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

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

Acute fracture
Hematoma formation
Microvascular ingrowth of granulation tissue
Cell differentiation to bone
Surgical intervention

Type of healing depends on:
- Type of fracture
- Type of reduction
- Stability needed
- Implant chosen

Simple fracture
- Anatomical reduction
- Absolute stability
- Direct bone healing

Complex fracture
- Anatomical alignment
- Relative stability
- Indirect bone healing
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

Relative (Flexible)

Traction
Cast
Ex Fix
Bridge Plating

Absolute (Rigid)

IM Nail
Compression Plating/ Lag screw
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