Evolving Principles of Foot and Ankle Trauma

Keith D. Cook, DPM, FACFAS
Director, Podiatric Medical Education
University Hospital
Newark, NJ
July 27, 2017
Objectives

- Understand general principles in the treatment of foot and ankle trauma
- Understand the principles of treatment for specific foot and ankle trauma
- Be able to treat the foot and ankle trauma patient
General Principles for Foot & Ankle Trauma Patient

- Comprehensive H&P
- X-ray / CT scan / MRI / Ultrasound
- Closed Reduction
- Compressive dressing and splint
- Conservative vs Surgical Treatment
- Timing of Surgery
  - Emergent, Urgent, Delayed
  - 21 day window
- Psychiatry of Trauma - Treatment
Surgical Intervention

- Anatomy
- > 2mm of fracture displacement
- Angulational deformities
- Soft tissue envelope
- Type of fixation
  - Internal
  - External
- Staged procedures
Compartment Syndrome

**Early Signs:**
- Paralysis (digital weakness)
- Paresthesias
- Pain out of proportion (unrelieved)
- Gross edema
- Mottled dusky skin

**Late Signs:**
- Pallor
- Delayed capillary refill
- Pulselessness
Compartment Syndrome

- **Compartment Pressures:**
  - Lower Leg > 30mmHg
  - Foot 20-25mmHg

- **Differential Pressure = diastolic pressure - intracompartment pressure**
  - + if < 30mmHg

- **Clinical Suspicion!!!!!

- **Decompressional Fasciotomies - 3 incisions**
Compartment Syndrome

- Dermal Fenestration With Negative Pressure Wound Therapy: A Technique For Managing Soft Tissue Injuries Associated With High-Energy Complex foot Fractures
  - JFAS, Jan/Feb 2016

- Pie crusting
5th Metatarsal Fractures
5th Met Base Fractures

Treatment
- Non-WB 4 weeks?
  - How long?
- Cam walker 2 weeks
- Progressive shoe gear and activities
Predictors of outcome of non-displaced fractures of the base of the fifth metatarsal
-International Orthopedics, May 2006

- 38 pts.
- 6 Jones fxs, 32 tuberosity avulsion fxs
- Mean NWB = 17 days, casting = 38 days
- Evaluated symptoms and activity level, Olerud & Molander scoring system, mean f/u 490 days
- 3 Jones, 32 tuberosity fxs radiographic healing
- Most significant predictor of poor functional outcome was NWB: increased discomfort, stiffness, worse global outcome
Are we non-WB 5th met base fractures too long?

- Partial WB, below knee cast is not necessary post-op for 5th met avulsion fractures
  - Archives of Orthopedic and Trauma Surgery, Sept. 2008
- Removable walking boot, crutches x 1 week after Jones fx fixation w/ 5.5mm screw
  - FAI, January 2009
Fifth Metatarsal Avulsion Fracture: A Rational Basis for Postoperative Treatment
-Arch Orthop Trauma Surg.  2009

- Biomechanical test of stability of tension banding and screw fixation
- Results: The forces acting on the base of the 5th metatarsal in the gait cycle are the same magnitude as the failure forces of internal fixation. Ankle immobilization achieves no reduction in muscle activation. Partial-WB reduces muscle activation.

- Conclusion: post-op treatment should be partial-WB
5th Met Base Fractures

- Bony union
- Asymptomatic fibrous union (Radiographic non-union)
Lisfranc Fracture-Dislocations
Review of 48 patients with Lisfranc ORIF

Pts. with non-anatomic reduction had a significantly higher prevalence of post-traumatic osteoarthritis than did those with anatomic reduction

Anatomic reduction resulted in better AOFAS & MFA scores

“Anatomic reduction & stable internal fixation has become a standard principle governing treatment of tarsometatarsal fracture-dislocations”
“It is well accepted that patients are likely to develop late joint deformity at the tarsometatarsal junction, joint separation, and radiographic and clinical evidence of post-traumatic arthritis when anatomic reduction is not obtained.”

20 pts. w/ ORIF, 21 pts. w/ primary arthrodesis

2 years post-op AOFAS score:
- ORIF = 86.6
- Arthrodesis = 88

5 ORIF pts went on to arthrodesis

Post-injury activity level:
- ORIF = 65%
- Arthrodesis = 92%
“Arthrodesis vs ORIF for Lisfranc Fractures”
Sheibani-Rad S, Coetzee JC, et al
Orthopedics 2012

- Systematic Review
- 6 articles
- Fisher’s exact test revealed no significant effect of treatment group on the AOFAS score percentage on patients who had an anatomic reduction
- This study highlights that both procedures yield satisfactory and equivalent results
“Does Open Reduction and Internal Fixation versus Primary Arthrodesis Improve Patient Outcomes for Lisfranc Trauma? A Systematic Review and Meta-analysis.”  
Clinical Orthopedics & Related Research, 2016

- 3 studies
- Risk of hardware removal higher for ORIF group
- No risk difference for revisional surgeries or non-anatomic reduction between groups
- Patient recorded outcomes did not favor either group
Lisfranc Screw Orientation?
Purpose: To determine the strongest orientation of Lisfranc’s screw when performing ORIF of Lisfranc fracture-dislocation injuries.
Alternative Lisfranc’s Screw: A Cadaver Study

- 6 pairs of fresh-frozen human cadavers
- 2 screw orientations of 3.5mm cannulated partially threaded screws, AO technique
- Alternative screw: placed from 2nd met base to medial cuneiform
- Tradition screw: placed from medial cuneiform to 2nd met base
Alternative Lisfranc’s Screw: A Cadaver Study

- Pulled to failure with MTS
- Results:
  - Alternative screw mean force to failure = 165.1 ± 58.6N
  - Traditional screw mean force to failure = 149.0 ± 54.9N
  - p = 0.247
Alternative Lisfranc’s Screw: A Cadaver Study

- Conclusion: The Lisfranc’s screw from the 2nd metatarsal to the medial cuneiform provides stability to the tarsometatarsal joint complex equal to or stronger than the traditional orientation.
- Technically easier

- Orientation of the “Lisfranc Screw”
  
  J Orthop Trauma 2012, Vinod K. Panchbhavi, MD
Open Fracture

- Osseous injury with a concomitant break in skin integrity

Diagram:
- CLOSED: NO ASSOCIATED SOFT TISSUE INJURY
- OPEN: ASSOCIATED SOFT TISSUE INJURY
Goals of Open Fracture Treatment

1. Prevent Infection
2. Promote Fracture Healing
3. Restore Function without Complications
Infection

- ALL open fractures are contaminated wounds that can become infected
- Type 1 = gram + cocci
- Type 2 & 3 = gram - rods
Infection Rates

- Type 1 = 0-2%
- Type 2 = 2-7%
- Type 3A = 7%
- Type 3B = 50%
- Type 3C = > 50%, Sepsis 25-50%
“Golden Period”

- First 6-8 hours post injury
- Contaminated Wound
- >6-8 hours = Infected Wound
The Relationship Between Time to Surgical Debridement and Incidence of Infection After Open High-Energy Lower Extremity Trauma
-JBJS, Jan 2010

- 315 pts. (8 level 1 trauma centers)
- Treatment: aggressive debridement, abx, fracture stabilization, timely soft tissue coverage
- Evaluated infection rate within first 3 months
- 84 pts. (27%) developed infection within first 3 months
- Increased infection with > 2cm bone loss, 3C fractures
- Time to debridement NOT predictive of infection
Does Timing to Operative Debridement Affect Infectious Complications in Open Long Bone Fractures? A Systematic Review
- JBJS 2012, 20;94(12)

- Sixteen studies reviewed
- 6 prospective, 10 retrospective
- Total of 3539 open fractures
- No significant difference in the infection rate was detected between open fractures debrided early or late
- On the basis of this analysis, the historical “six hour rule” has little support in the available literature
IV Antibiotics

- First generation cephalosporin
  - Ancef = 2 gm initially, then 1gm Q8 hours
- Aminoglycoside
  - Gentamycin = 3-5 mg/kg daily
- Soil contamination or farm injuries = 10-20 million units penicillin G daily
- Broad Spectrum?
- PCN allergy = clindamycin or vancomycin
- Duration = 72 hours?
Short Duration of Antibiotic Prophylaxis in Open Fractures Does Not Enhance Risk of Subsequent Infection - Trauma, June 2013

- Retrospective case control study
- 1492 open fractures
- Gustillo & Anderson
  - Type 1 = 663 (44.4%)
  - Type 2 = 370 (24.8%)
  - Type 3 = 310 (20.8%)
  - Unclassified = 149 (10.0%)
- 54 infections (3.6%) at median of 10 days
Short Duration of Antibiotic Prophylaxis in Open Fractures Does Not Enhance Risk of Subsequent Infection
- Trauma, June 2013

No significant infection risk when comparing 1 day vs 2-3 days vs 4-5 days vs > 5 days of antibiotics

Infection associated with Grade 3 fractures and vascular injury or compartment syndrome

Conclusion: Infection in open fractures is related to the extent of tissue damage but not the duration of antibiotics.
Objective: formulate guidelines for treatment of open ankle fractures.

Reviewed 15 studies

2 prospective, 13 retrospective

498 pts

373 treated by immediate internal fixation

- 81% satisfactory result
- 15% poor results: non-anatomic reduction, articular surface damage, or deep infection
Recommended Guidelines:
- Gross debris and contamination removed in ED
- Cephalosporins administered in ED
- Wound cultures unnecessary
- Optimal antibiotic duration unknown
- Should be taken to OR within 24 hours
- Thorough debridement and irrigation
- No evidence against the use of tourniquets
Recommended Guidelines:

- Rigid internal fixation should be used. Only when there is inadequate soft tissue coverage, external fixation should be considered
- Grade 1 wounds may be closed primarily
- Grade 2 wounds should be left to heal by secondary intention, or delayed primary closure
- Grade 3 wounds should be closed by skin grafts or free flaps
K.A. s/p lawn mower injury
K.A. Post-op
KA 6 mon post-op
Calcaneal Fractures

Goals

- Restore Articular Surface
- Maintain height, length, width
- Preserve Subtalar and C-C motion
Complications

- MMI ~ 1-2 years
- Arthritic Changes
- Wound Dehiscence
- Edema
- Sural Neuritis
- Peronal Tendonitis
Smaller Incision

- Decrease soft tissue damage (2\textsuperscript{nd} hit)
- Decrease periosteal stripping
- Decrease post-op infections
- Decrease risk of wound complications
Minimal Incision
Technique

- Incision
- Steinman pin = joy stick
- Distract, reduce varus
- Reduce posterior facet
- Temporary fixation
- Screws as needed
- Plate
- Fill bone defect
CS ped struck
Ankle Fractures

- Goals of Treatment
  - Anatomic Alignment
  - Achieve dynamic congruity
  - AO Principles
Ankle Fractures

- Anatomic plates
- Locking plates
- Posterior malleolus fractures
Post-op
Post-op

- Non-WB vs Early-WB
- Cast vs CAM
- ROM
- CT evaluation
Putting it all together

- Each trauma is different
- Surgical plan
- Frequently many techniques
- Post injury course
Thank you!