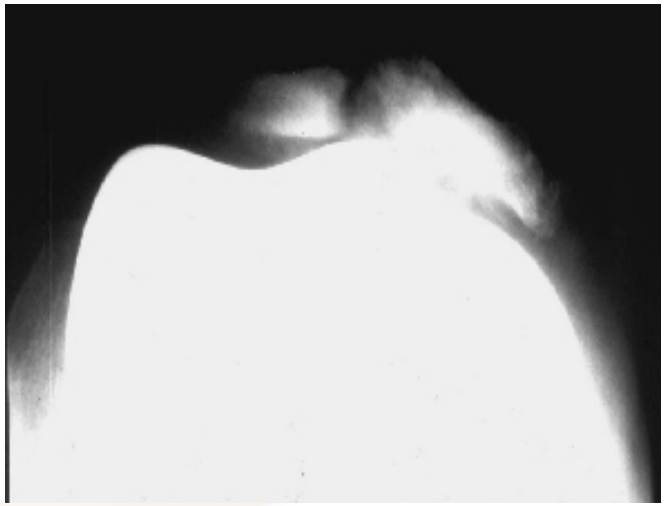
Carolina
KNEE CENTER

TKA Periprosthetic Fracture

- Periprosthetic Femur fractures
- Periprosthetic Tibial fractures
- **Patella fractures**

Patella Fractures

- Predisposing Technical Factors
  - Excessive resection
  - Large central hole
  - Overstuffing the PF joint
  - Malalignment
  - Lateral geniculate sacrifice during lateral release



Patella Fractures

Management Principal:

The extensor mechanism is the key!

Patella Fractures

Type I → stable implant

→ intact extensor mechanism

Treatment → immobilization

→ 37/38 satisfied

Ortiguera/Berry

JBJS, 2002

Patella Fractures

Type II → disrupted extensor mechanism

→ +/- stable implant

Treatment → operative

→ 50% complication rate

42% reoperation rate

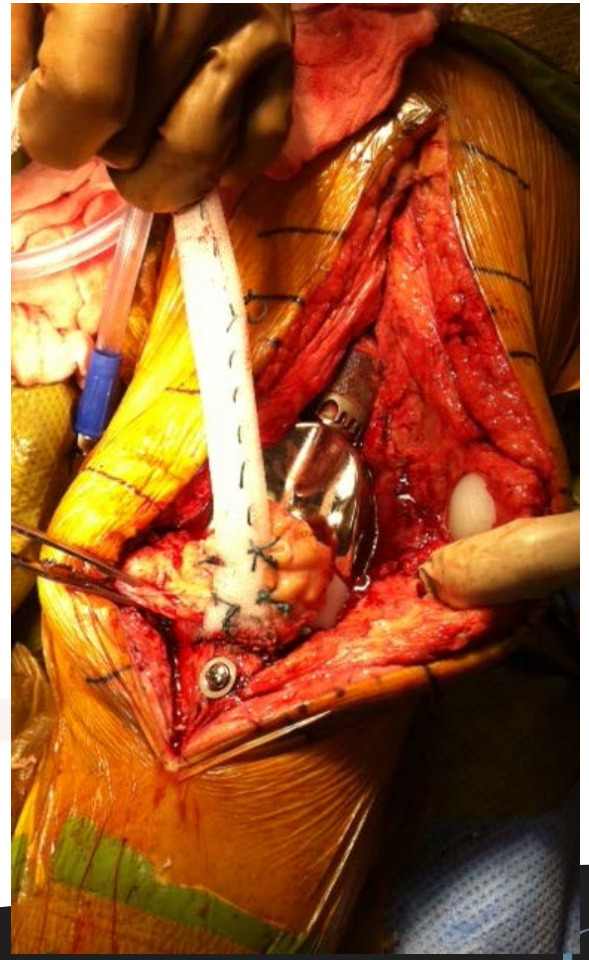
Ortiguera/Berry

JBJS, 2002

Extensor Mechanism Disruption

Mayo series

- Abdel, Hanssen
  - 65 of 77 functioning well at average 4 years
  - Complication of extensor lag average of **26 degrees**



Summary Knee

- Frequency Increasing
- Supracondylar Fractures with well fixed components: Locked Condylar Plate vs IM Nail vs. Nail+Plate
- Loose Components = Revision TKA
- Stable = conservative vs. ORIF
- Patella Fractures: Extensor Mechanism is Key
  - Operative intervention historically has yielded poor results

Summary

- Goals
  - Fracture Union
  - Maintain alignment
  - Rapid mobilization
  - Early ROM

Summary

- Treatment must be individualized
  - Location of Fracture
  - Stability of the Component
  - Bone quality
  - Patient capabilities/needs

Thanks to Bryan Springer, Walt Beaver, and Josef Jolissaint