

External Fixation for Lower Leg Injuries



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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

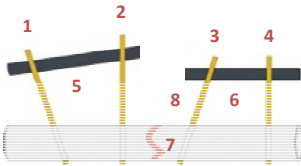
- Principles of External Fixation
- Indications for Ankle External Fixation
- Techniques for Non-Internal Fixation

Basic Frame Application

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

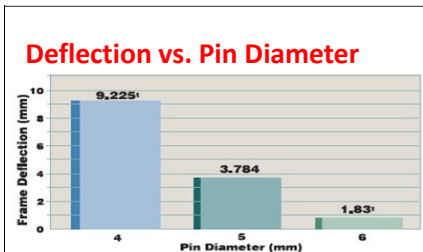
Frame Application – Stable Base

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



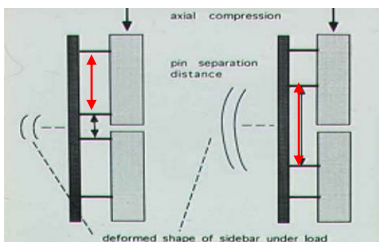
Construct Stability: Pins

- Pin diameter greatest impact $\sim (\text{radius})^4$
 - 4mm:5mm:6mm $\sim 1:3:6$



Construct Stability: Pins

- Pin spacing \sim (working length)²



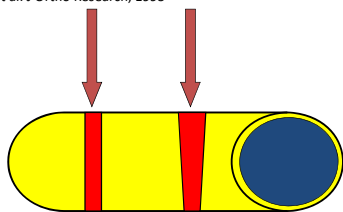
Pin & Wire Technique

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

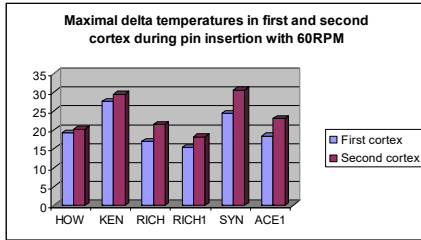


New Generation Pins

- Power insertion (self drilling/tapping)
 - Facilitate placement and portability
 - Hand placement = more "wobble" \rightarrow conical hole
 - Thesis: Yves Adrienne, Univ of Brussels, 1993
 - Seitz et al: J Hand Surgery 1991
 - Wikenheiser et al: J Ortho Research, 1995

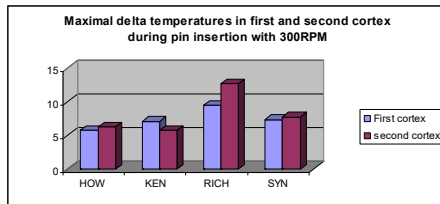


Pre-drill & Hand Insertion



~15-30 degree temperature rise

Power Insertion

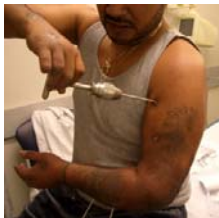


~5-15 degree temperature rise

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

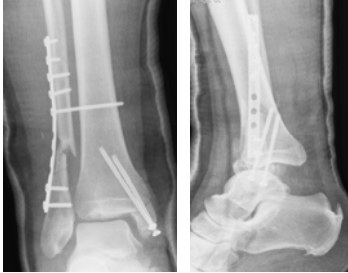


Grade III- "something"



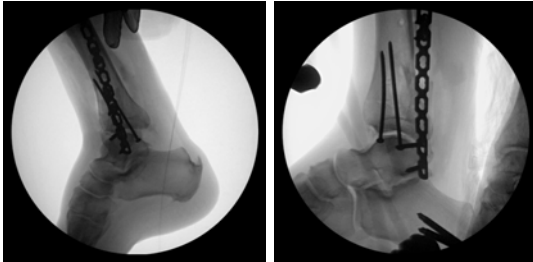
Unstable after ORIF

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



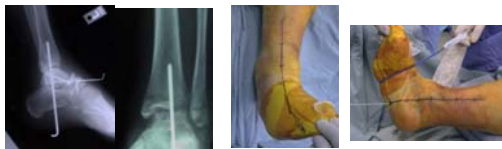
Osteoporotic Patients

- 90 yo pilon fracture



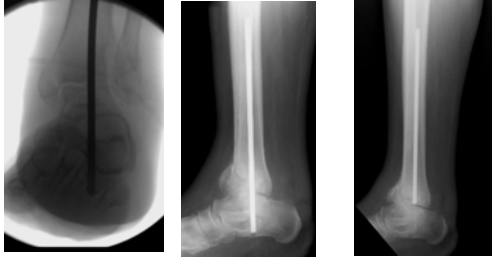
Childress Pin: Trans-Calcaneotalotibial

- Harold Childress
 - JBJS 1965
- Very important to use large pin and bend 90 degrees outside of calcaneus!



Morgan-Jones et al: Vertical transarticular Steinman pin fixation...Ann R Coll Eng 2000
Scocia T, Ziran BH: Use of Vertical Transarticular pin for..... Am J. Ortho 3002

Childress Pin Done Wrong



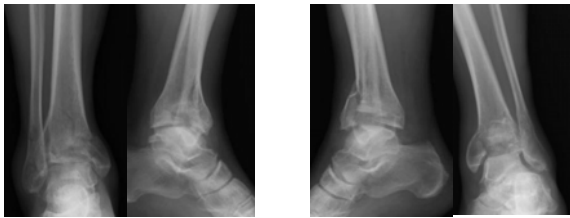
Definitive Treatment

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**

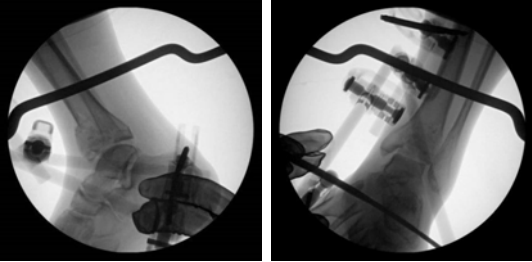
Left and Right Images



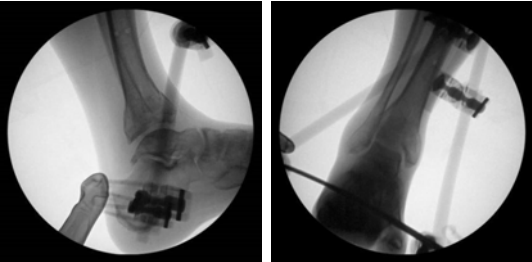
Right

Left

Left Intra-operative

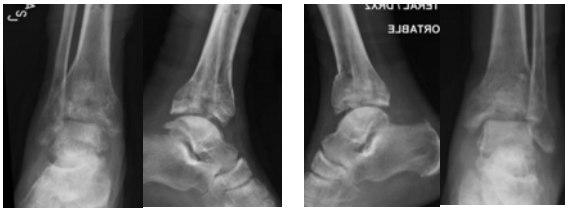


Right Intra-operative



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



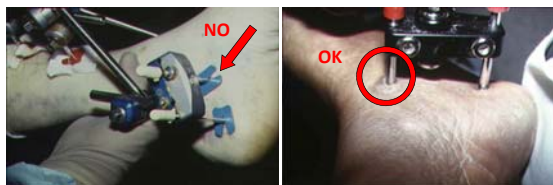
No pressure on heal
Pin remote to wound/surgical site
Pin can last over a year

Ankle Frames

- Delta Frame
- Anteromedial tibial pins
- Calcaneal transfixion pin

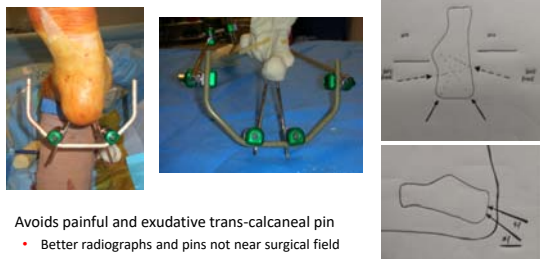


Ankle frames



- 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

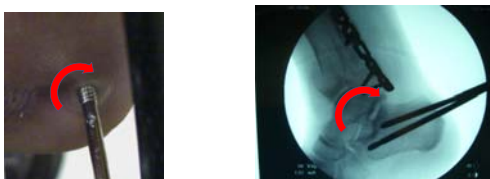
*Ziran BH, Morrison T, Little J, Hileman B.: A new ankle spanning fixator construct for distal tibia fractures: optimizing visualization, minimizing pin problems, and protecting the heel. J Orthop Trauma. 2013
 *DiDomenico LA, Giagnacova A, Cross DJ, Ziran BH: An alternative technique for transosseous calcaneal pinning in external fixation. J Foot Ankle Surg. 2012 Jul-Aug;51(4):528-30

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

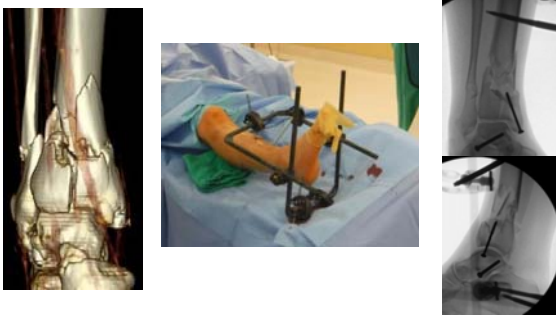
New Innovations:
Single Use Disposable Sets

- 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