External Fixation for Lower Leg Injuries

Disclosures

- Paid Consultant/Royalties
  - Synthes, Acumed, Citieffe
- Reviewer
  - J Ortho Trauma, Patient Safety in Surgery
- Committees
  - AAOS: College of Surgeons Committee on Trauma (ASCOT)
  - OTA: Health Policy

Objectives

- Principles of External Fixation
- Indications for Ankle External Fixation
- Techniques for Non-Internal Fixation
Basic Frame Application

- The Stable Base Concept
  - Acknowledgement of J. Hutson MD
- Construct Stiffness Modulation
- Pearls of Pin Placement

Frame Application – Stable Base

- Two pins in each segment
- Connect to form “STABLE BASE”
- Reduce fracture, apply third bar

Construct Stability: Pins

- Pin diameter greatest impact ~ (radius)^4
  - 4mm:5mm:6mm ~ 1:3:6

Deflection vs. Pin Diameter

- Graph showing deflection in millimeters against pin diameter in millimeters.
Construct Stability: Pins

- Pin spacing ~ (working length)$^2$

Pin & Wire Technique

- Compartment on stretch
- Pins in antiseptic fluid
- Bicortical pin/wire
- If bad “feel”
  - Change site
  - d/c pin/wire

New Generation Pins

- Power insertion (self drilling/tapping)
  - Facilitate placement and portability
  - Hand placement = more “wobble” \( \rightarrow \) conical hole
  - Thesis: Yves Adrianne, Univ of Brussels, 1993
  - Seitz et al: J Hand Surgery 1991
  - Wilkenheiser et al: J Ortho Research, 1995
Pre-drill & Hand Insertion

Maximal delta temperatures in first and second cortex during pin insertion with 60RPM

~15-30 degree temperature rise

Power Insertion

Maximal delta temperatures in first and second cortex during pin insertion with 300RPM

~5-15 degree temperature rise

Less thermal injury with power insertion!

Why?

• Why does placement by hand generate more heat?
  • TIME IN CONTACT WITH BONE!
Indications for Ankle External Fixation

- Open injuries requiring staged treatment
- Unstable fractures after ORIF
- Soft tissues preventing ORIF
- Definitive treatment of C-Host/osteoporosis
- Protection of Soft-tissues during DCO

Staged Treatment

Grade III- “something”
Unstable after ORIF
70yo Grade III open, 2week s/p ORIF

Revision ORIF with luxation
Use of exfix for stability and soft tissue management

Soft Tissues Needing Time or Care
Soft Tissues Needing Time or Care

Osteoporotic Patients
- 90 yo pilon fracture

Childress Pin: Trans-Calcaneotalotibial
- Harold Childress
  - JBJS 1965
- Very important to use large pin and bend 90 degrees outside of calcaneous!
Childress Pin Done Wrong

Definitive Treatment
When It Just Shouldn’t Be Fixed

- 53 yo male, GLF
- Diabetes, 2 ppd smoking, Renal Failure
- Recent MI and stroke
- Dysvascular skin
- Bilateral pilon ankle variants

- The Classic C-Host

Left and Right Images

Right

Left
Left Intra-operative

Right Intra-operative

Post Exfix Removal
*Not perfect but not infected or amputated*

*Ambulates with ankle brace and cane*

Right  Left
**Protecting Soft Tissues During DCO**

Pressure on heal
Pin close to wound or surgical site
Likelihood of pin loosening and suppuration

No pressure on heal
Pin remote to wound/surgical site
Pin can last over a year

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**Ankle Frames**

- Delta Frame
- Anteromedial tibial pins
- Calcaneal transfixion pin

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**Ankle frames**

- Beware of middle or anterior calcaneal pins!
  - Tornetta J. Ortho Trauma 2004
- Better to use mid foot or talus
- Use 4mm or 3mm pins in MT
Pin Placement-Posterior

- Avoids painful and exudative trans-calcaneal pin
- Better radiographs and pins not near surgical field
- Speaker’s Personal preference

Advantages

- Elevates heel
- Natural dorsiflexion
- Radiographic visualization

Why does posterior pin placement work better?

Micro motion in axis of ankle/pin thread → bone erosion
Posterior pins = perpendicular to thread "cut" direction
New Innovations:
*Single Use Disposable Sets*

- Simpler and cheaper than complex fixators
- No need to reprocess

Images courtesy of Citieffe

Case Example

Take Home Points

- Ankle external fixation has evolved
- The soft tissues guide treatment
- Use “stable base” concept
- Posterior pin placement has advantages
- New technology in pre-packaged less costly kits
Thank You