



*Ath***ELITE** **ORTHO***pedics*  
AND SPORTS MEDICINE

Douglas A. Flory, MD

# Foot Crush Injuries

A Bad Actor.....

# A Little About Me

- Board Certified Orthopedic Surgeon
- Dual Fellowship Trained
- **Knee/Shoulder(Sports Medicine)**
- **Foot/Ankle**
- 11 years experience
- Started my own practice in 2009
- Extensive work comp experience from around the state

# A Little About Me

- All appointments within **24-48 hours**
- EMR system with e-faxing of all notes within 24 hours; most same day
- Take the time to explain things to the patient
- Combine state-of-the-art care with a personal touch: Makes us a better team



*Ath*ELITE ORTHO*pedics*  
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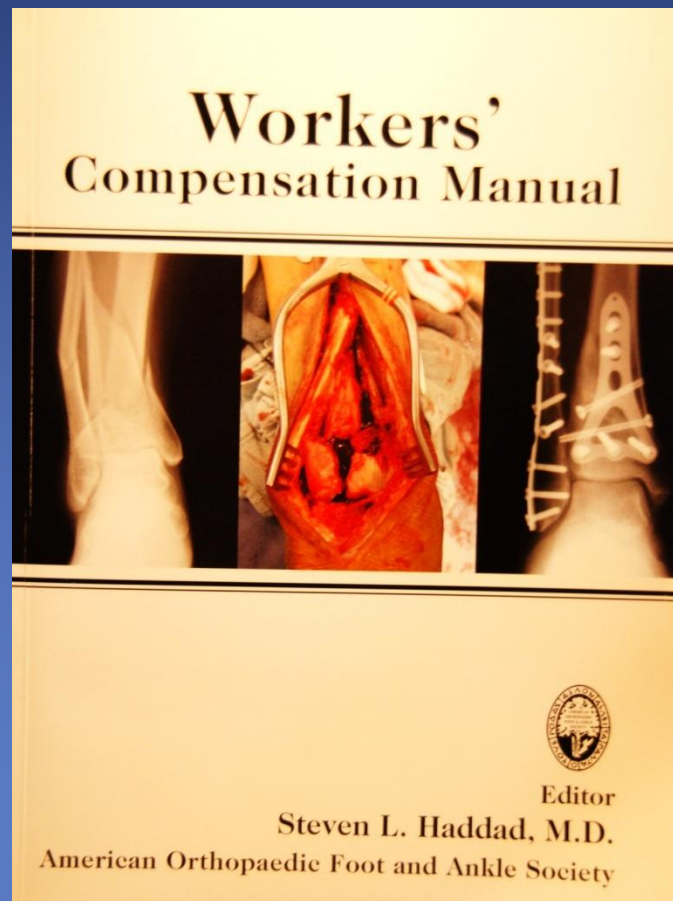
[www.atheliteortho.com](http://www.atheliteortho.com)

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# Worker's Compensation Manual

American Orthopedic Foot and Ankle Society



Published in 2004

I wrote 2 of the chapters

Each topic 2-3 pages

# Foot Crush Injuries

A Bad Actor.....

# Foot Crush Injuries

- Incidence and Economic Impact
- Outcomes
- Mechanisms
- Evaluation
- Treatment Concerns
- Case Example



# Foot Crush Injuries

- 120,000 – 180,000 foot/toe injuries per year
- Crush injuries estimated to be 2-5%
- Significant challenge due to high risk of prolonged morbidity
- Myerson found 46% good results, 29% fair results, and 25% poor results
- Heavy objects falling on foot, machinery with moving parts, equipment or vehicle rolling over foot

# Foot Crush Injuries

- Compression force
- Mangling – crush with laceration
- Shear/Degloving – skin separated from underlying tissue
- Bureau of Labor Statistics study – 75% of injuries occurred when worker's weren't in compliance
- U.S. Market for industrial footwear/guards is about \$1 Billion per year

# Evaluation

- History – mechanism of injury, footwear
- Medical History – diabetes, smoking, prior injuries, immunosuppressed, medications(steroids)
- Exam – condition of skin, deformities, assessment of neurovascular status(? vascular above ankle), r/o compartment syndrome
- Imaging – Xrays, +/- CT scan, occasionally MRI, but not usually early

# Foot Crush Injuries

- Skin/Subcutaneous Tissue
- Muscles/Tendons/Ligaments
- Nerves – stretch, tear, compression(bruise)
- Vascular – spasm vs. permanent damage
- Bones – fractures(closed and open), dislocations

# Foot Crush Injuries

- Bony injuries frequently not main indicator of outcome
- Open injuries – immediate irrigation and debridement and provisional fixation
- Closed injuries – frequently have to postpone treatment 7-10 days because of swelling, skin condition

# Early Complications

- Compartment Syndrome
- Infection
- Skin Loss – traumatic or necrosis
- CRPS/RSD
- Nerve Injury
- Vascular Injury

# Foot Crush Injuries



# Skin

- Bruising/Blistering
- Traumatic Lacerations – close during treatment
- Skin loss – Traumatic or Necrosis
- Close without tension, heal by secondary intention for small areas, VAC treatment, skin grafting, muscle flaps, hyperbaric oxygen chamber





# Nerves

- Most in the foot are sensory injuries
- Temporary loss of feeling – return in days to 6-9 months
- Neuroma – may require later surgery to resect and bury
- Can cause CRPS/RSD – be alert and treat early and aggressively (bone scans not helpful)

# Vascular

- Limited ability to restore vascularity below ankle
- Almost no ability in the forefoot
- Vessels may spasm initially and recover over several hours (8-12); small flow during spasm
- Severe crushing/tearing leads to necrosis in forefoot/toes
- Let the area declare itself over 48-72 hours to plan skin coverage and surgery

# Muscles/Tendons/Ligaments

- Muscle will heal
- Repair tendons/ligaments early as soft tissues allow
- Occasionally have to delay due to condition of skin

# Bony Injuries

- Soft tissues priority in closed injuries
- Fixation of fractures is based on location, severity, and soft tissues
- Ex-Fix, ORIF with plates/screws, Percutaneous screw fixation, K-wires(toes only)
- May consider bone stimulator, ultrasound, graft for high risk fractures in diabetics and/or smokers

# Late Complications

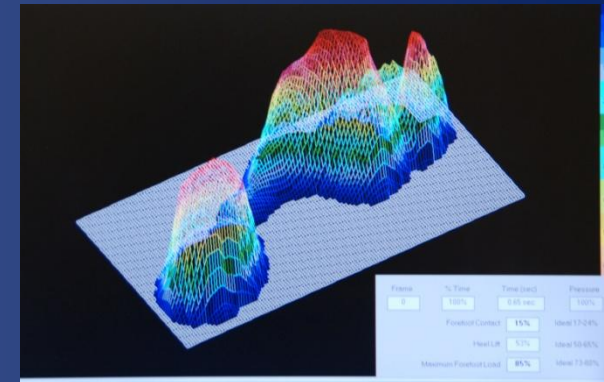
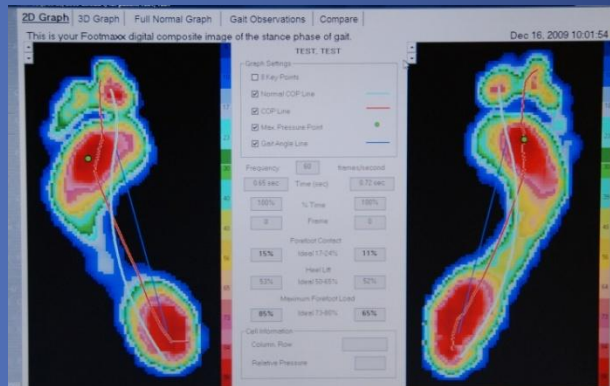
- Fractures - delayed/nonunion, malunion
- Contractures
- Joint Deformities – hammertoes/claw toes
- Neuroma/Neuritis
- Balance/Ambulation - amputation
- Scarring

# Rehab

- Very important
- Start as soon as injuries allow
- ROM, Strength, Gait/Balance training, Scar treatment
- Modalities – ultrasound, e-stim, ASTM/Graston
- Work Conditioning – depending on job and ability to work with restrictions

# Shoewear

- Most need some type of custom insert
- Accomodative, semi-rigid
- Some need Orthotist to create “filler” insert if amputation



# Case Example

- 48 y.o. male
- Working for a concert company
- Picking up trash and loading into compactor
- Up on top of dumpster when compactor door shut
- Crushed his Left forefoot under door
- Wearing tennis shoes



# Case Example

- Saw patient about 24 hours after injury
- 1 pack per day smoker
- No diabetes
- No prior injuries
- Presented in a posterior splint
- Pain mainly in forefoot, mild in midfoot

# Case Example

- Ankle normal
- Mild swelling in the midfoot
- Moderate swelling in forefoot
- No deformities
- Significant bruising and discoloration in toes 2-5
- Early signs of vascular compromise in toes 2-4

# Case Example

- Sensation intact
- Decreased capillary refill
- No compartment syndrome
- Vascular spasm vs. severe crush of toe vessels
- Multiple clean transverse toe fractures in 2-4

# Case Example



# Case Example

- Felt needed to let soft tissues “declare itself”
- Post-op shoe and padded compression
- Non-weight bearing on Left foot with crutches
- Ice and elevation
- Pain medication
- Re-evaluated in 48 hours



# Case Example



# Case Example

- Toes 2-4 developed dry necrosis
- Toe 5 recovered vascularity
- Only option was to perform amputations
- Toes 2-4 amputated at the MTP joints
- Able to partially close surgical incisions

# Case Example

- Open portion healed by secondary intention over about 3-4 weeks with saline wet to dry dressings
- Non-weight bearing x 4 weeks then heel only x 2 weeks
- Physical Therapy for strengthening, gait/balance training
- Sent to orthotist for a custom “filler” orthotic at 10 weeks once swelling had subsided



# Case Example



# Case Example



# Case Example

- Soft tissues healed completely
- No CRPS/RSD
- Normal distal sensation
- Good strength and function of Great Toe and 5<sup>th</sup>
- Returned to work full duty without restrictions at 4 months post injury
- Now wears steel toed boots when working around machinery

# Summary

- Return to work is highly variable in regards to both **time** and **permanent restrictions**
- PPI is variable
- Most will require some type of custom orthotics
- Remember: **46% good** results, **29% fair** results, and **25%** with **poor** result

# Goal is Functional Foot



Thank You!!

Questions?



*The Easy Choice!!*

*Douglas A. Flory, MD*