Surgical Management of Forefoot Trauma

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Objectives

Attendees should increase their knowledge in the following:

- Common forefoot injuries
- Indications for surgery in forefoot injuries
- Contraindication to surgery in forefoot trauma
- Surgical management of Various forefoot injuries
- Concepts in fixation for various surgical treatments in forefoot trauma
Prevention of Foot Injuries

Lawnmower  Barefoot
Puncture Wounds
# Puncture Wounds

<table>
<thead>
<tr>
<th>Immunization Data</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never immunized</td>
<td>TIG 250IM + dT</td>
</tr>
<tr>
<td>Immunized + Dirty Wound</td>
<td>dT booster if last booster &gt;5yrs</td>
</tr>
<tr>
<td>dT boosters</td>
<td>Every 10 years</td>
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Puncture Wounds (Green and Bruno)

- **Type I:**
  - early diagnosis
  - Surgical drainage and debridment
  - Appropriate abx coverage

- **Type II:**
  - a delay in diagnosis from 9-14 days.
  - Surgical debridment
  - appropriate abx coverage will eradicate
  - Possible bone involvement

- **Type III:**
  - Delay in diagnosis > 3 weeks
  - Chronic infection
  - Possible bone resection
# Open Fracture Classification

<table>
<thead>
<tr>
<th>Type I:</th>
<th>Type II:</th>
<th>Type I + II:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clean</td>
<td>• Moderate contamination</td>
<td>• Ancef x 3 days</td>
</tr>
<tr>
<td>• &lt; 1 cm</td>
<td>• &gt; 1 cm</td>
<td></td>
</tr>
<tr>
<td>• Little Soft tissue</td>
<td>• Moderate comminution</td>
<td></td>
</tr>
<tr>
<td>involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No crush</td>
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</tbody>
</table>
Open Fracture Classification

**Type III:**
- Highly contaminated
- > 5 cm
- Extensive soft tissue involvement
- Severe comminution
- Ancef + Aminoglycoside x 3 days
- If Surgery, add 3 additional days

**IIIA:**
- Adequate soft tissue coverage

**IIIB:**
- Not enough soft tissue coverage with extensive periosteal stripping

**IIIC:**
- Arterial injury may progress to amputation
Toe Fractures
Proximal Phalanx

Distal Phalanx
First MPTJ Dislocation Injury:

- **Jahss Classification**
  - **Type I**: dorsal dislocation of the proximal phalanx and sesamoids with the intersesamoidal ligament intact
  - **Type IIA**: dorsal dislocation of the proximal phalanx and the sesamoids with rupture of the intersesamoidal ligament
  - **Type IIB**: dorsal dislocation of the proximal phalanx and the sesamoids with transverse fracture of one of the sesamoids and rupture of the intersesamoidal ligament
  - **Type IIC**: dorsal dislocation of the proximal phalanx and the sesamoids with complete disruption of the intersesamoidal ligament and fracture of both sesamoids
Jahss – Type I

• Dorsal dislocation of proximal phalanx and sesamoids with the intersesamoids ligament intact
  – Closed reduction usually unsuccessful
  – ORIF required
    • Dorsal linear incision
    • BK cast 3-4 weeks
Jahss – Type II

- Dorsal dislocation of proximal phalanx and sesamoids with rupture of the inter-sesamoids ligament
  - Type IIA- no fracture of sesamoids
  - Type IIB- transverse fracture of sesamoid

- Treatment: Closed reduction
  - Type IIB – distal fracture fragments or whole sesamoid may need to be excised
  - Type IIC –
Nail Injuries

Rosenthal Classification

Zone I: Distal to the phalanx
Zone II: Distal to the lunula
Zone III: Proximal to the distal end of the lunula
Workman’s Comp
Sesamoid Fractures
Plantar Plate Tears

• Etiology:
  – Chronic excessive metatarsal pressure
    • Shoe Gear
    • Long Second
    • Hypermobile 1st TMT
  – Trauma
  – Inflammatory Arthritis
  – Corticosteroid injections
Plantar Plate Tear - Diagnostic

• Ultrasound:
  – Normal plantar plate = homogeneous hyperechoic band arching over metatarsal head
  – Torn = discontinuous or heterogeneously hypoechoic

• MRI:
  – Normal plantar plate =
    • hypointense on all pulse sequences, and uniform in morphology
  – Torn plantar plate =
    • increased intrasubstance signal in distal plantar plate
    • Signal without discontinuity may indicate degenerative change, particularly on longer TE sequences.
Diagnosis of Plantar Plate Tear

Diagnostic:

– Clinical:
  • Positive Draw Sign (toe DF 25 degrees)
  • Gaping of toes

Staging:

– Ultrasound
– Arthrogram
– MRI
Procedure Options

1. **Conservative Care**
2. **Primary Plate Repair through plantar approach**
3. **Weil Osteotomy (Grade 0-1)**
4. **Weil Osteotomy and Plantar Plate Repair w/ Dorsal Approach**
5. **Flexor Tendon Transfer with or without PIPJ Fusion**
Plantar Approach

• Indications:
  – < 4-mm second met
  – SCAR on plantar
  – Mostly used in acute trauma
  – Fiberwire /Corkscrew

• The Direct Plantar Plate Repair Technique: Jeffrey E. McAlister and Christopher F. Hyer,. Foot Ankle Spec, September 2013
CPR Technique

- .062” K-wire from phalanx
- Crossing drill tunnels:
  - dorsal medial to plantar lateral
  - dorsal lateral to plantar medial
  - parallel holes can also be employed.
5th Metatarsal Fracture Patterns

• One of most frequent injuries
• Evidence:
• Zone I (avulsion fractures):
  • Even multi-fragmented, displaced and intra-articular fractures give good results with conservative care
• Zone II (Jones’):
  • Have good to excellent results with functional treatment
• Zone III (Met-Diaph):
  • Better results with surgery
Nutrient artery

Metaphyseal arteries

Periosteal blood supply
5th met base fracture?

• Don’t forget to evaluate for Cavus foot type!!!

• May need to correct Cavus
Instrumentation:
• Solid or Cannulated
• Recommend solid
• Superimpose screw to get ideal diameter
• Should grab internal cortex
• 4.5, 5.5, 6.5 mm
Specialty Plates with Hook
Do you fix these?
Metatarsal Neck Fx

Facts:

• Usually Displace Plantar
• May require reduction and fixation:
  • Closed reduction and Pinning
  • Open Reduction and Pinning
  • ORIF with plate
Avascular Necrosis of the 2nd Metatarsal:

- Freiberg
  - Type I: no DJD; articular cartilage intact
  - Type II: peri-articular spurs; articular cartilage intact
  - Type III: severe DJD; loss of articular cartilage
  - Type IV: epiphyseal dysplasia, multiple head involvement
Metatarsal Shaft Trauma
• Soft Tissue Viability
  – If unacceptable then consider K-Wire fixation
  – Must be stable proximally so may need to extend into TMT or Cuboid
• Soft Tissue Viability
  – If acceptable:
    • Bridge plating
    • Bi-cortical
    • Do not invade joint
Stress Fractures

- 17yo ballet dancer
- increasing pain in her forefoot with dancing.
- No pain with walking.
- Pain improved some with a week of rest, but returned when she started dancing again.
  - Focal tenderness over the 2nd metatarsal
Metatarsal Stress Fractures

• Risk Factors
  – High arches
  – Repetitive impact activity (running, marching, dancing)

• Avoidance of painful weight-bearing
  – Non-weight-bearing with crutches if pain with walking

• Slow return to normal activity when pain free with walking and to palpation over the stress injury
  – May need orthoses to help prevent future injury
Gunshots

Velocity

- Energy $= \frac{1}{2} mv^2$
- Energy increases by the square of the velocity and linearly with the mass
- Velocity of missile is the most important factor determining amount of energy and subsequent tissue damage
Gunshots

Wounding Power

• Low velocity, less severe
  – Less than 1000 ft/sec
  – Less than 230 grams

• High velocity, very destructive
  – Greater than 2000 ft/sec
  – Weight less than 150 grams

• Shotguns, very destructive at close range
  – About 1200 ft/sec
  – Weight up to 870 grams
Gunshot Wounds (Ordog)

- Type O: No injury (blood splatter)
- Type I: Blunt injury (non-penetrating)
  - Bulletproof vest, thick clothing, shoe gear
- Type II: Graze injury (abrasion, injury to epidermis, superficial dermis)
- Type III: Blast effect without missile penetration (bullet missed, blank ammunition at very close)
- Type IV blast effect with missile penetration
- Type V: Penetration
  - A: Laceration through dermis
  - B: Sub-cutaneous
  - C: All deep structures
  - D: Body cavity
  - E: More than one body region
- Type VI: Perforating
- Type VII: Penetrating with missile embolization
Conclusions

• Tissue damage and contamination dependent upon missile energy
• Careful vascular assessment mandatory
• High velocity and shotgun blasts require surgical debridement or if joint involvement or retained metal or bone displacement
• Recommend all victims treated with antibiotics (Knapp, JBJS 1996)
  – IV not indicated unless prophylaxis for surgery
  – Oral abx x 72 hours as effective as IV
• Fracture extension, fragmentation common
  – Many require surgical stabilization d/t instability
  – Indirect reduction, internal fixation recommended for diaphyseal injuries
Compartment Syndrome
Presentation

• Symptoms
  • pain out of proportion to injury
• Physical exam
  • pain with dorsiflexion of toes (MTPJ)
  • places intrinsic muscles on stretch
  • tense swollen foot
• loss of two-point discrimination
• pulses
• presence of pulses does not exclude diagnosis
Operative Treatment

• Operative
  – emergent foot fasciotomies
• Compartment measurements with absolute value of 30-45 mm Hg
• compartment measurements within 30 mm Hg of diastolic blood pressure (delta p)
• intraoperatively, diastolic blood pressure may be decreased from anesthesia
• must compare intra-operative measurement to pre-operative diastolic pressure
I complained I had no shoes until I met a man who had no feet!