Biomechanics of Fracture fixation

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Calcaneal Traction!
Goals of fracture fixation

- Restore length and alignment
- Decrease pain
- Assist rehabilitation
- Fracture union
- Prevent complications
Fixation not necessary!
Deformity
Restore length and alignment
Decrease pain
Articular fracture – accurate reduction
Non articular - length and alignment
Assist rehabilitation
Assist rehabilitation - Mobilize
Assist rehabilitation –
Restore joint function
Fracture union - Loss of fixation
Fracture nonunion
Prevent Complications
Interplay
Biological/Mechanical

- Interference with healing during implant insertion
- Stiffness of implant alters strain at fracture site
- Failure of implant
“Race between fracture repair and implant failure”
Three major fracture fixation devices

Plates and screws
IM Nails
External fixators
Plates and screws

- Versatile
- Serve many mechanical functions
- Articular fractures
- Forearm fractures
Compression –
Screws alone
Compression screws – Neutralization plate
Buttress plate
Buttress plate
Neutralization plate
Compression plate –
Articular fractures
Plates and screws – articular fracture fixation
Problem – high bending forces
New Innovations - Locking plates
New Innovations

Ca Phosphate cement as an aid to internal fixation of the proximal humerus
Plates and screws – disadvantages

- Invasive technique
- Higher bending moment than nails
- Complications
- Load bearing
Complications
IM Nails

- Long Bones of the lower extremity
- Best mechanically and biologically
- Closed technique and locking were big advances
- Suited only to certain locations (least versatile)
Compared to plates
Indirect technique
Compared to plates decreased bending moment
Compared to plates
Wide healing
- Closed technique
- Span the whole bone
- Locking
- Heal with broad callus
Problems near The end of The bone
Not well
Suited to
Some bones
External fixators

- Versatile
- Serve many mechanical functions
- Open fractures and fractures with bad soft tissue injury
- Mechanically diverse
Types of external fixators

- Simple pin fixator
- Clamp pin fixator
- Ring fixator
- Combination fixator
Pin Fixator
Clamp fixator
Ring/Wire Fixator
Combination fixators
Combination fixators
Initial Pin Fixator
Changed to a ring wire fixator
Fixators are versatile

Distraction
Compression
Neutralization
BIFOCAL TREATMENTS

Bone Transport
Distraction Osteogenesis
Combination with other methods
Combination with other methods
Change the mechanical environment during treatment – “Dynamic Frame”
Fixators for temporary treatment
Fixators for Soft tissue Defects
• Serve many functions
• Articulated
External Fixator - Disadvantages

• Mechanical disadvantage
• Pin/soft tissue/bone interface
Mechanical disadvantage and Pin problems
Pin bone problems
Summary -
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Mechanical

Biological