PLEASE CLICK ON THE FOLLOWING LINK TO WATCH THE LECTURE ONLINE:-

https://www.youtube.com/watch?v=dhj8azvRINY&list=PLuBRb5B7fa_d_ITkxtB-KQYUusx0C1s_x

Stability and Reduction

Surgical Management steps

- Surgical approach
- Fracture reduction
- Fracture fixation


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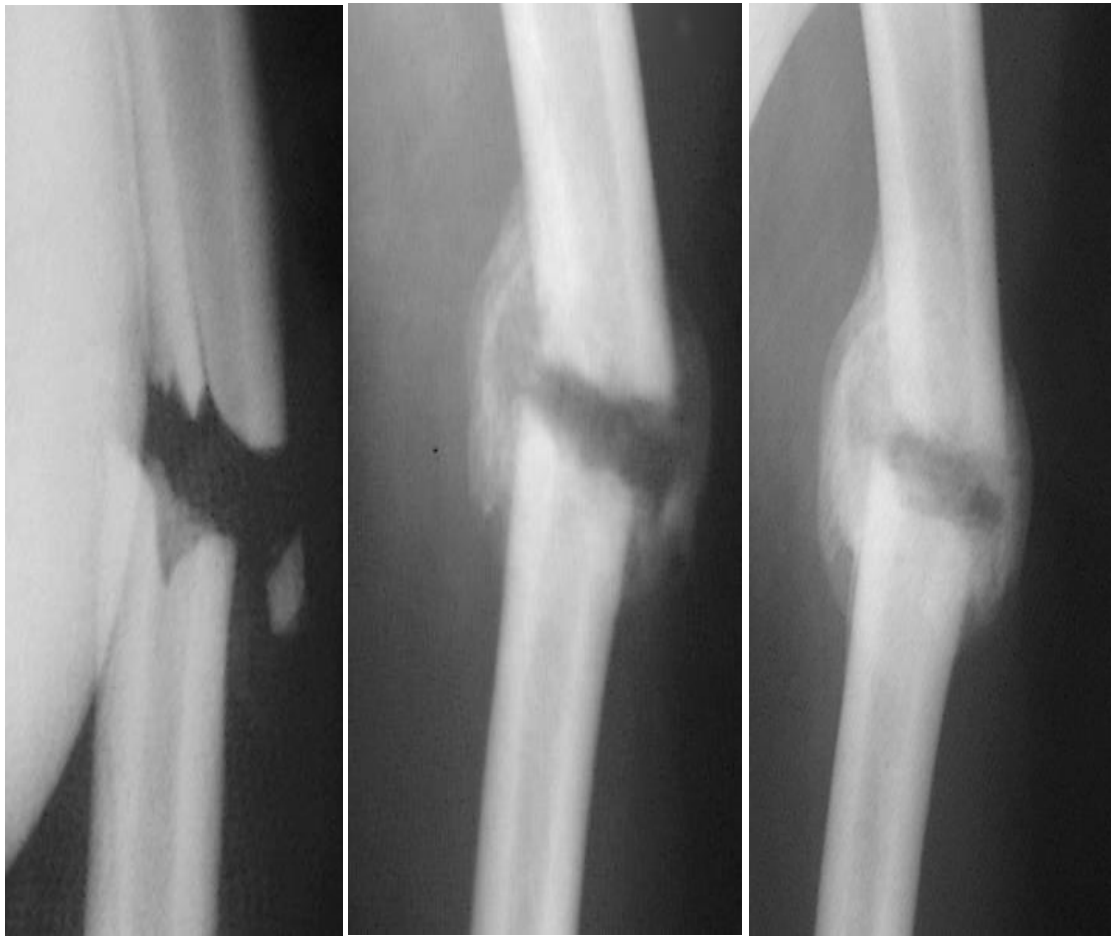
Learning objectives

- Define absolute and relative stability
- Describe how the biological behavior of fractured bone is affected by absolute or relative stability
- Define indications for selection of absolute or relative stability
- Explain techniques for achieving absolute or relative stability
- Describe benefits and hazards of direct and indirect reduction
- List indications for direct and indirect reduction

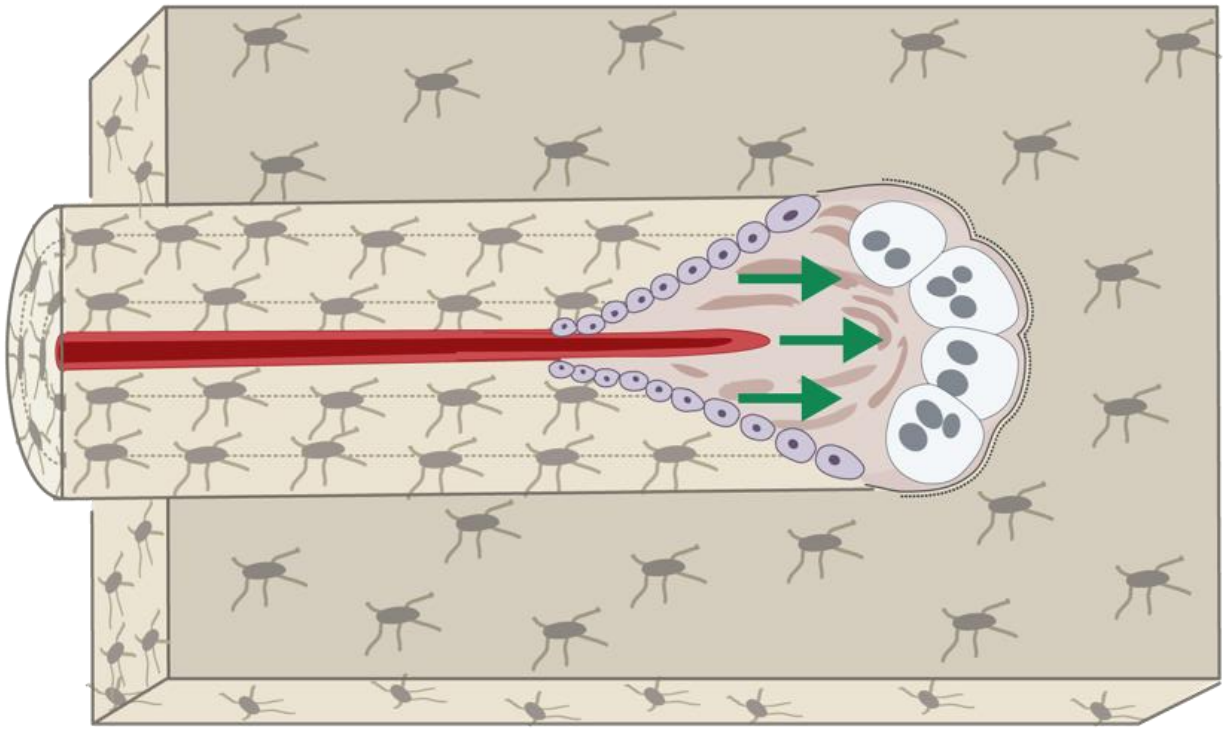
Fractured bone is designed to heal

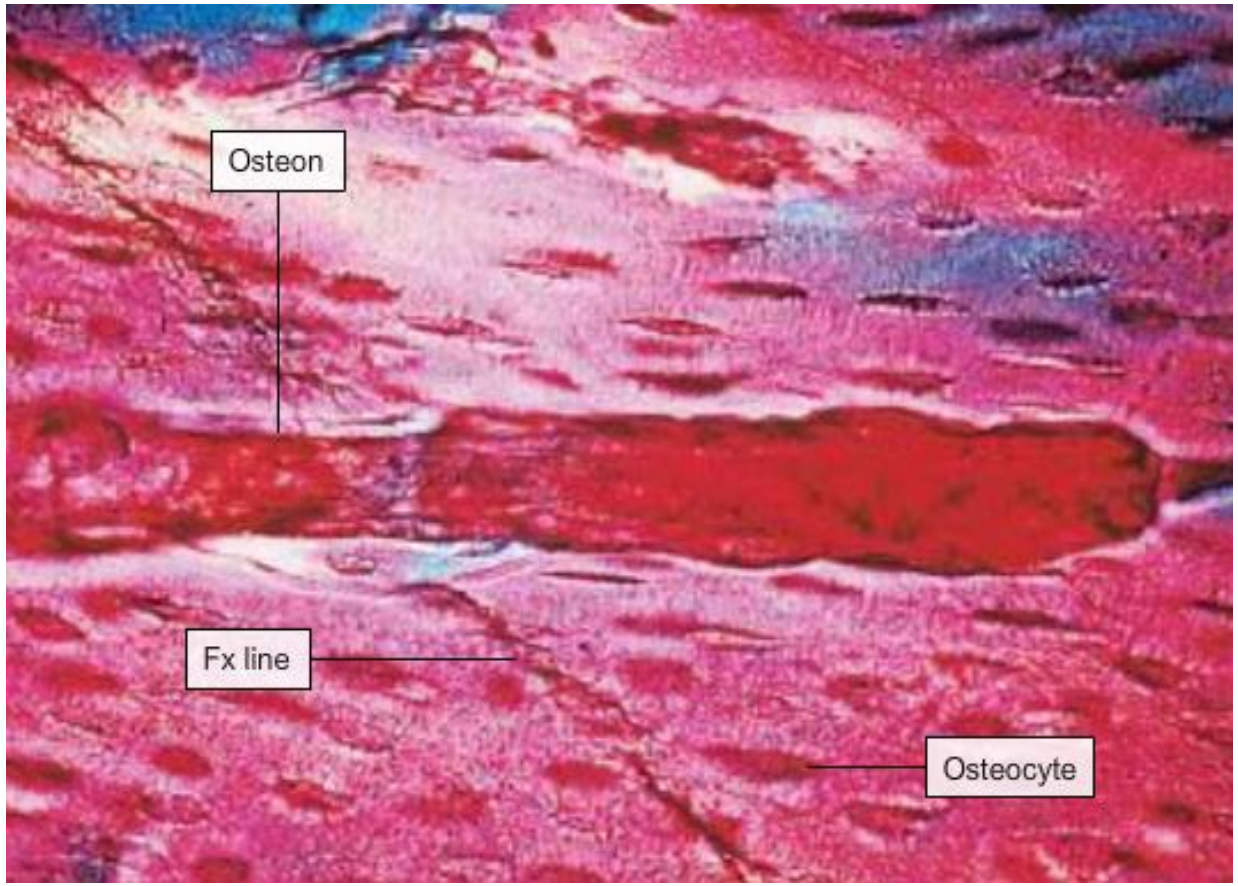
- When left alone, a fractured bone will heal on its own
- However, deformity may occur resulting in:
  - Shortening
  - Angulation
  - Rotation



Types of Bone Healing

- Direct (cutting cones) Vs Indirect (callus formation)





How stability affects healing

- Internal fixation of fractures alters the biology of fracture healing

- Method of bone healing depends on:
    - **Type of fracture** (simple or complex)
    - **Type of reduction** (anatomical or functional)
    - **Type of stability achieved** (absolute or relative)
    - **Type of implant chosen** (providing absolute or relative stability)

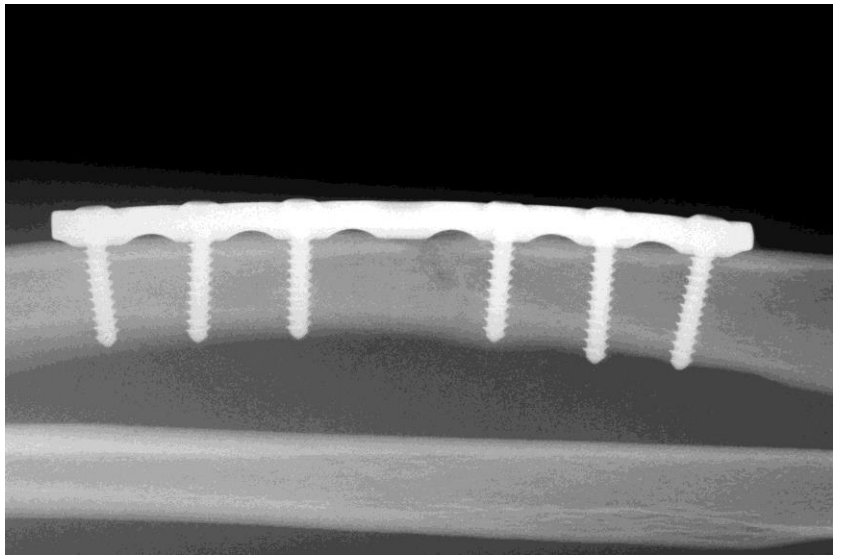
Definition of absolute stability

- No micro-motion at the fracture site under normal physiological loads
  - This requires open reduction
  - This requires anatomical reduction of the fracture
- Best achieved by interfragmentary compression
- Usually leads to direct bone healing

Implants that produce absolute stability

- Lag screw fixation (interfragmentary compression)
- Axial compression with compression plate
- Buttress plate

Lag screw



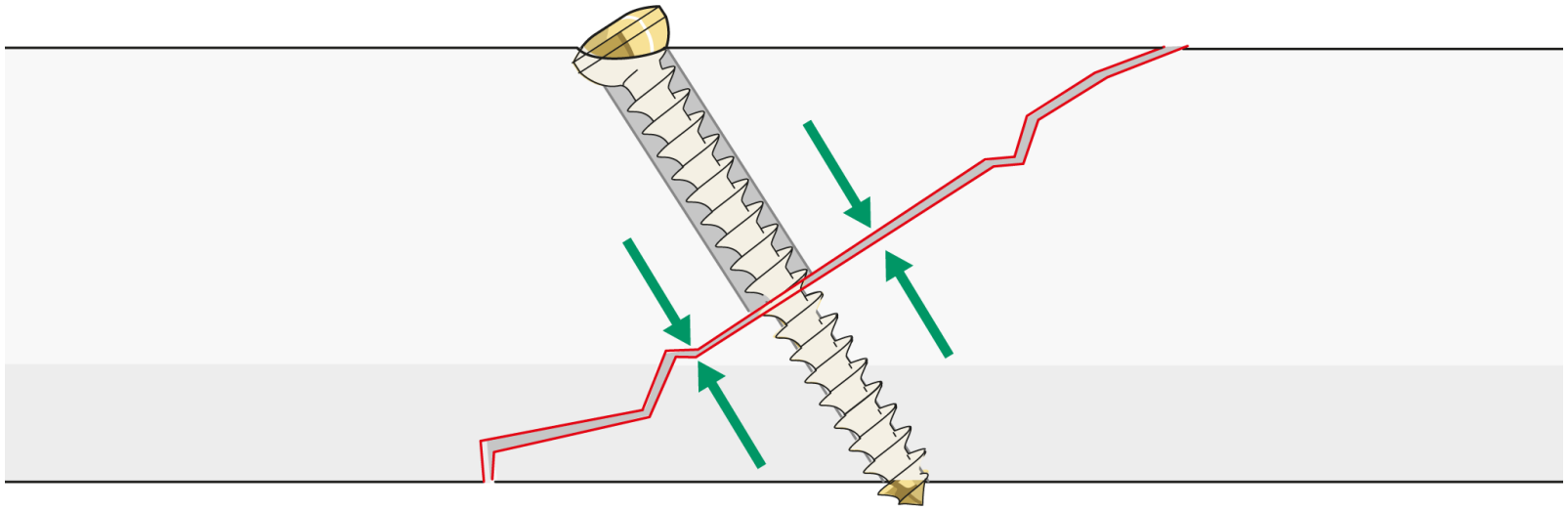
Axial compression plate

Buttress plate

Lag screw fixation

- Lag screw is a technique, not a type of screw

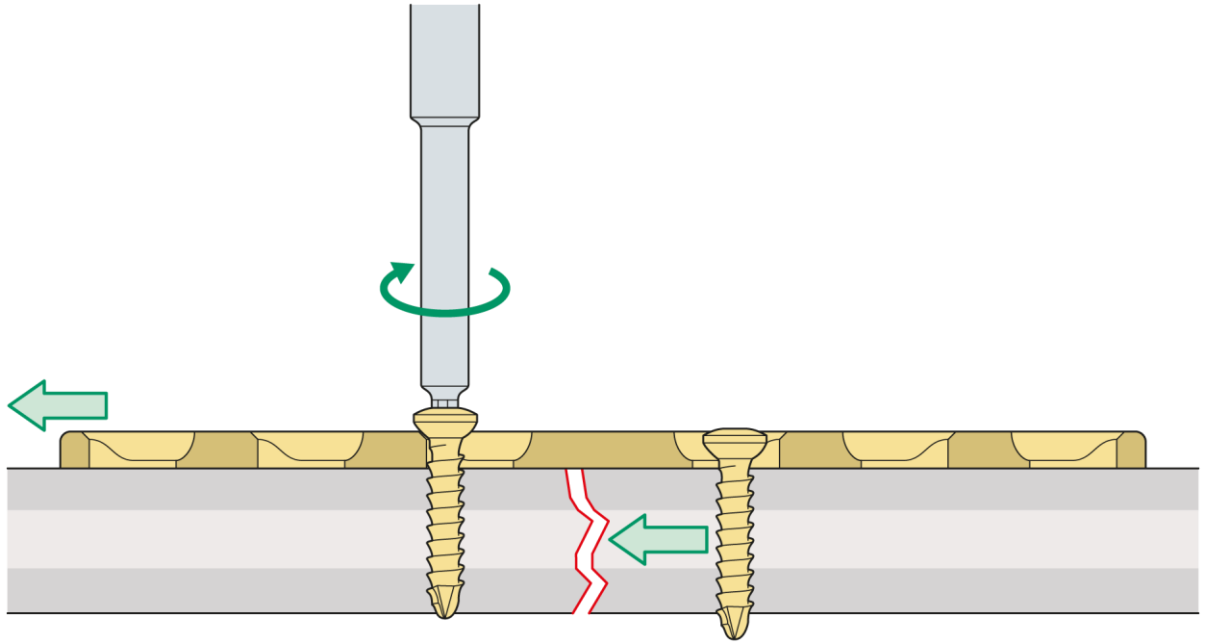
- Any screw can function as a lag screw to provide interfragmentary compression if it is inserted properly



Axial compression with a plate

Dynamic compression holes allow axial compression through the plate

- Transverse fractures
- Lag screw not possible
- Requires anatomical reduction



Clinical indications for absolute stability

- Articular fractures
- Simple diaphyseal fractures, especially in forearm
- Some simple (Type A) metaphyseal fractures
- Osteotomies
- Utmost care for the vascularity of soft tissues, periosteum, and bone

Definition of relative stability

- There is some motion between fracture fragments
- Motion must be below the limits of tolerance of healing bone tissue
- Best methods to produce relative stability include some type of extramedullary or intramedullary splint
- Bones that heal by relative stability → callus formation

Complex fractures

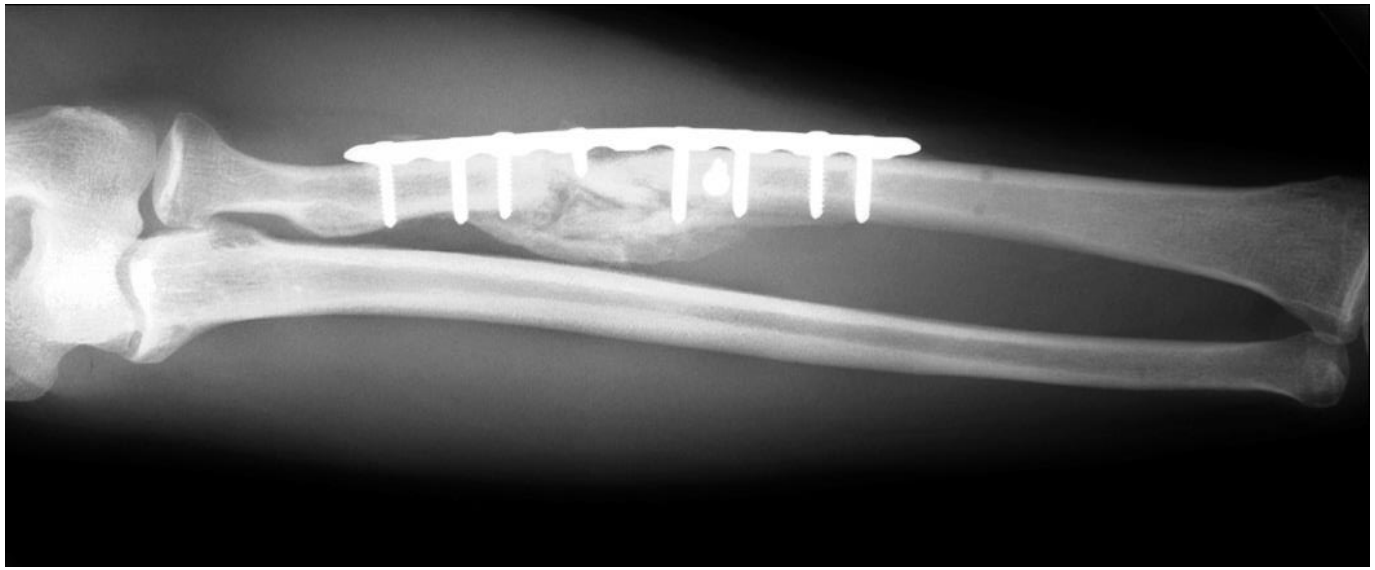
- Cannot be reduced anatomically
  - Without damaging blood supply
- Needs anatomical **alignment**
- Best done with indirect reduction techniques
- Needs only **relative stability**
- Heals with callus formation

Types of stability required

- Multifragmentary fractures can tolerate more motion between the many displaced fragments
- Require indirect reduction and only **relative stability**

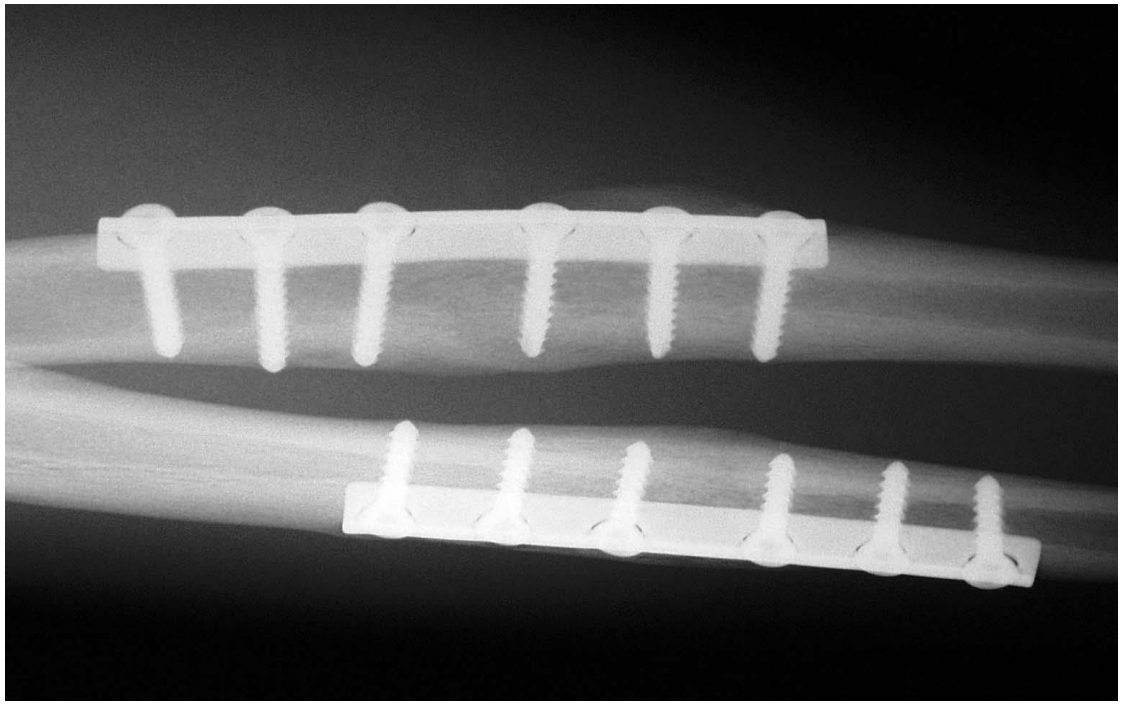
Multifragmentary fractures

- Tolerate more motion between the fracture fragments
- Overall motion is shared by several fracture planes, which reduces tissue strain or fracture and deformation at the fracture gap
- Flexible fixation can stimulate callus formation thereby accelerating fracture healing



Relationship between fracture and stability

- The closer the fracture fragments, the more stability is needed to prevent disruption of healing granulation tissue
- Anatomically reduced fractures require **absolute stability**



Clinical indications for relative stability

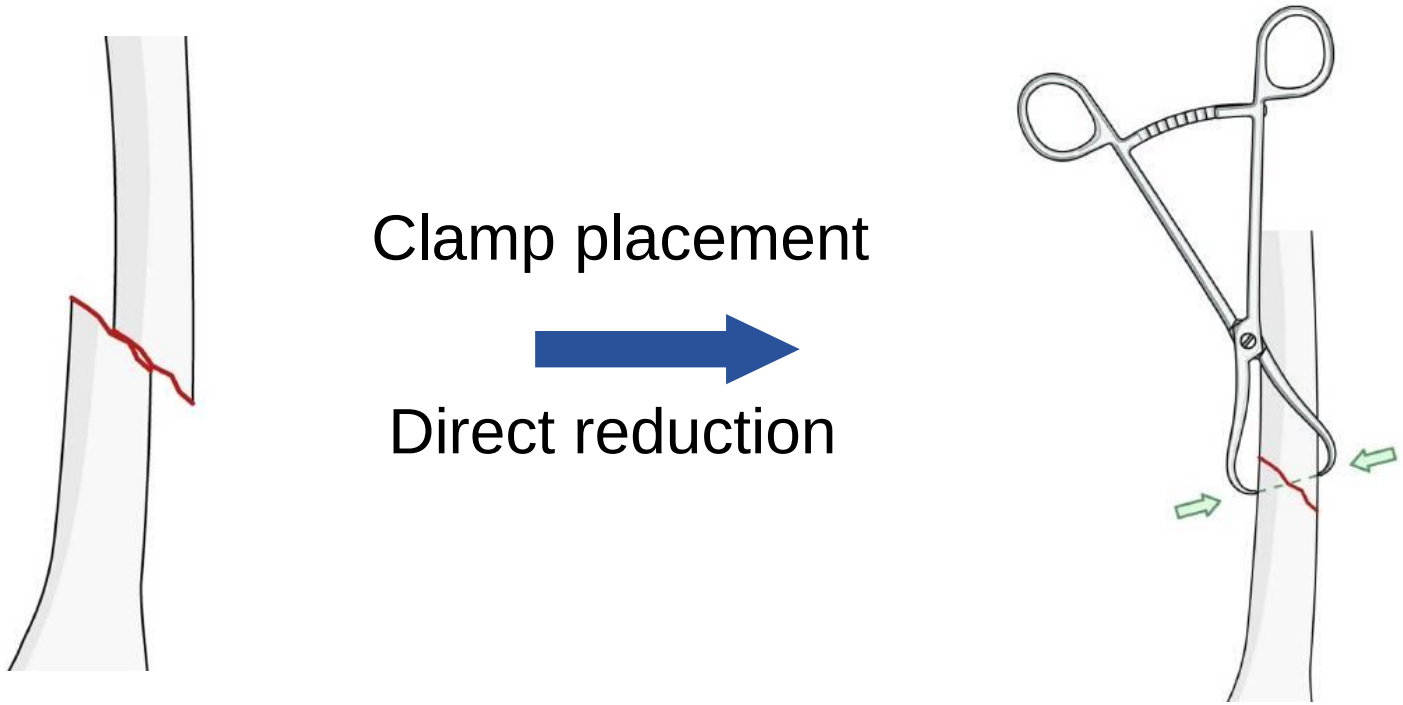
Any non-articular, multifragmentary fracture

Reduction

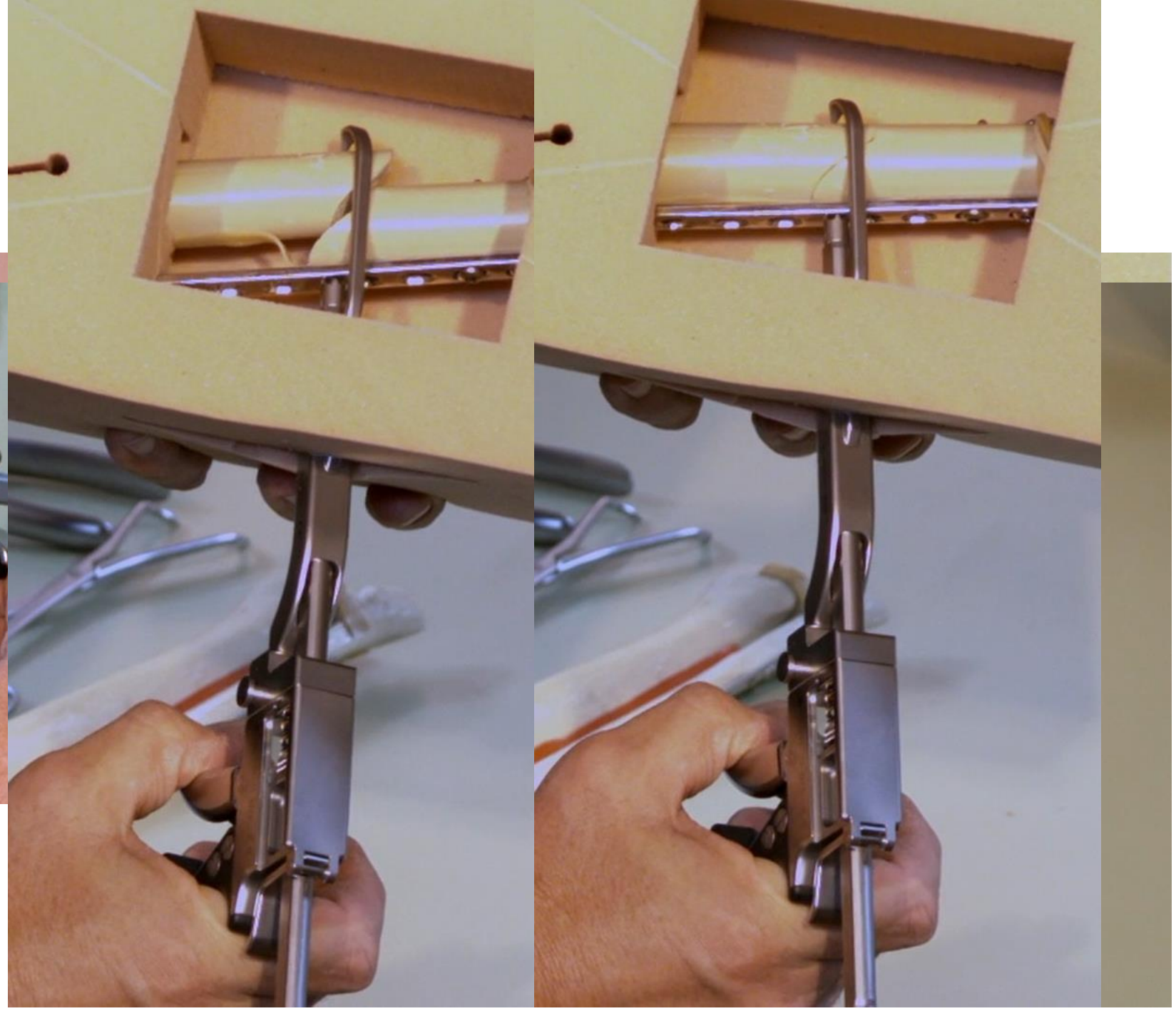
- The action of returning the affected part of the body to its normal position
- A critical step in fracture care
- Think about it during preoperative planning

Direct reduction:

- Fragment exposure and direct fragment manipulation to achieve reduction
- Reduction visually assessed at the fracture line

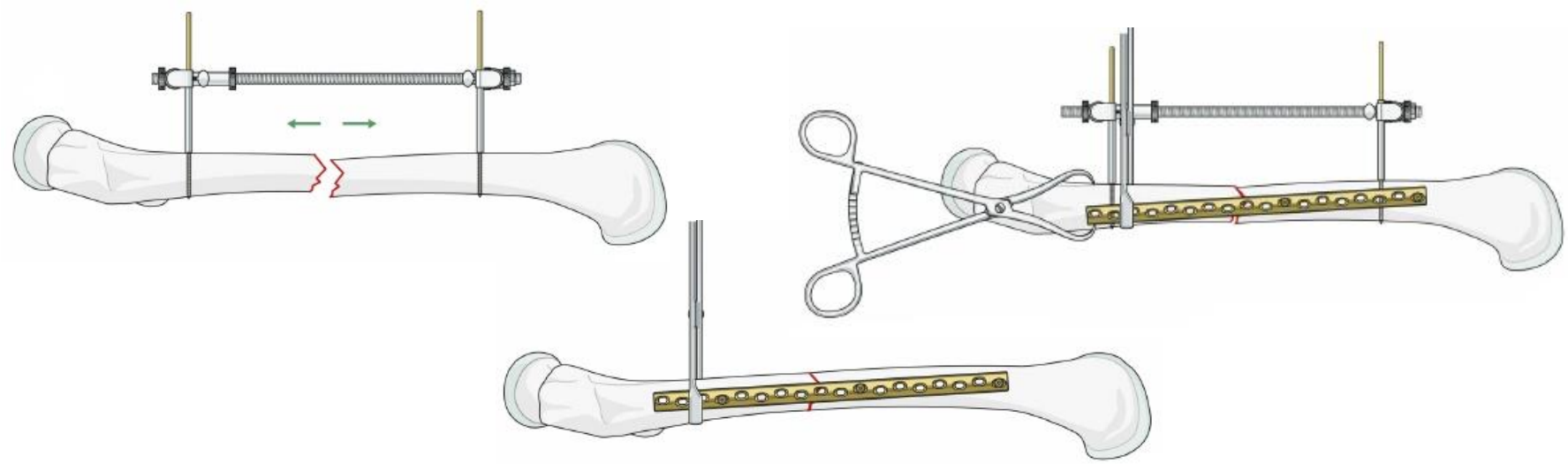


Tools

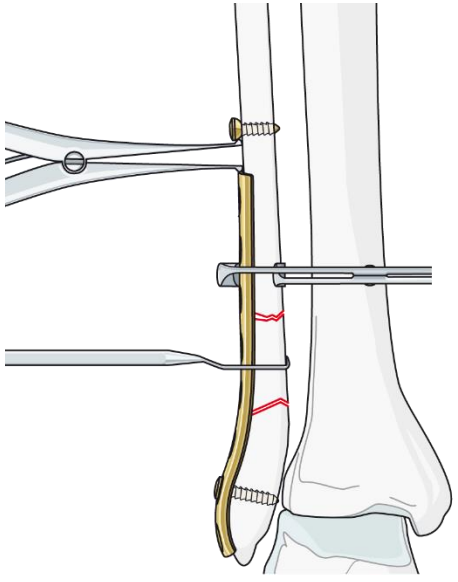


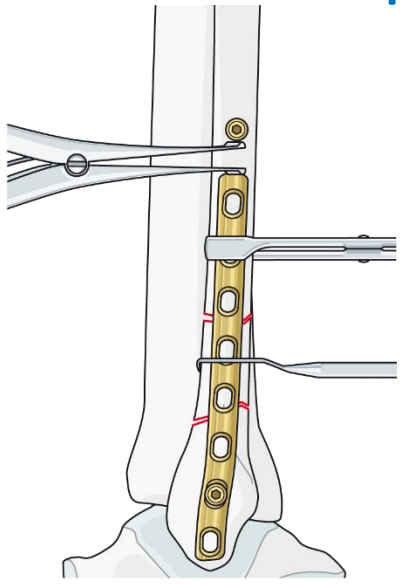
Indirect reduction:

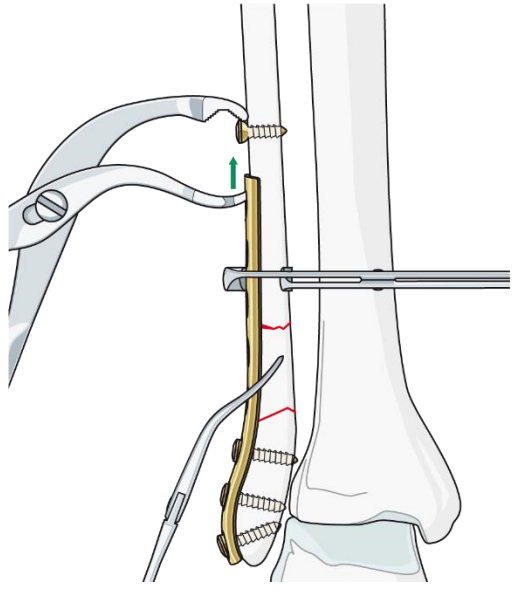
- Blind reposition of fragments
- Performed without direct fragment manipulation
- Open, closed, or percutaneously
- Reduction assessed by imaging or anatomical relationships

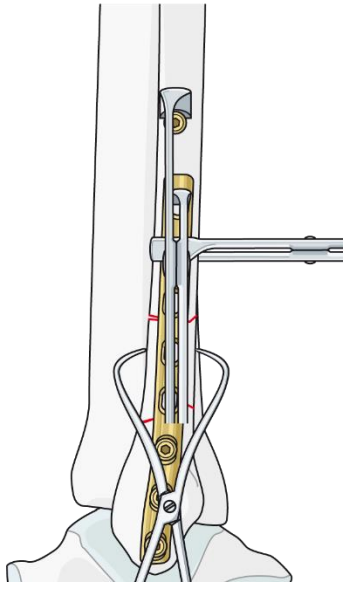


Indirect reduction techniques









Problem

$$\text{Quality of reduction} \quad \alpha \quad \frac{1}{\text{Maintenance of blood supply}}$$

Indications for direct reduction

- Articular fractures

- Simple configuration fractures

Indications for indirect reduction

- Extraarticular multifragmentary fractures
- Metaphyseal or diaphyseal fractures with soft tissues compromised and concerns for the potential of skin healing:
  - Systemic disease
  - Soft-tissue injury

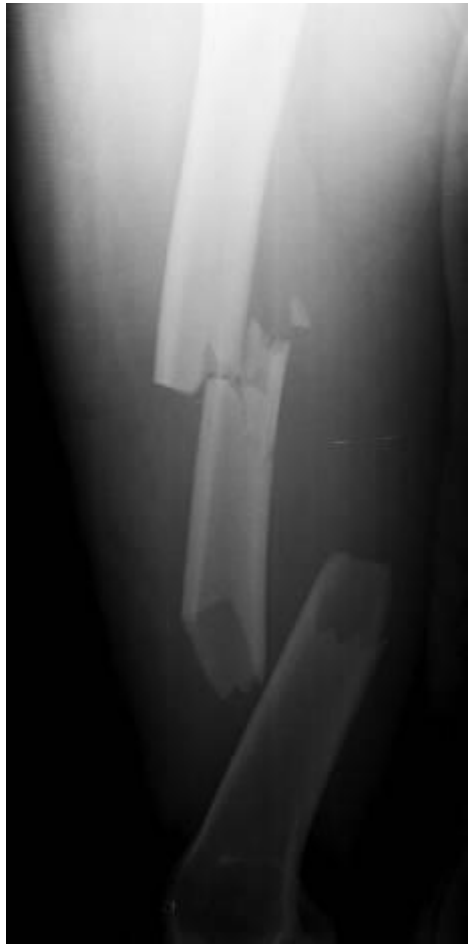
Direct reduction—incision and exposure

- Long incisions to minimize tension on soft tissues
- Full fasciocutaneous flaps—avoid skin flaps and retraction
- Leave periosteum intact
- Work inside and through fracture lines
- Minimize soft-tissue stripping of fracture fragments

Indirect reduction—incision and exposure

- First reduction:
  - Traction (manual, external fixation, distractor, fracture table)
  - Bumps, mallets, joysticks
  - Implant as reduction aid

- Knowledge of surgical anatomy:
  - Work through soft-tissue windows

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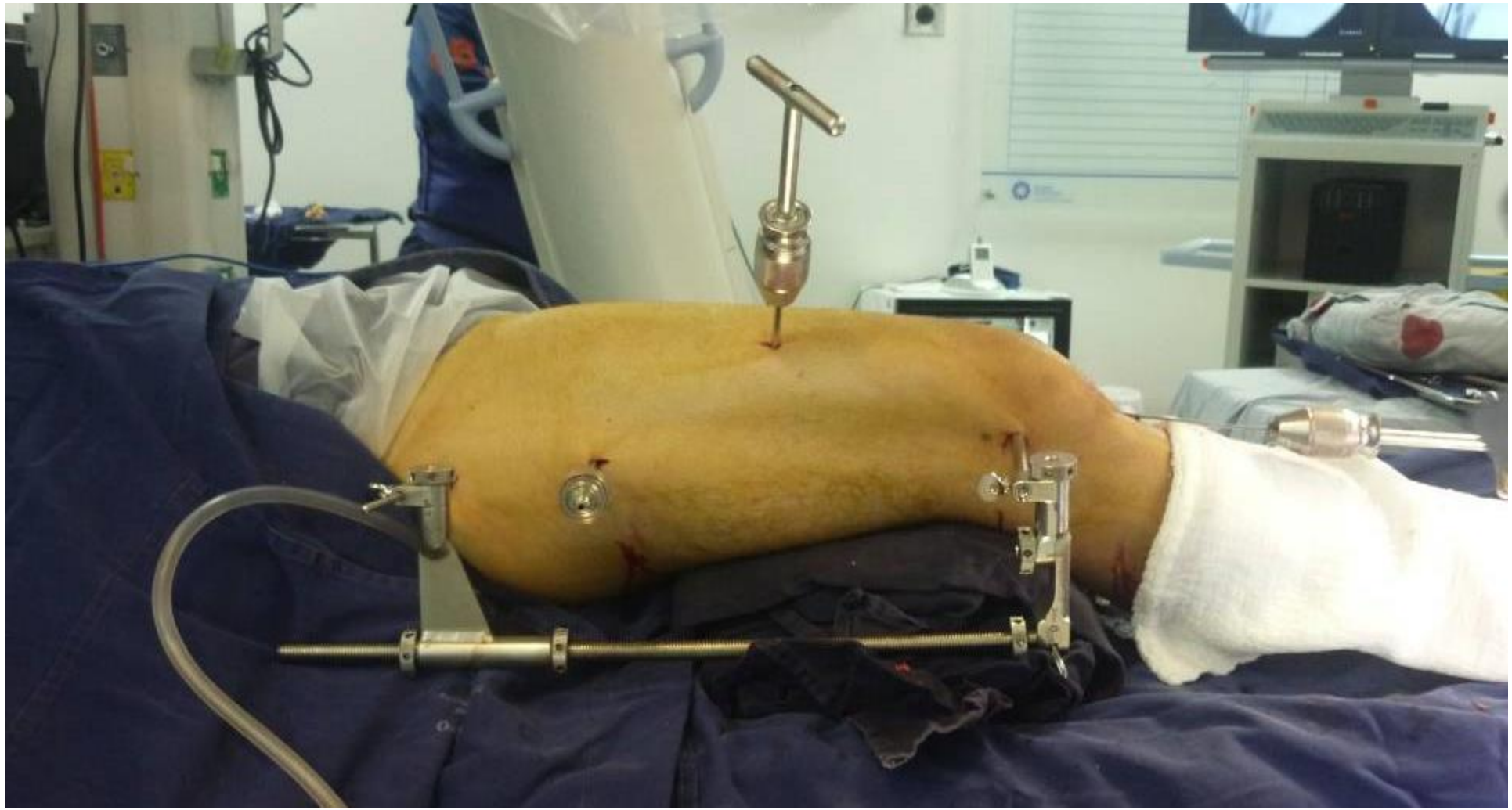


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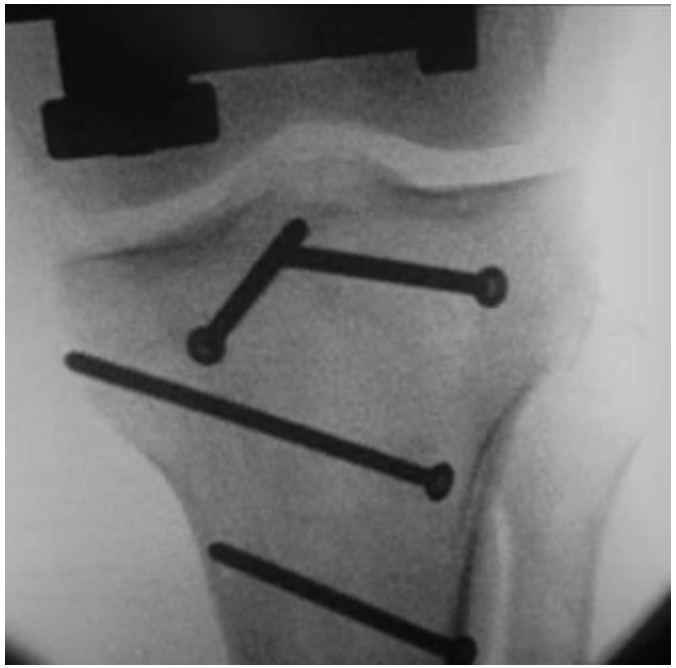

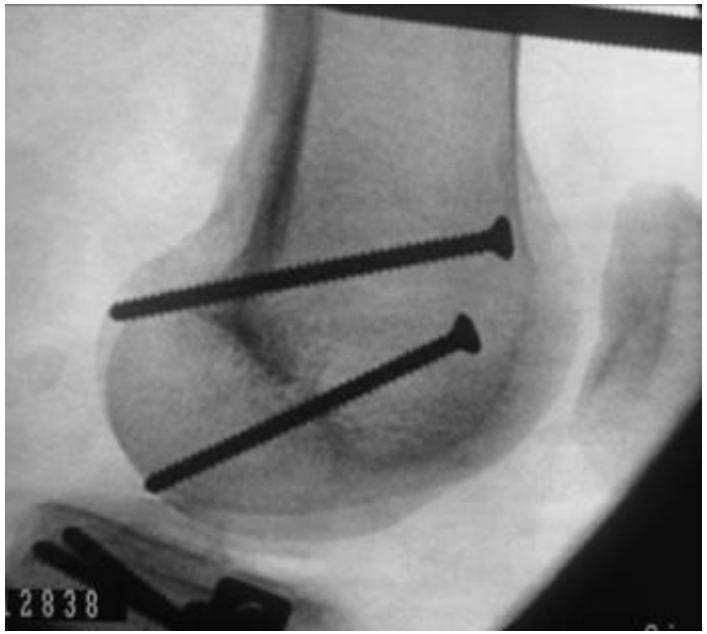
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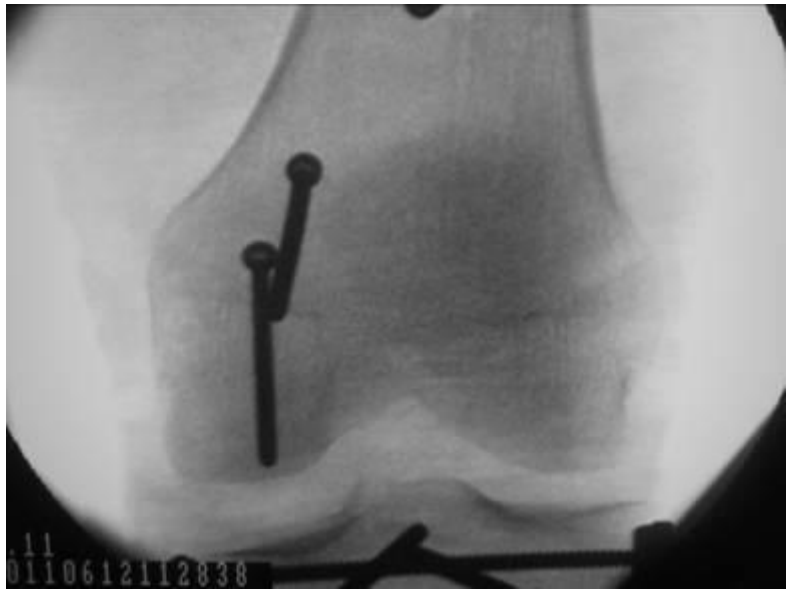
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Indirect reduction of metadiaphyseal part


I34

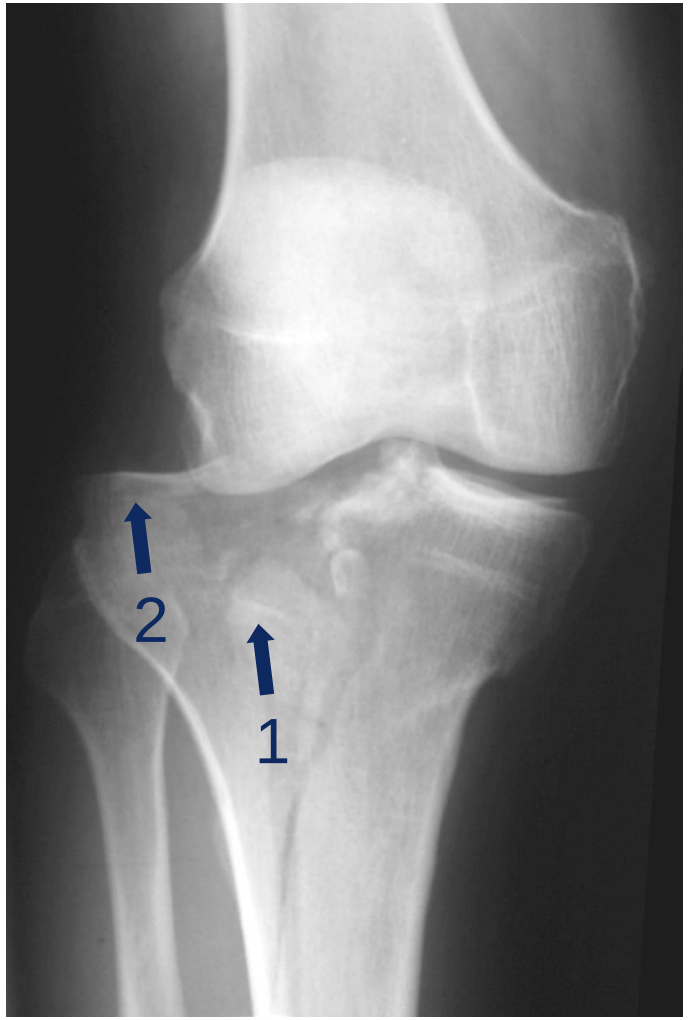

I34


EXIT


I44


CJ


R
MO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A

B


a
b
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Take-home messages

- Absolute stability→ no motion between fracture fragments
- Best by interfragmentary compression (lag screw technique)
- Indicated for articular fractures and simple diaphyseal fractures
- Direct bone healing with no callus

Take-home messages

- Relative stability→ small amount of motion between fracture fragments
- Indicated for all non-articular multifragmentary fractures
- A small amount of interface with motion will stimulate callous formation and accelerate bone healing
- Common methods for relative stability include traction, casting, external fixation, internal fixation, bridge plating, and intramedullary nails

Take-home messages

- Direct reduction→ Fragment exposure and direct manipulation of fracture fragments:
  - Articular fractures
  - Simple configuration fractures
- Indirect Reduction→Use of tools or implants without direct manipulation of fracture fragments
- Indicted for extraarticular multifragmentary fractures
- Possibilities for technique are limitless
- Same techniques can be used for Both

Solution: understand two things

1. Part of the bone broken
   - Epiphysis: anatomical reduction
   - Metaphysis and diaphysis: functional reduction
2. Strain theory
   - Simple fractures:
     - Absolute stability
     - Anatomical reduction
   - Complex fractures:
     - Relative stability
     - Functional reduction