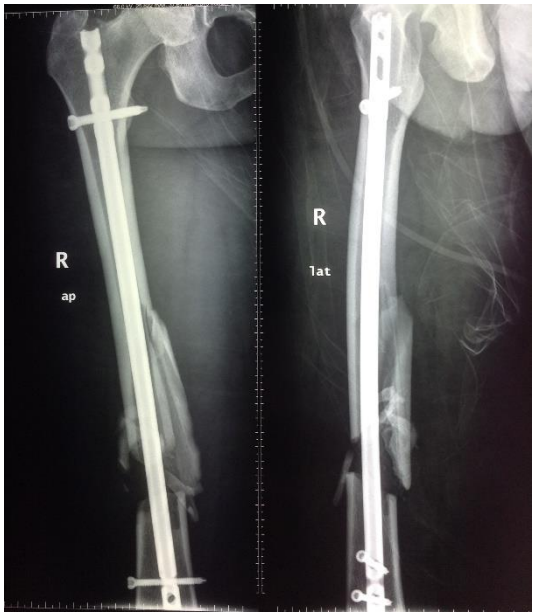
Relative stability: biomechanics, techniques, and fracture healing



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Learning outcomes

- Define relative stability
- Describe the biological behavior of fractured bone
- Define indication for relative stability
- Explain techniques for achieving relative stability

How stability affects healing?

Fracture fixation alters the biology of fracture healing

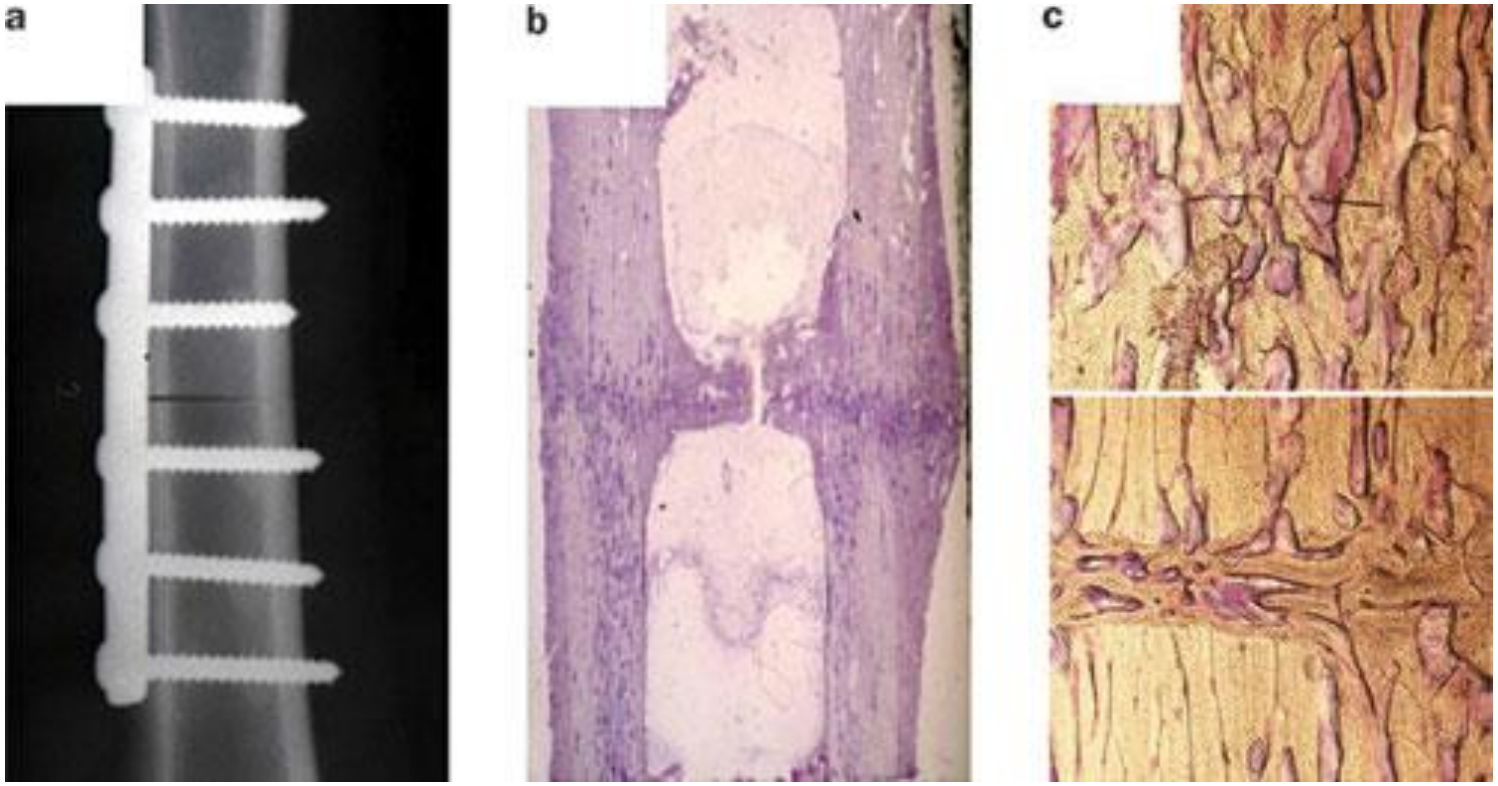
Bone healing depends on:

- **Type of fracture** (simple or complex)
- **Type of reduction** (anatomical or alignment)
- **Type of stability achieved** (absolute or relative)
- **Type of implant** (rigid or flexible)

Definition of absolute stability

- No **motion** between fracture fragments
- **Cortical contact** but no tolerance of fracture gap
- Best methods **lag screw or compression plate**
- Healing through osteonal **cutting cones**

Primary diaphyseal bone healing in a sheep metatarsal osteotomy model

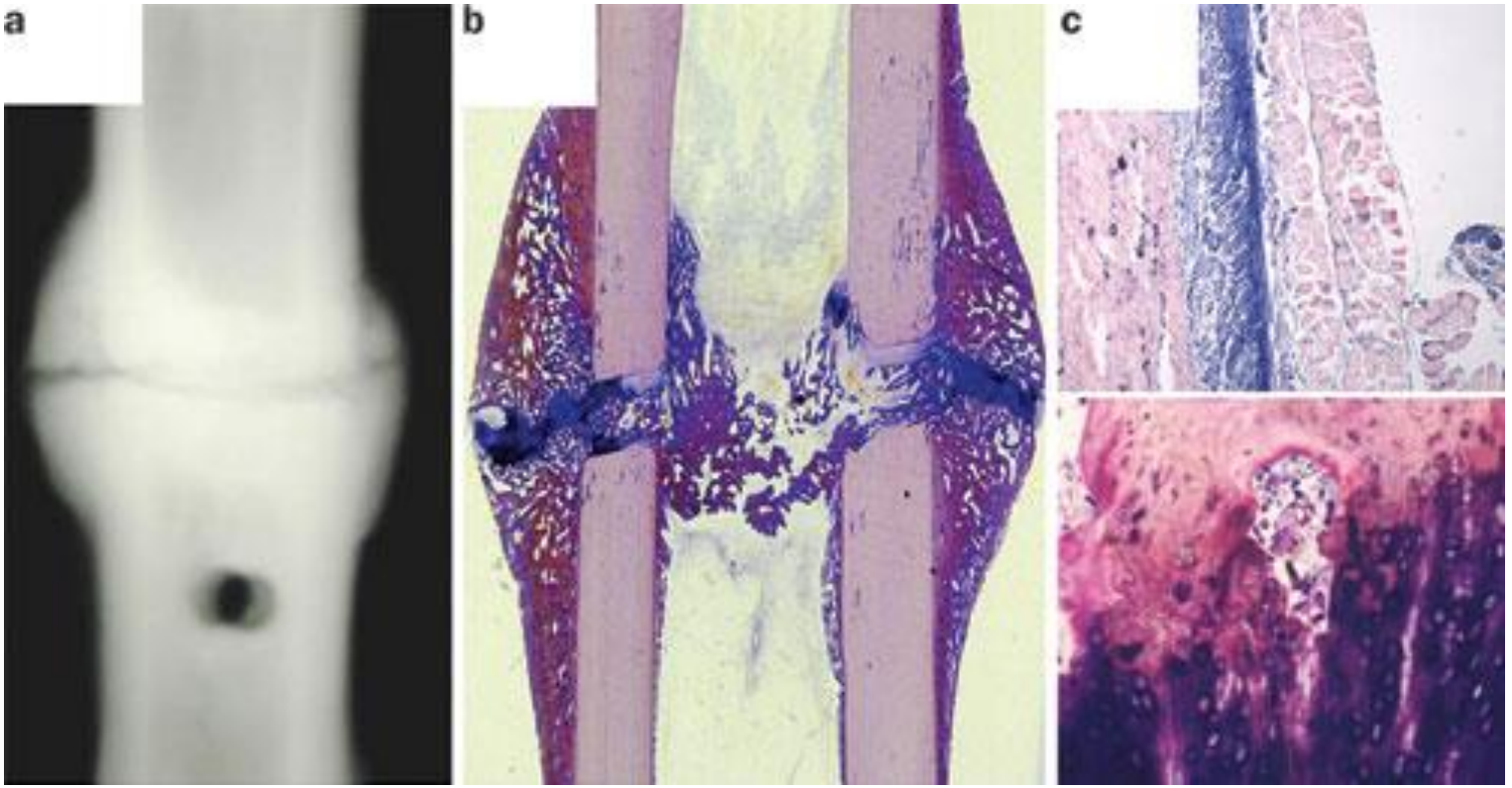


Claes, L. *et al.* (2012) Fracture healing under healthy and inflammatory conditions *Nat. Rev. Rheumatol.* doi:10.1038/nrrheum.2012.1

Definition of relative stability

- Some **motion** between fracture fragments
- Must be **below the limits of tolerance** of healing
- Best methods **extra- or intra-medullary** splint
- Healing is characterized by **callus formation**

Secondary diaphyseal bone healing in a sheep tibia osteotomy model



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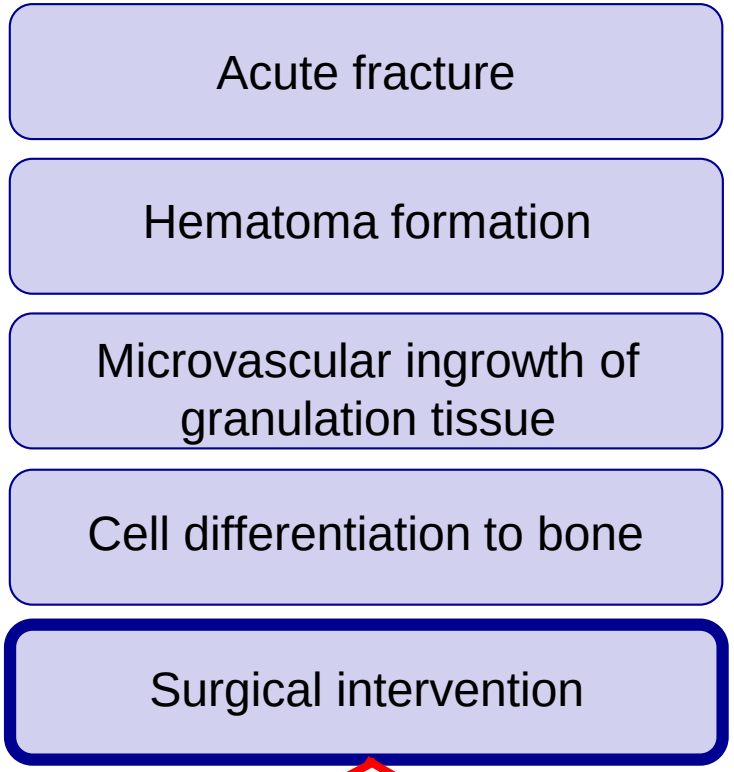
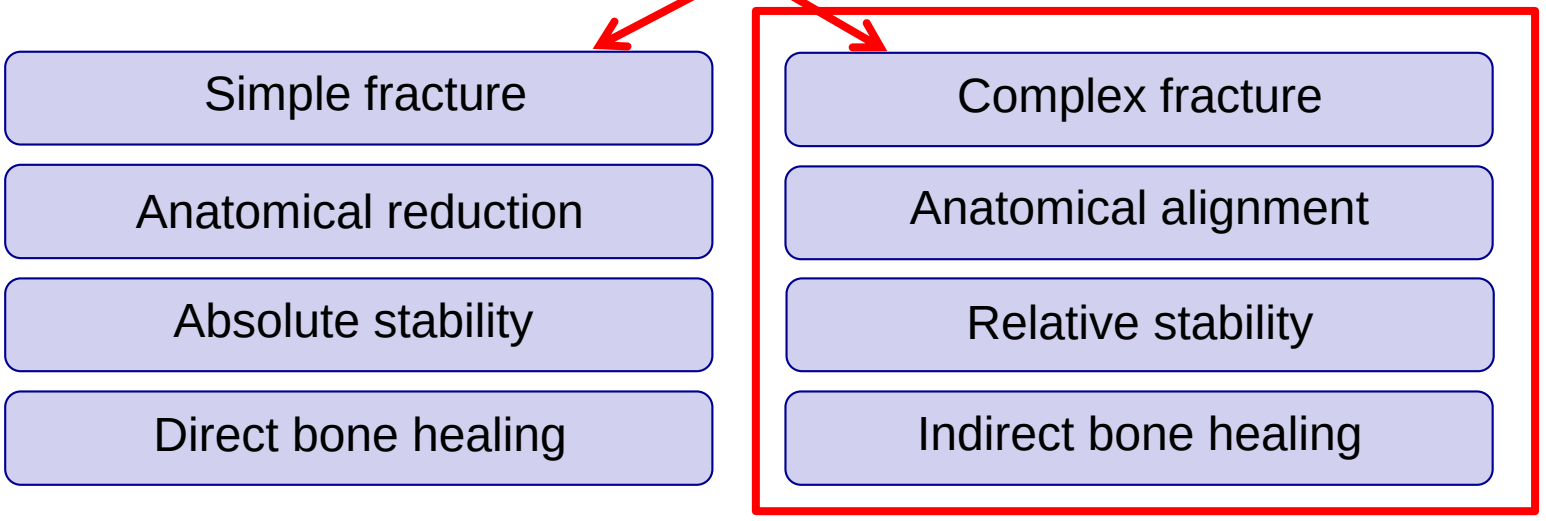
Cascade of events in fracture healing



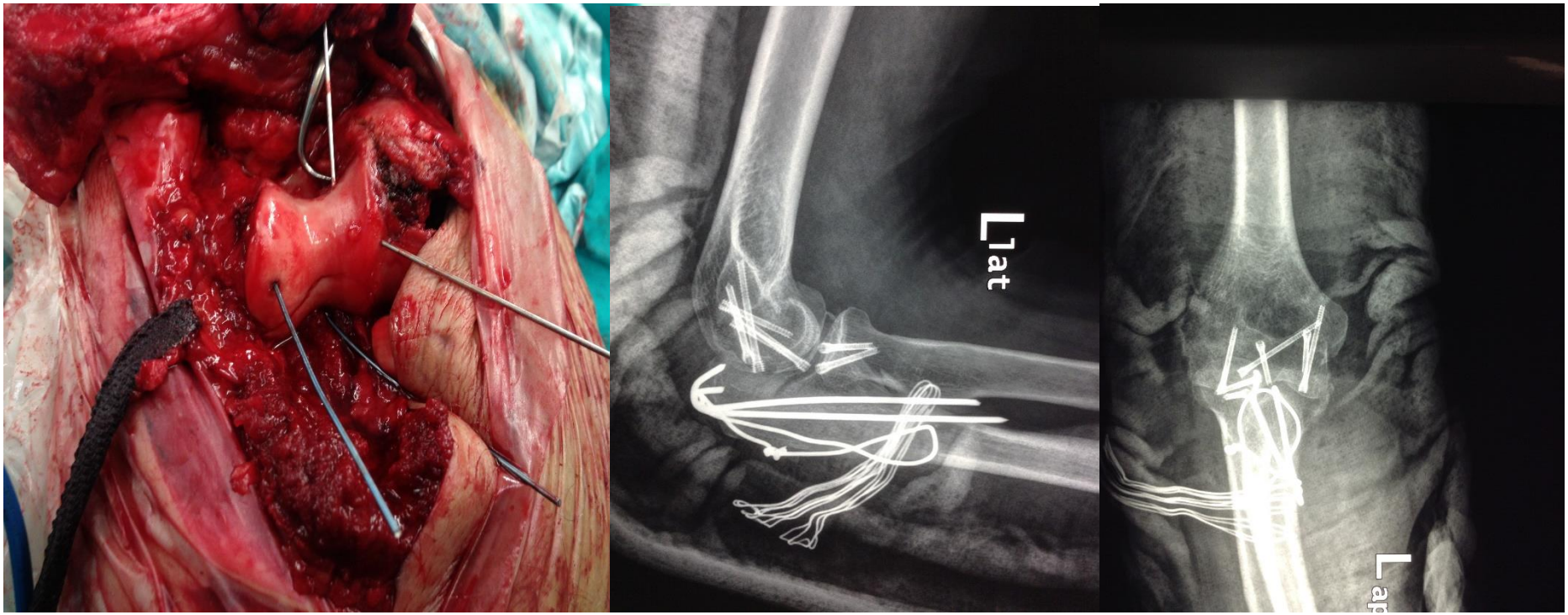
Type of healing depends on:

- Type of fracture
- Type of reduction
- Stability needed
- Implant chosen



Articular fractures

Anatomical reduction and interfragmentary compression

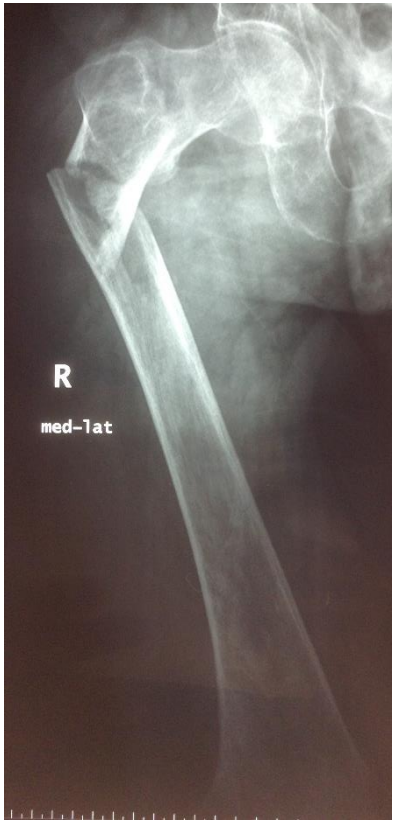


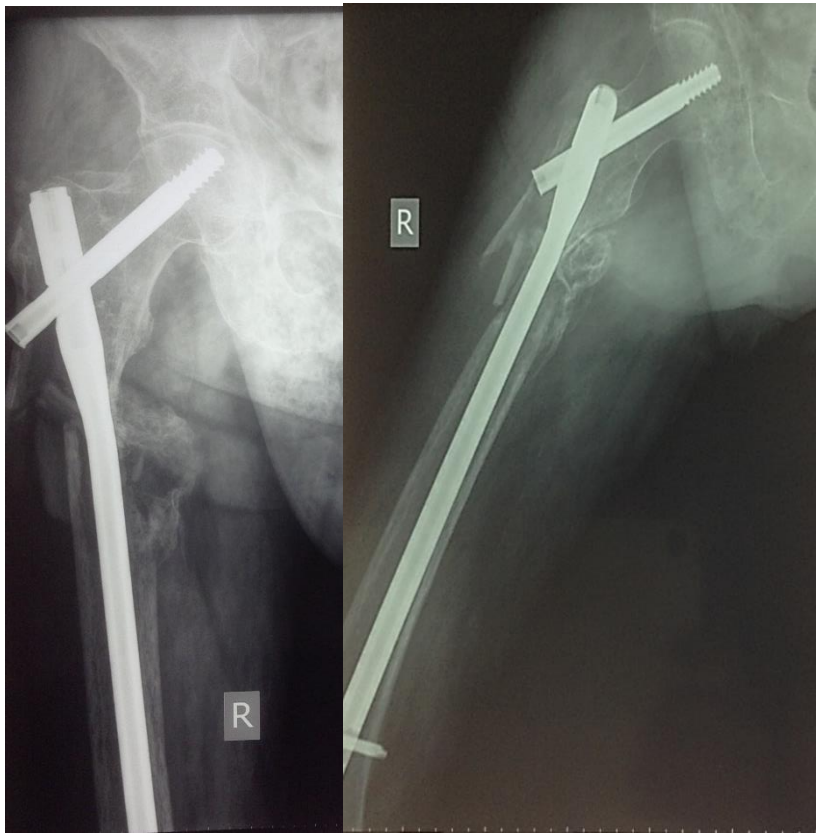
Simple fractures

Rigid fixation with the AO principles of compression plating

Multifragmentary fractures

Tolerate more motion between fracture fragments = motion is shared by **several fracture planes**, which reduces tissue strain at the fracture gap





Flexible fixation can stimulate callus formation

Complex fractures

- Cannot be reduced anatomical, without damaging blood supply
- Needs anatomical **alignment**
- Best done with indirect reduction techniques
- Needs only **relative stability**
- Heals with callus formation
- The articular portion needs anatomical reduction

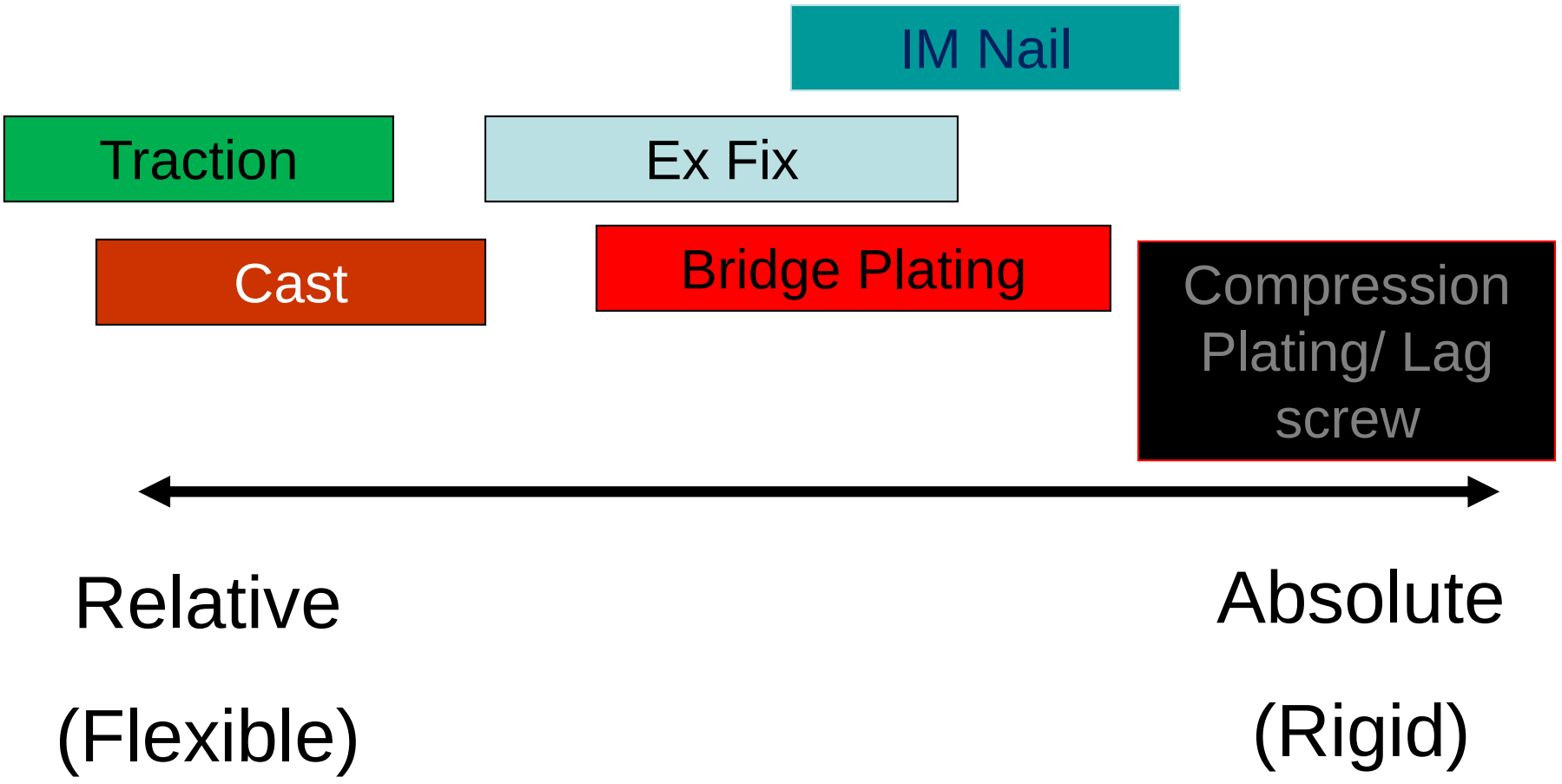
Clinical indications for relative stability

- Any non-articular, multifragmentary fracture

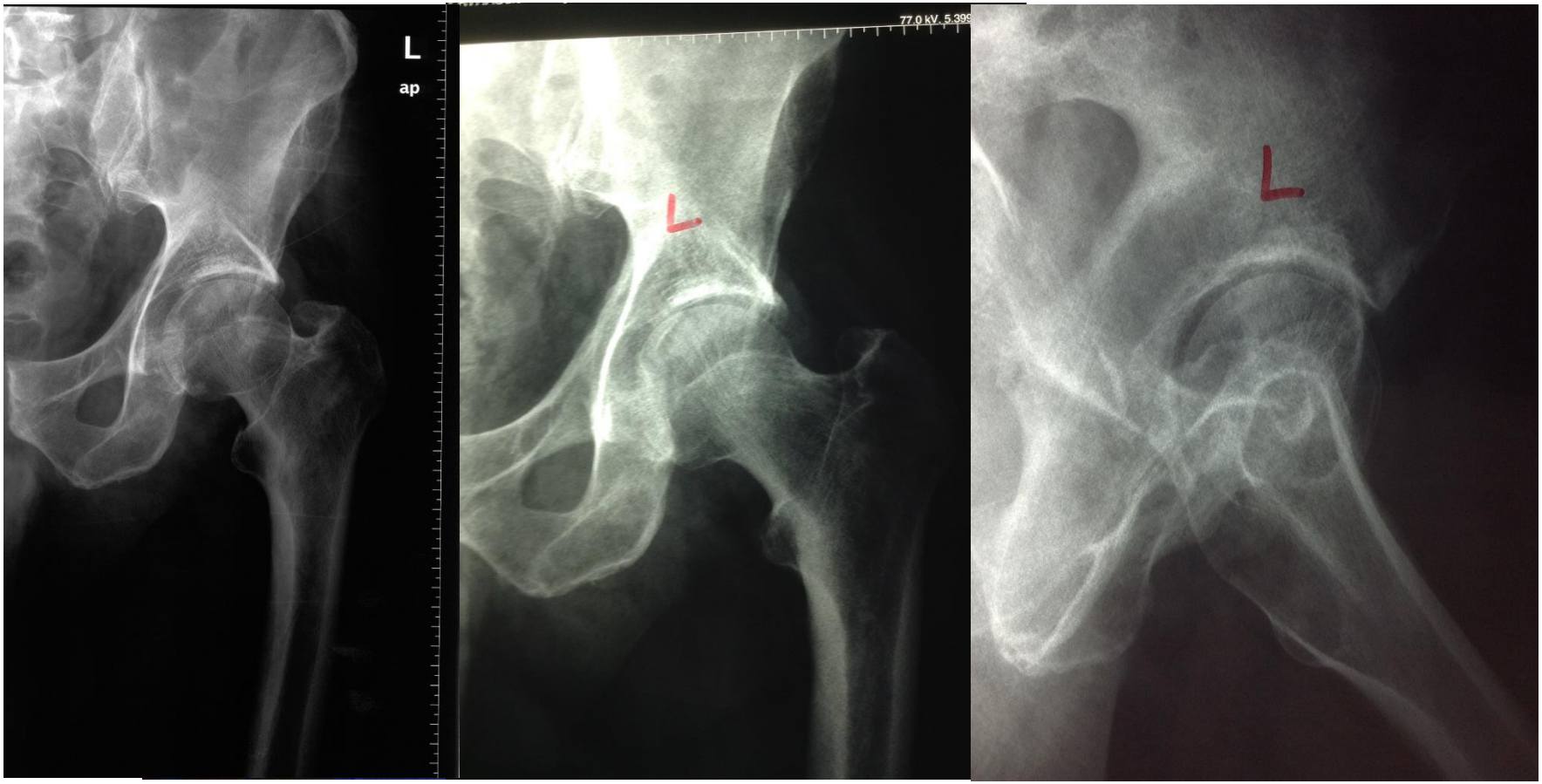
Methods to produce relative stability

- Traction
- Casts
- External fixation
- Internal fixators (fixed-angle devices)
- Intramedullary nailing
- Bridge plating

Spectrum of Stability



Traction



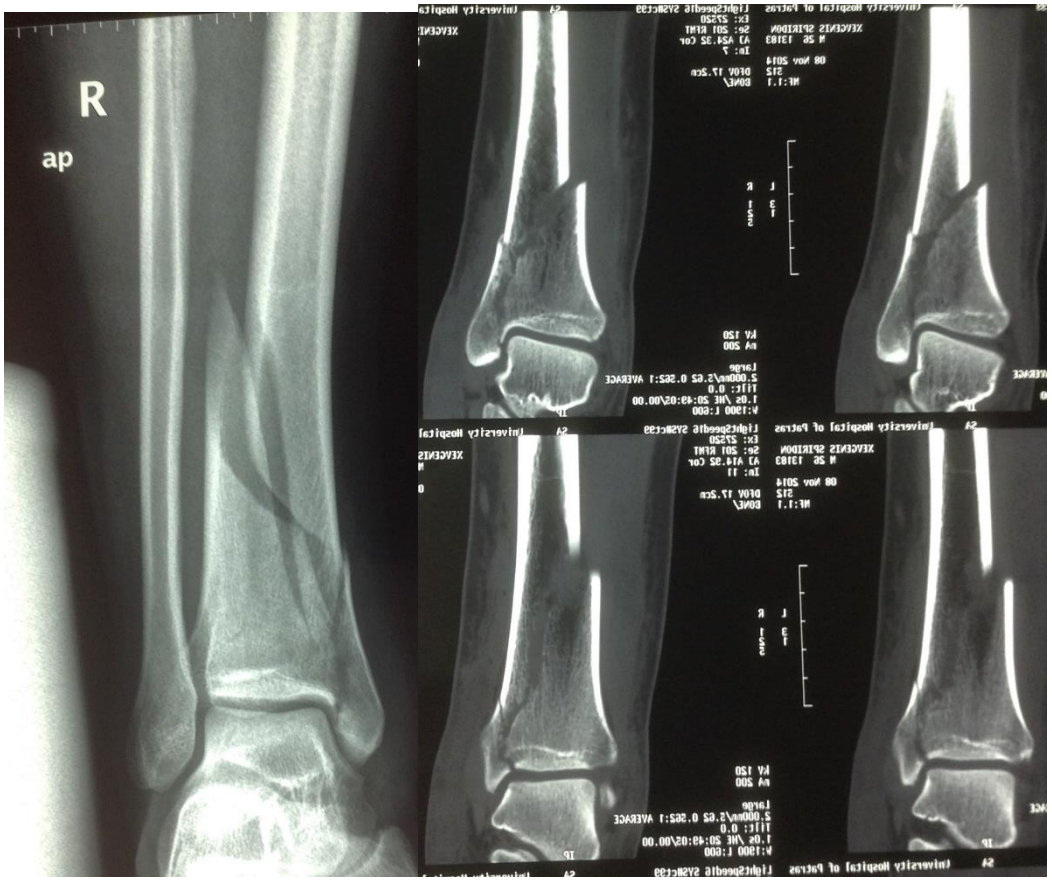
Casting

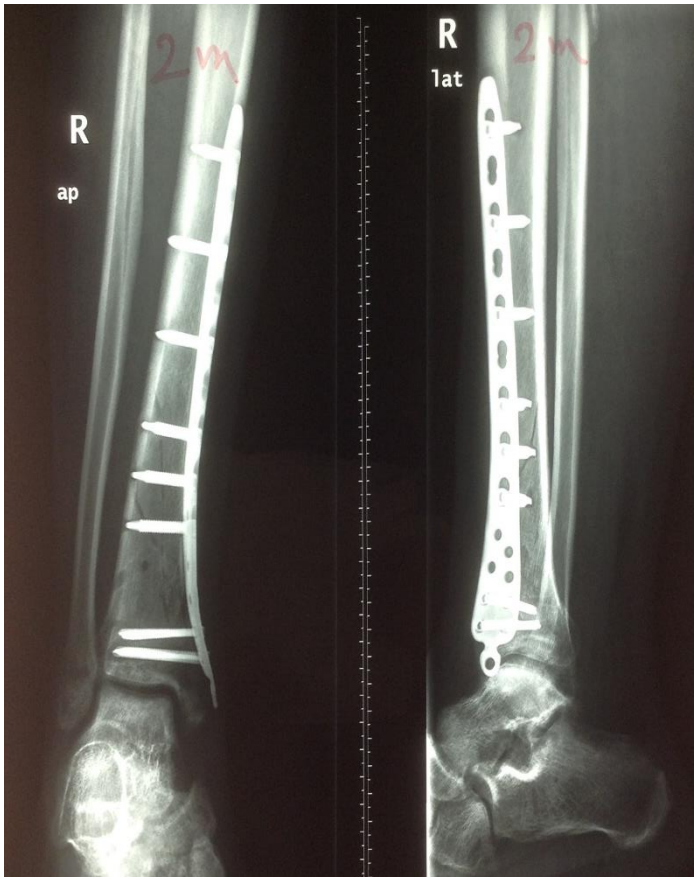
3 weeks

12 weeks

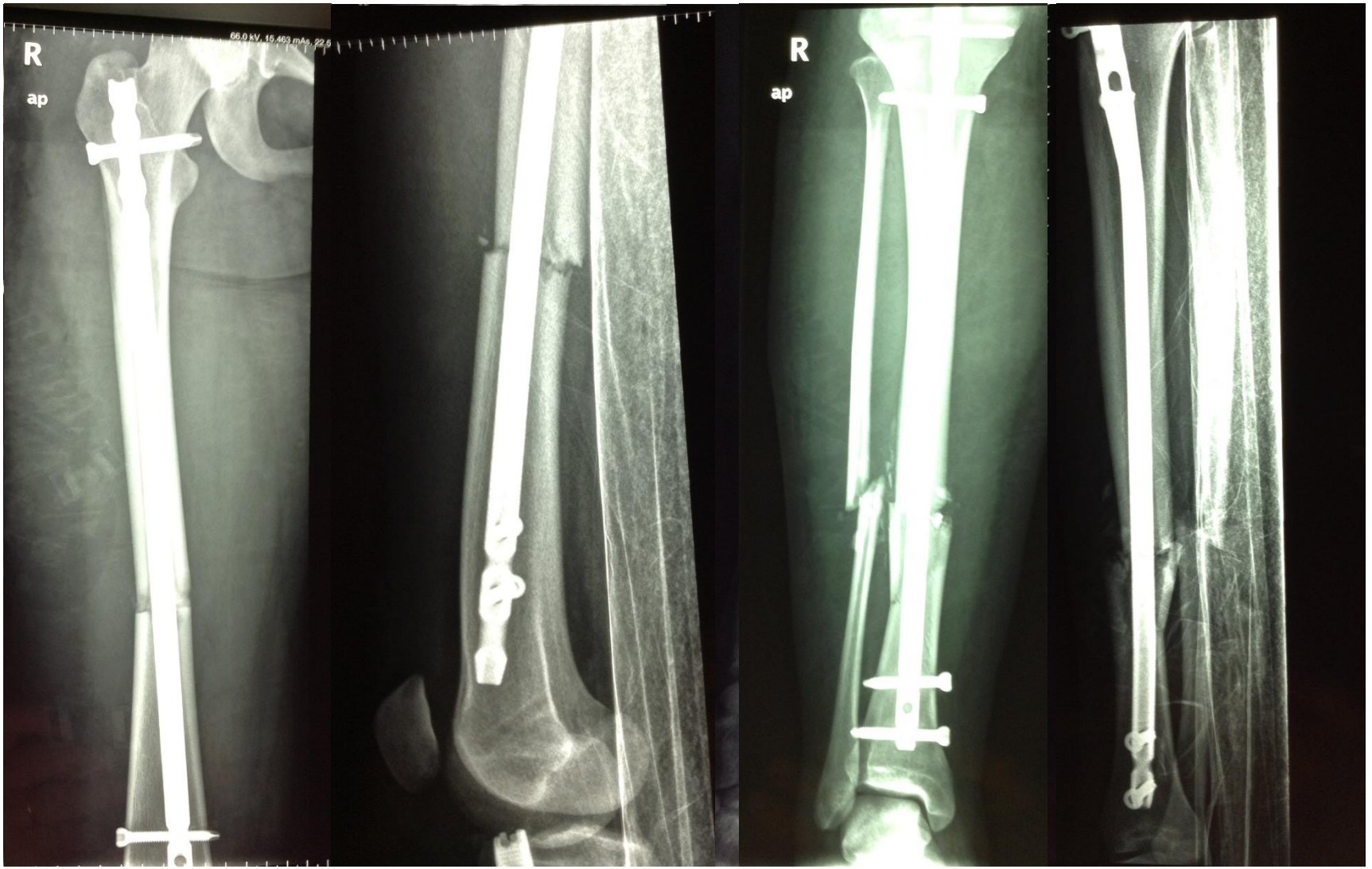
External fixation

Internal fixators





Intramedullary nailing



Bridge plating

Indirect bone healing with callus

Take-home messages

- Relative stability indicates that there is a small amount of motion between fracture fragments
- Clinical indication for applying implants for relative stability include 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