

Minimally invasive osteosynthesis— minimizing surgical footprints

Arvind von Keudell
Associate Professor

AO Trauma Advanced Principles Course
Odense, DK

BRIGHAM HEALTH



**BRIGHAM AND
WOMEN'S HOSPITAL**

Arvind von Keudell, MD, MPH

Overlæge

**Associate Professor of Orthopaedic Surgery
Bispebjerg Hospital/University of Copenhagen**

**Associate Professor of Orthopaedic Surgery
Brigham and Women's Hospital/ Harvard Medical
School**



**Bispebjerg
Hospital**



**UNIVERSITY OF
COPENHAGEN**



**HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL**



Mass General Brigham

AO

Learning objectives

- Describe the principle and concept of minimally invasive treatment
- Distinguish between conventional and minimally invasive fracture treatment
- Explain pros and cons of conventional and minimally invasive treatment
- Depict indications and tools for direct/indirect reduction
- Describe implants used for minimally invasive osteosynthesis (MIO) (screw, plate, intramedullary (IM) nail, external fixator)

Minimally invasive osteosynthesis

- Concept of biological fracture treatment
- Reduce the iatrogenic trauma (surgical footprint) caused by surgery
- Preserve blood supply to fracture fragments
- Keep the proper environment for bone healing

Minimally invasive osteosynthesis shaft

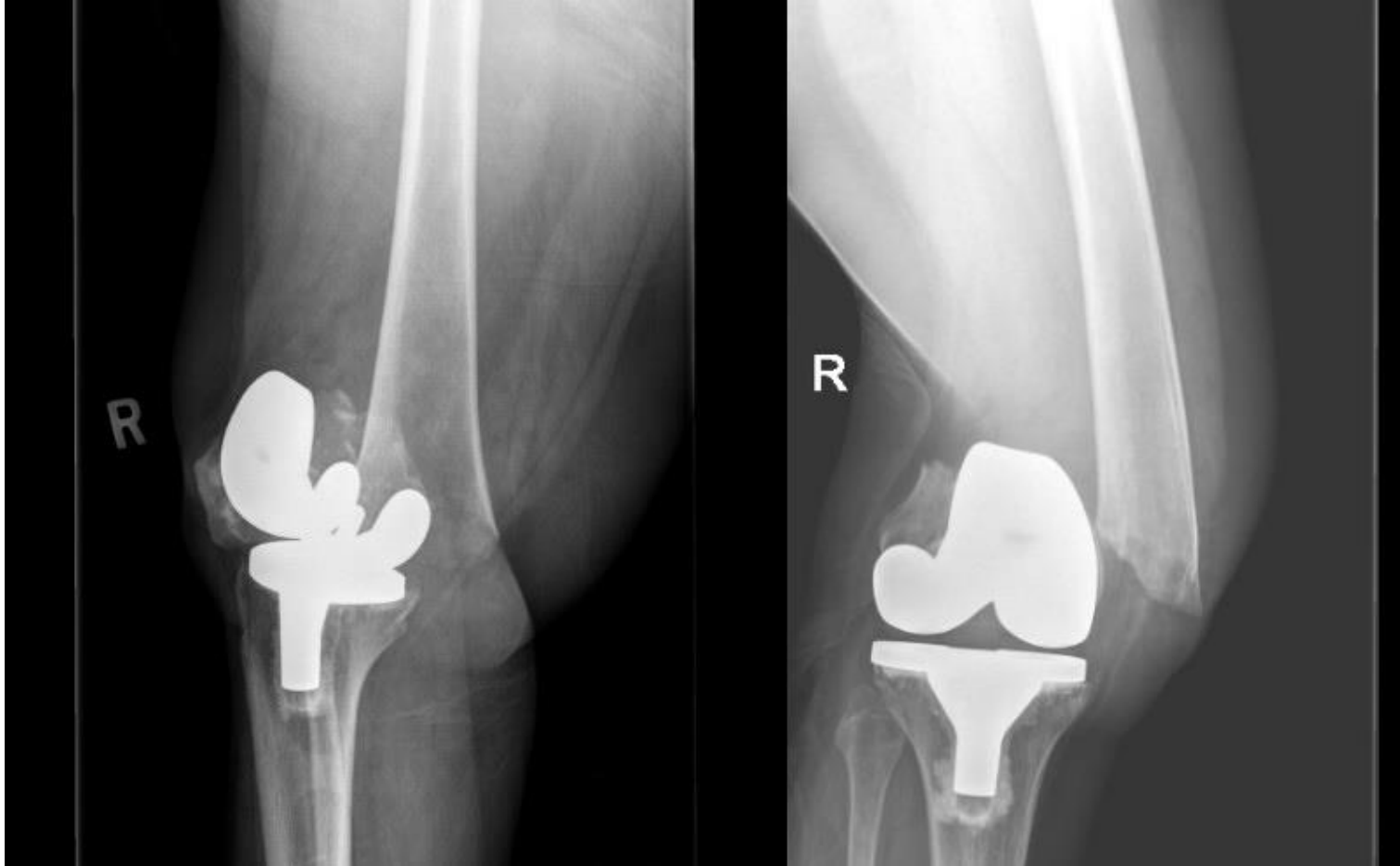
Soft-tissue window:

- Away from the fracture site
- Big enough to see or touch the plate and bone



Indirect reduction

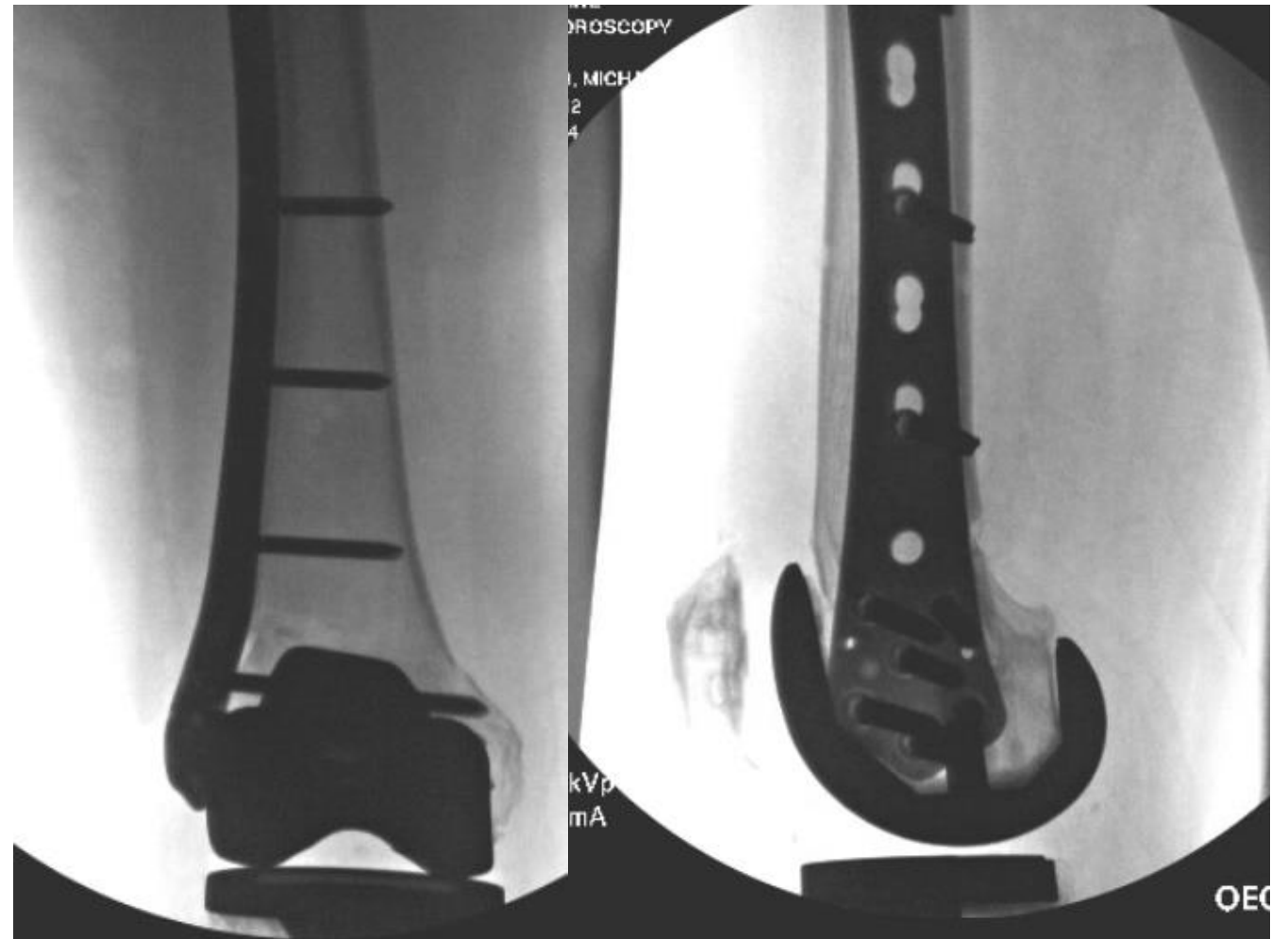
66F 4 years out from TKA fell during a seizure – closed but skin threatened



Femoral Distractor

- Place pins percutaneously – anterior to posterior
- Bar away from surgical field
- BEWARE OF MALROTATION
- Pins should be coplanar to help with rotation



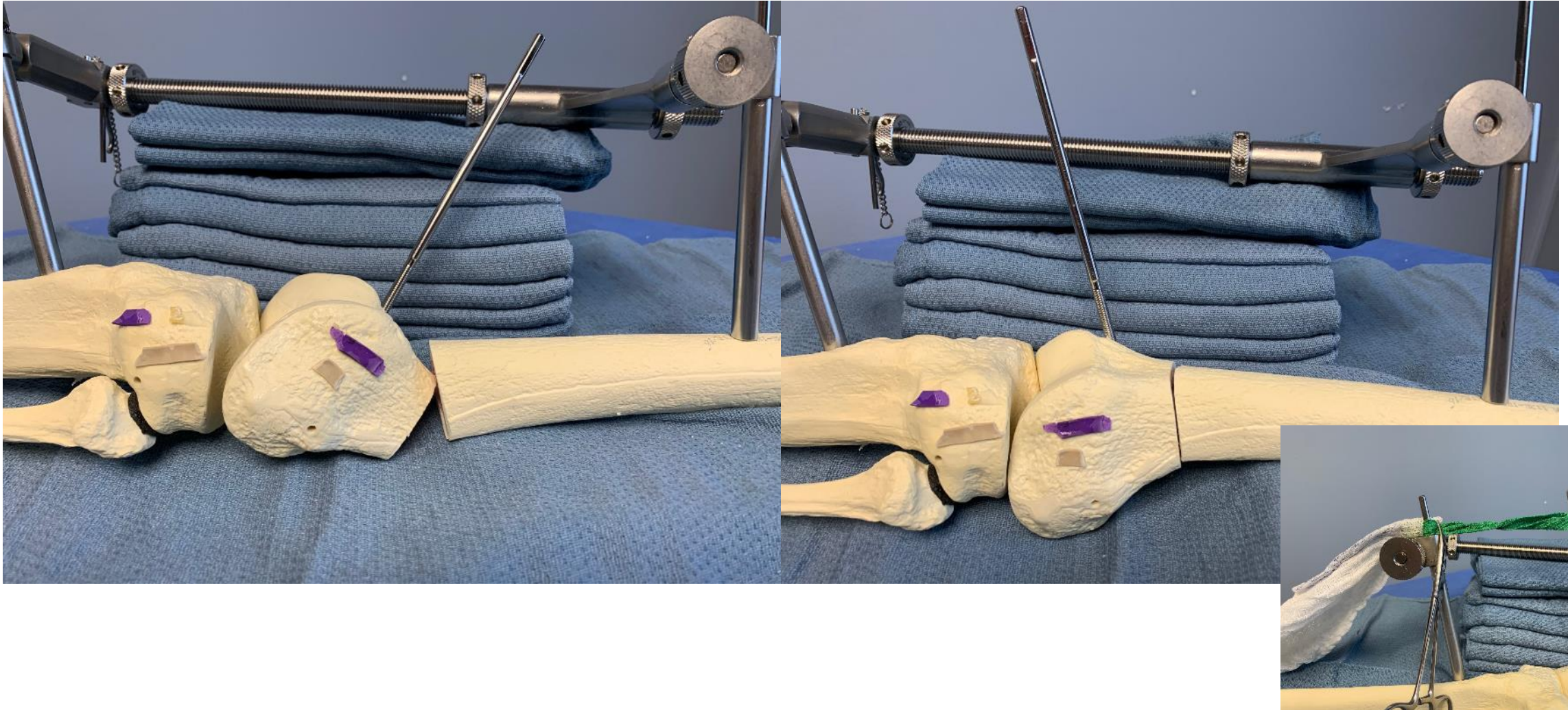


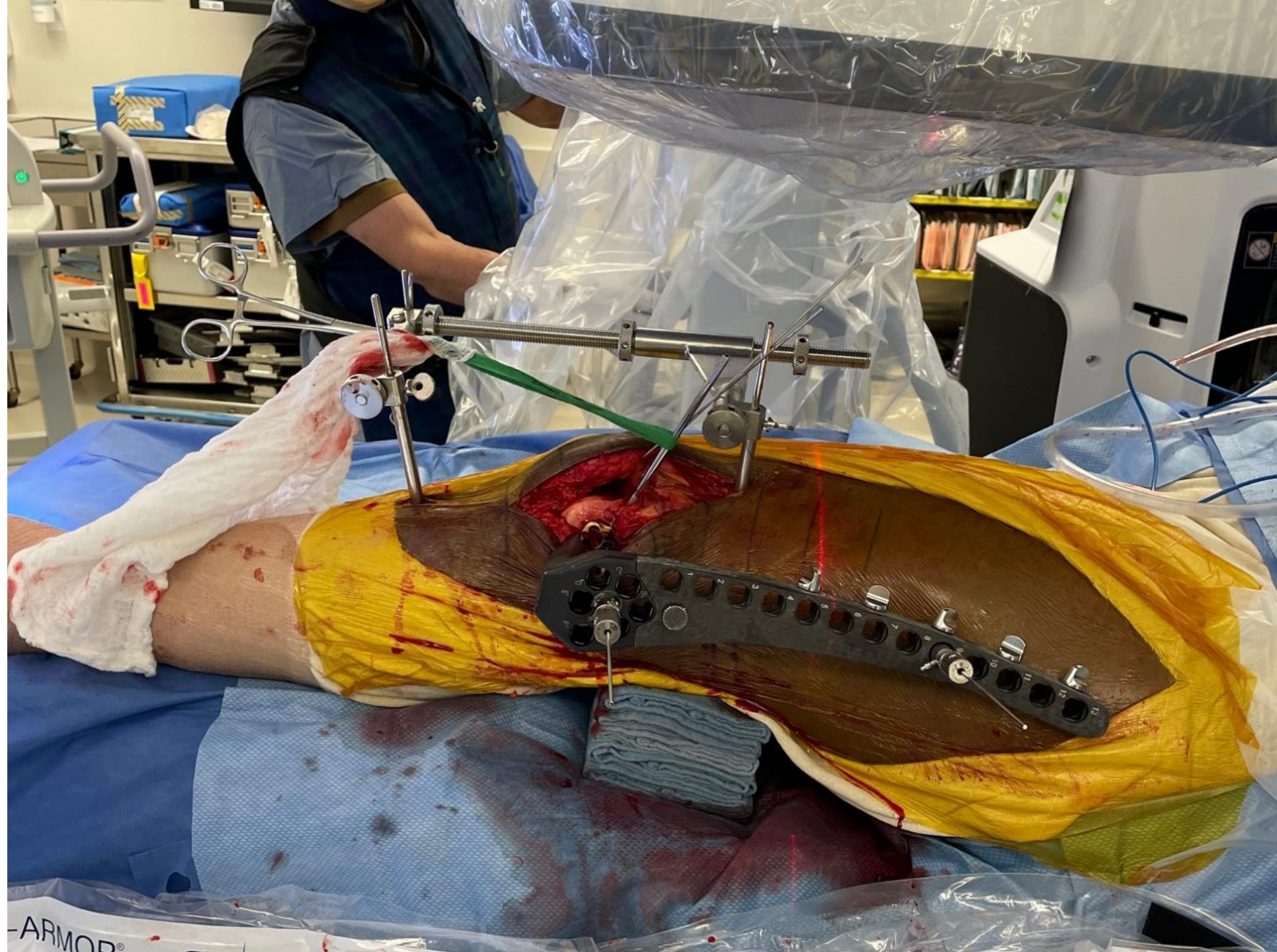
Initially over-distracted with the femoral distractor to allow for reduction, and then allowed to compress.

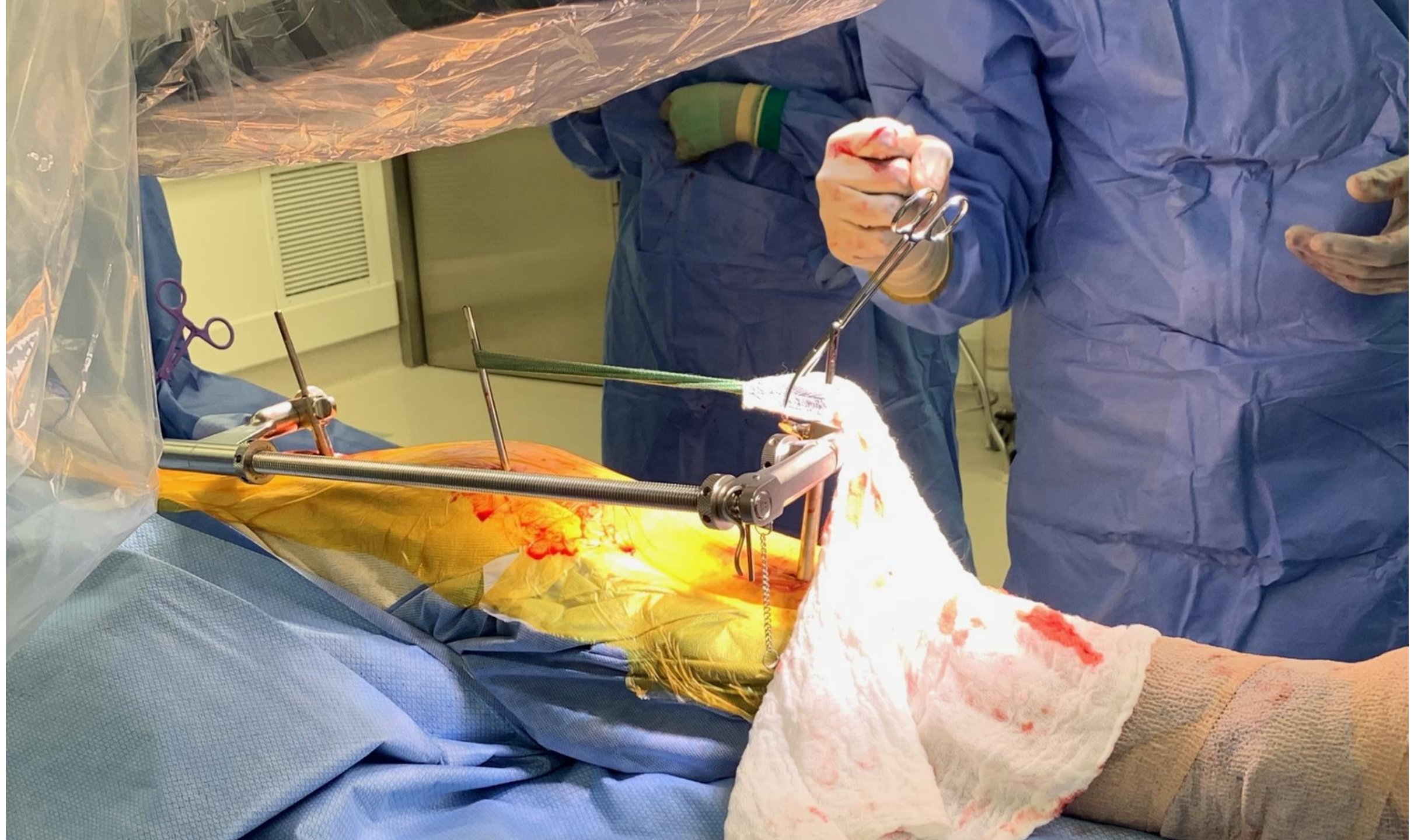
Ambulatory with a walker at 3 weeks and a cane at 8 weeks

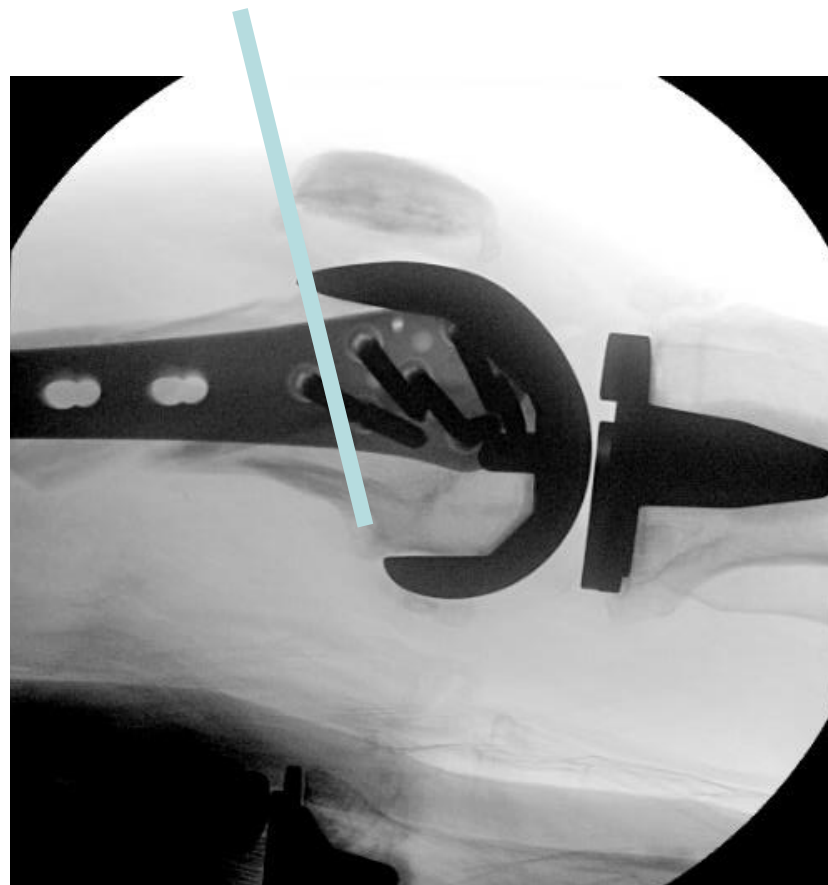
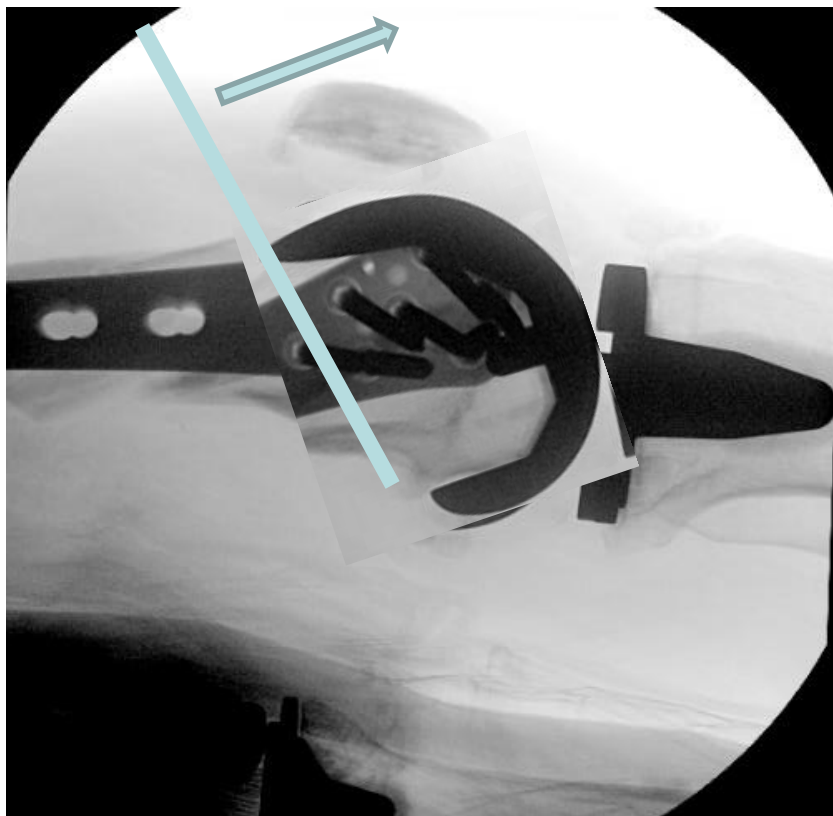


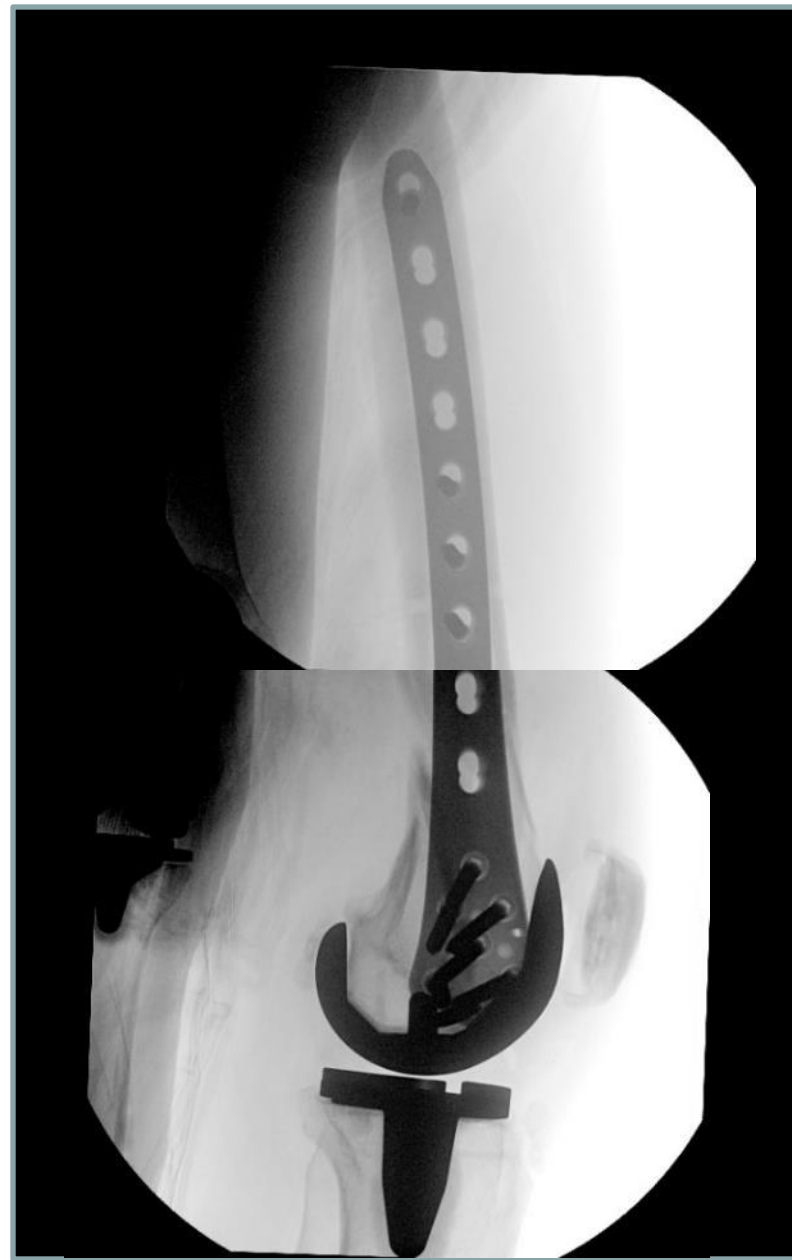
Additional pin used to control sagittal alignment











Back to baseline independent ambulation without assistive devices



Minimally invasive osteosynthesis fracture site

Minimal additional trauma at the fracture site



Direct reduction

Conventional ORIF versus MIO

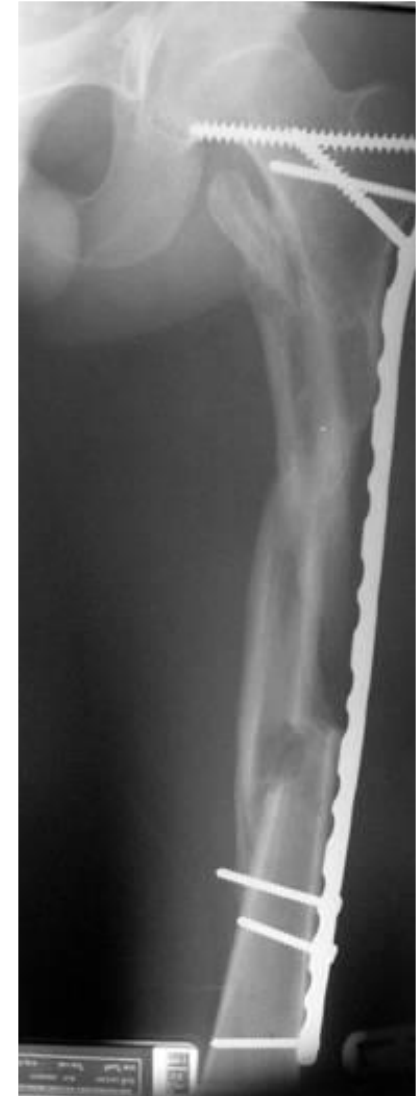
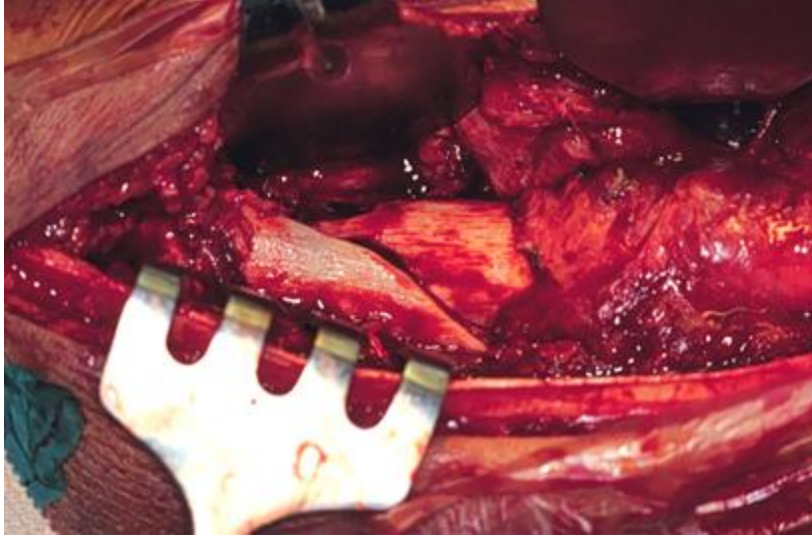
Open reduction internal fixation:

- Soft-tissue injures
- Disrupts blood supply to fracture fragments
- Delayed union
- More anatomical alignment

Minimally invasive osteosynthesis:

- Preserves soft tissue
- Preserves viability of fracture fragments
- Rapid healing
- More malalignment

Conventional ORIF versus MIO



Minimally invasive osteosynthesis requires good planning—four “T”s

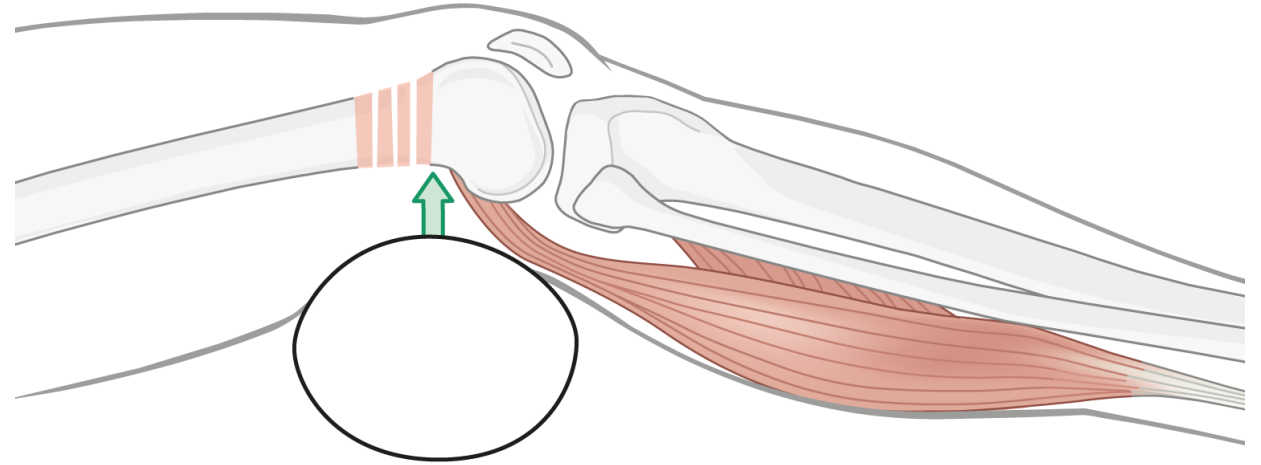
- Timing—skin condition, difficult reduction in delayed case
- Tools—reduction → MIO tools, fixation → stable implants
- Teamwork—surgeons and operating room personnel (ORP)
- Techniques and tactics

Indirect reduction—traction and manipulation

- Manual traction
- AO distractor
- Fracture table
- Reduction handle
- External fixator

Tools for indirect reduction

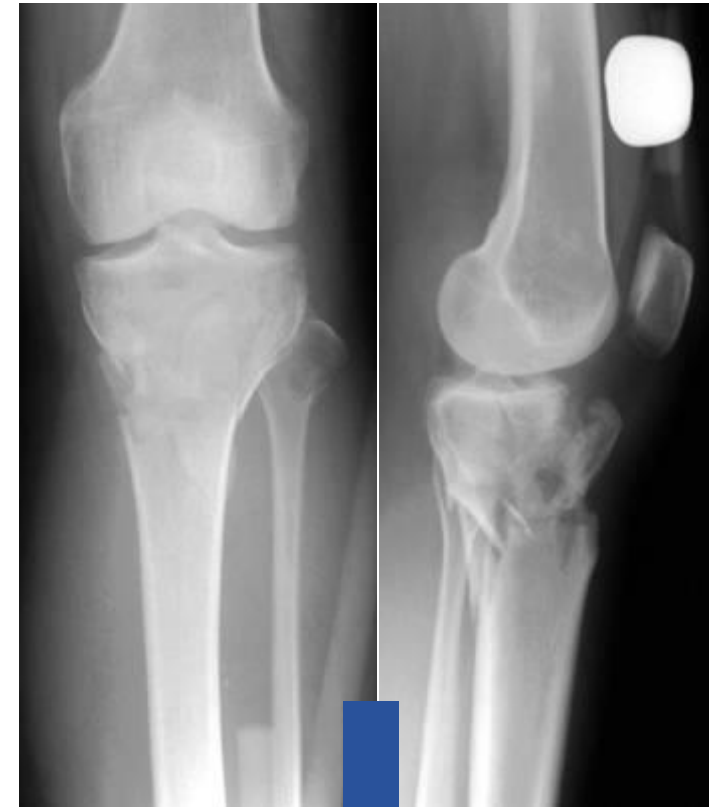
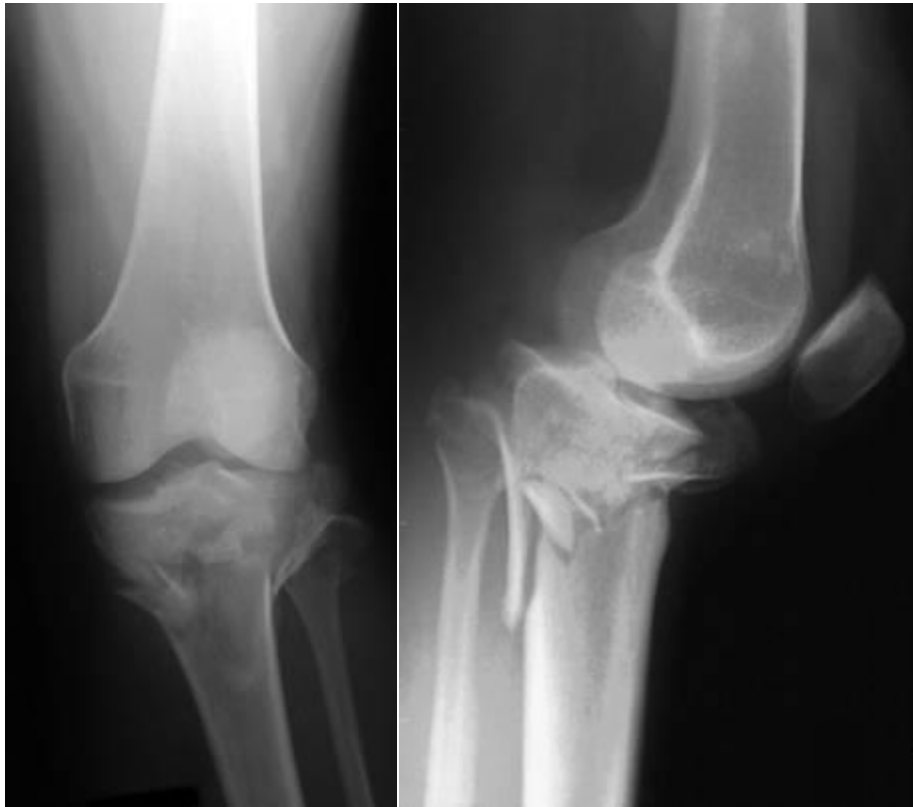
- Bolster, towel
- Joystick
- Plate
- Screw and plate
- Collinear clamp with plate



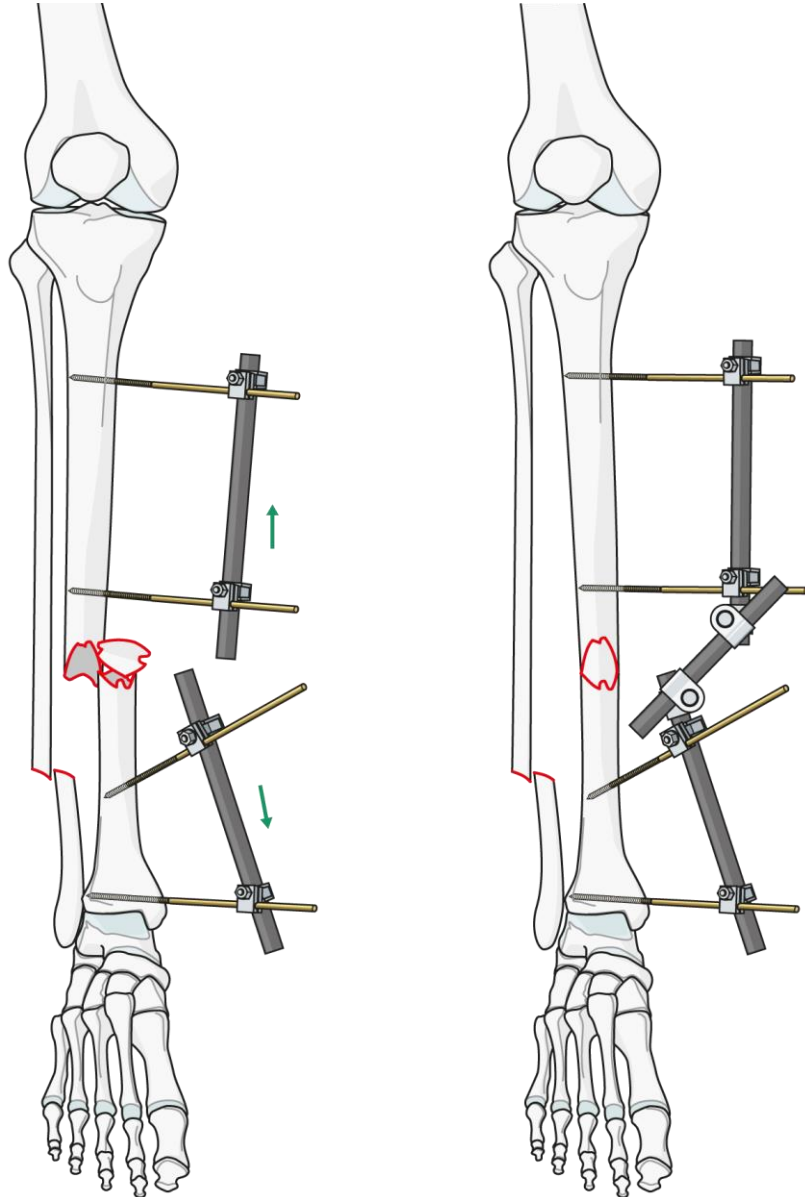
**Direct force applied
away from the fracture site**

Traction—ligamentotaxis

- Ligamentotaxis → reduction
- Fragments that attach to soft tissue



External fixation



Screw and plate



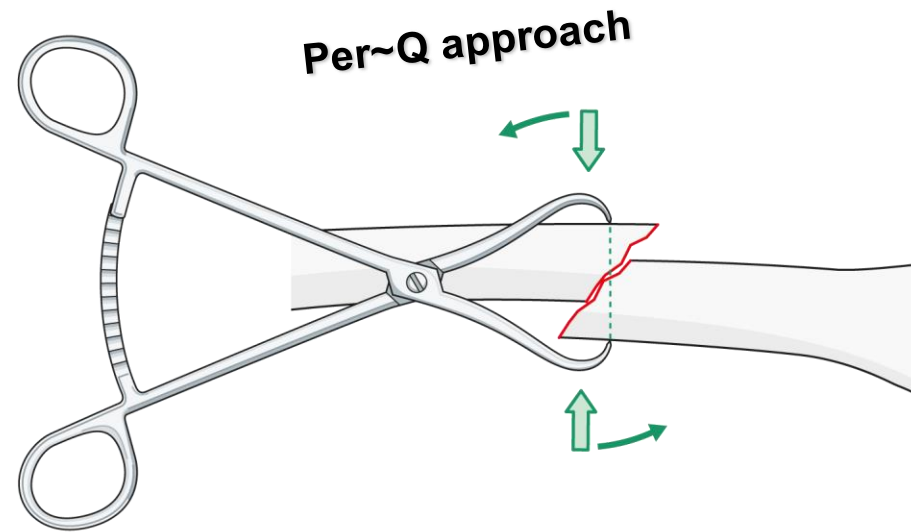
More tools for direct or reduction

- Hohmann retractor
- Screw (lag screw)
- Collinear clamp
- Pointed reduction clamp
- Cerclage

Force applied directly
at the fracture site

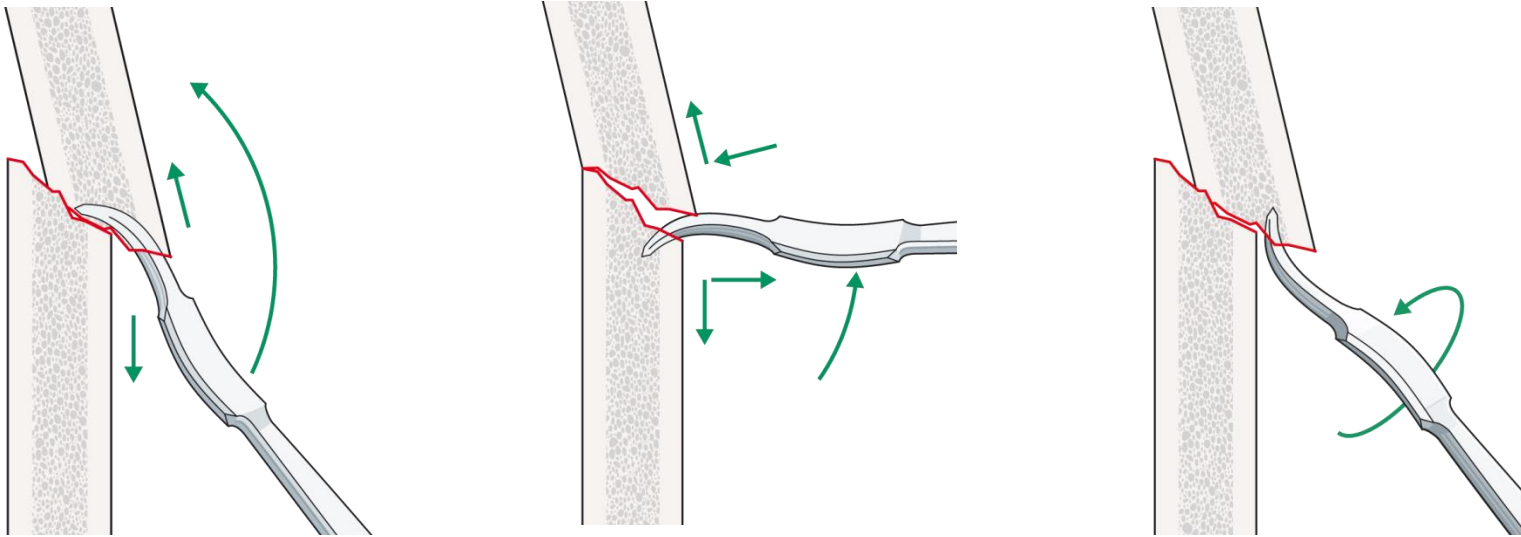
Open or closed (MIPO)

Reduction forceps



Hohmann retractor

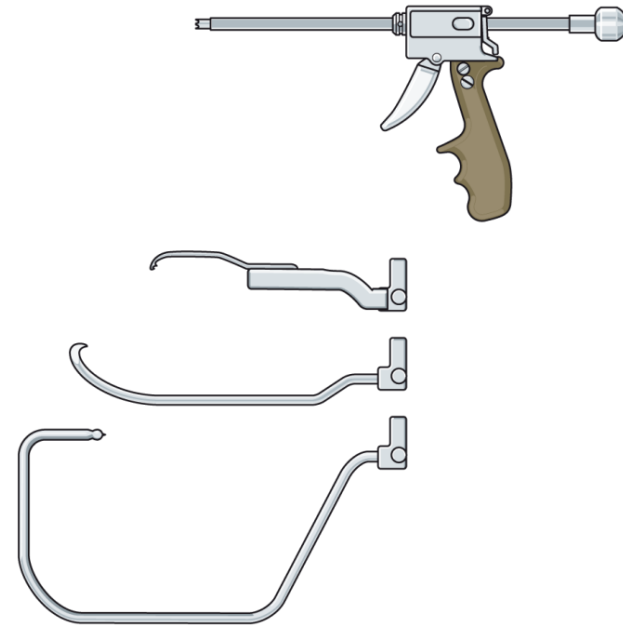
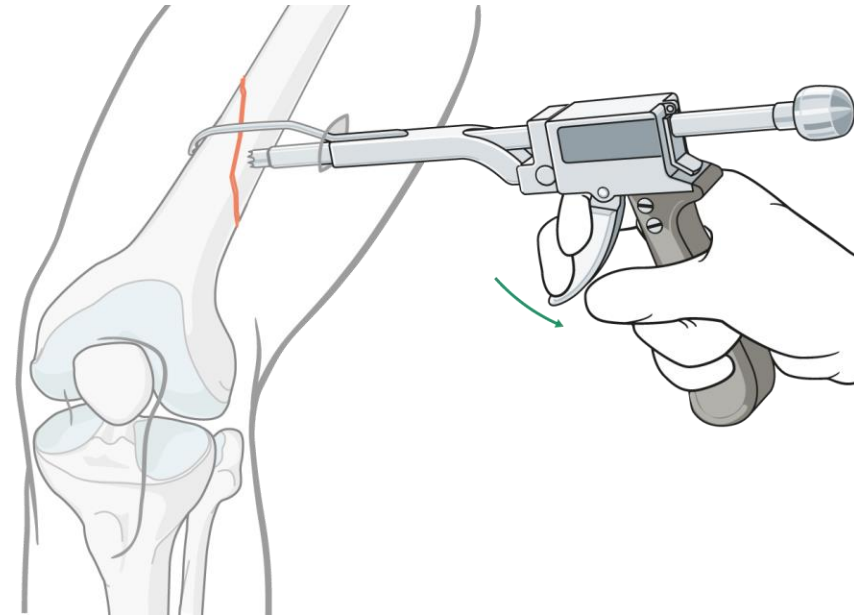
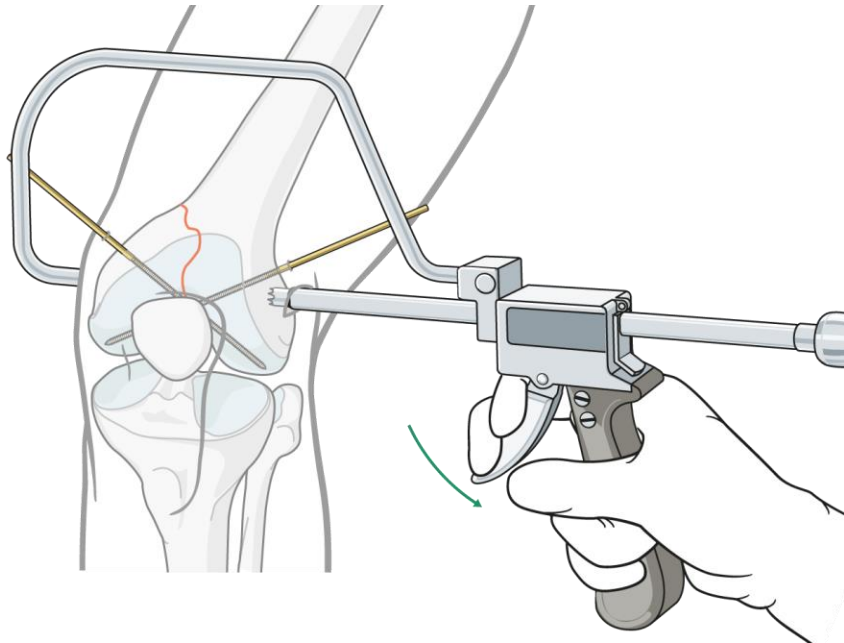
- Use as a lever or pusher
- Reduction by turning and bending



- Advantage: big force with little exposure
- Hazards:
 - Additional fragmentation
 - Loss of reduction upon Hohmann removal

Collinear forceps

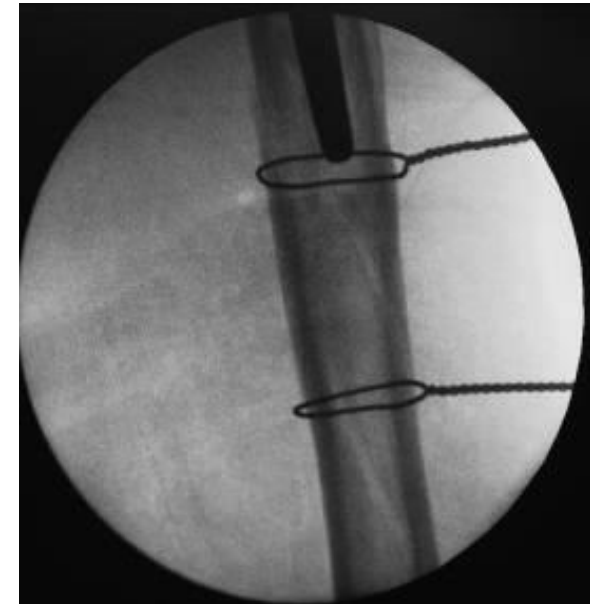
- Collinear closing system with modular arms
- Good for articular, oblique, and spiral fractures



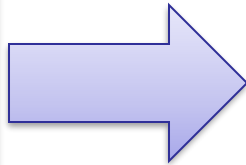
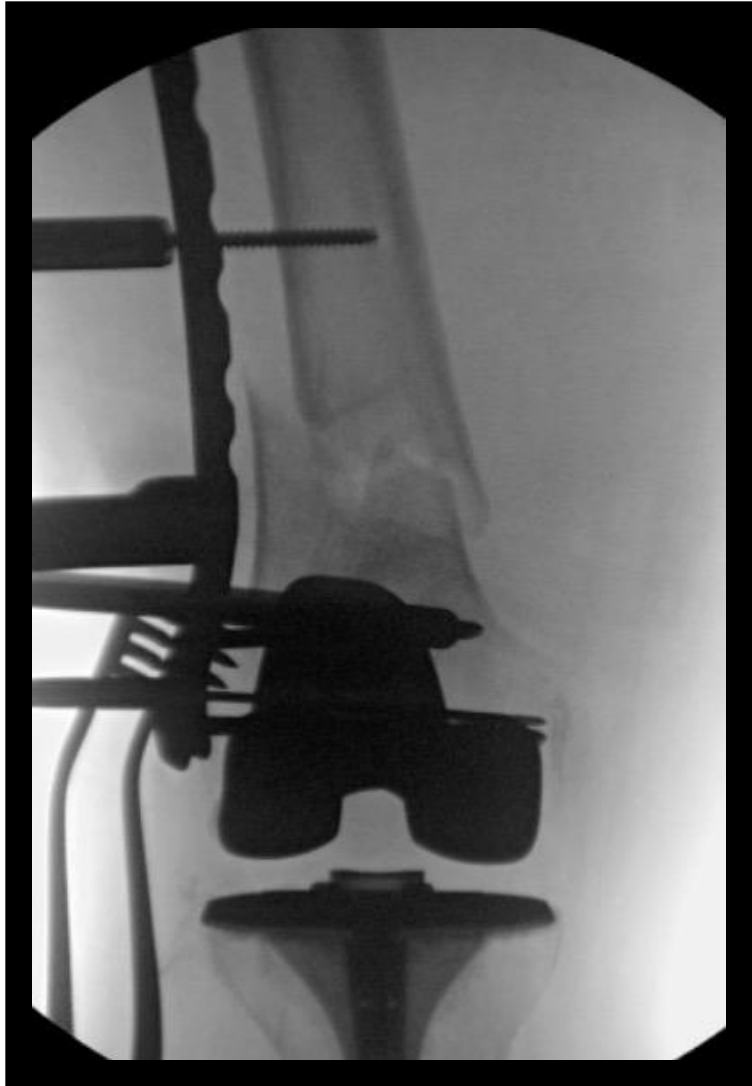




Cerclage wiring



Cortical Screw as a Reduction Tool



Cortical screw can be placed percutaneously and tightened to lateralize the shaft as needed.

Advantages of minimally invasive osteosynthesis

- Rapid and strong bone healing
- Less infection
- Decrease the need for bone graft
- Less pain
- Faster rehabilitation
- Better cosmetic appearance

Disadvantages of minimally invasive osteosynthesis

- Limited view
- Increased C-arm time
- Malunion
- Delayed union with flexible fixation in simple fractures

Take-home messages

- Preoperative plan and case analysis are critical
- Soft-tissue window: key is not length of incision
- Be aware of danger zones!
- Indirect or direct reduction as necessary
- Reduction tools: minimal additional trauma
- Basic principles of ORIF remain the same