Top 5 Sports Foot and Ankle Injuries

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Ankle injuries - Epidemiology

- Most common injury sustained during sporting activities
- Account for up to 40% of all athletic injuries
- Most commonly seen in basketball, soccer, running, and ballet/dance
- Account for up to 53% of basketball injuries & 29% of soccer injuries
- Multiple associated injuries
- 10% of ER visits in US
  - Incidence of 30,000 ankle sprains daily

Athletic Foot and Ankle Injuries

- Ankle Sprains
- Achilles Tendon Injuries
- Osteochondral Injuries
- Stress Fractures
- Turf toe

Ankle injuries

- 75% involve lateral ligament complex
  - Equal incidence b/w males & females
- 80% make a full recovery with conservative tx
- 20% develop mechanical or functional instability resulting in chronic ankle instability
Lateral Ankle complex

• Consists of 3 ligaments:
  – ATFL
  – PTFL
  – CFL

• ATFL is the weakest lateral ankle ligament
• Isolated testing of the ankle ligaments demonstrates that the ATFL is the 1st to fail (deep deltoid is last)

History

• Mechanism of injury
• Prior ankle injuries
• Ability to continue to play or bear weight
• Location of pain
• “Pop” (more severe injury)
• Level of activity
• Rehab: Period of immobilization?
  – Type? Duration?

The position of the talus relative to the long axis of the leg is important for determination of the function of the lateral ankle ligaments:

• In neutral DF: ATFL is perpendicular to the axis of the tibia & CFL is parallel
• CFL provides resistance to inversion or varus tilt

• When talus is PF: (most common position for lat ankle inversion injuries), ATFL is parallel & CFL is perpendicular
• ATFL is responsible for resisting inversion stress

Physical Exam

• Inspection
  – Swelling
  – Ecchymosis
  – Blisters
  – ? Gross deformity
• ROM: Active & passive
• Palpation
  – Ligaments: ATFL, CFL, PTFL, Syndesmosis, Deltoid
  – Bone: Fibula, Tibia, Talus, 5th MT, Calcaneus
  – Tendons: Peroneal, Post tibial
Special tests

- **Anterior drawer**
  - Pt is seated, flexed leg hangs off table
  - Examiner stabilizes distal tibia with 1 hand while other hand grasps heel & pulls foot forward
  - Performed in neutral DF (CFL) & PF positions (ATFL) & compared w/contralateral ankle
    - False neg results may occur by involuntary guarding or pain
    - 3 mm translation of 3 mm compared to uninjured side or absolute value ≥ 10mm correlates w/ATFL incompetence

(Karlsson AJSM 1989)

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Special tests

- **Talar Tilt**
  - Pt is seated, leg secured with examiner’s open hand, & the heel is grasped from behind w/the opposite hand
  - Varus (inversion) force is applied to produce talar tilt
  - Performed in neutral DF (CFL) & PF positions (ATFL) & compared w/contralateral ankle

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Imaging

- Standard ankle series: AP, lat, mortise (wt bearing)
Useful for evaluation of acute, subacute & chronic lateral ankle ligament injuries.

Associated injuries to talar dome, peroneal tendons, IO ligaments, tarsal coalition.

Swenson et al. AJSM 2009.

Grading System

<table>
<thead>
<tr>
<th>Acute Grade</th>
<th>Anatomic Injury</th>
<th>Historical Findings</th>
<th>Exam Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Stretching of the ATFL</td>
<td>Inversion injury, subacute pain and swelling, continuous athletic activity</td>
<td>Mild swelling, mild ATFL tenderness, stable ankle</td>
</tr>
<tr>
<td>II</td>
<td>Partial tearing of the ATFL</td>
<td>Inversion injury, acute pain and swelling, inability to continue athletic activity, painful gait</td>
<td>Moderate swelling, moderate ATFL tenderness, stable ankle</td>
</tr>
<tr>
<td>III</td>
<td>Complete rupture of the ATFL ( \pm ) CFL</td>
<td>Inversion injury with associated “pop,” acute severe pain and swelling, inability to walk</td>
<td>Severe swelling, severe ATFL tenderness, unstable ankle</td>
</tr>
</tbody>
</table>

Less important to differentiate a grade I from grade II, but a distinction should be made between a grade I & grade III, or an isolated ATFL from an associated syndesmotic injury.

Initial Treatment (1st 24-48 hours)

- Rest/ Crutches
  - Gradual return to full weight bearing as tolerated.
- Immobilization
  - Fracture boot or splint
- Ice
  - 20 minutes per hour while swelling present
- Elevation
  - Above heart level while reclining to decrease swelling.
- Anti-inflammatory Medications
  - Ibuprofen, Naproxen

Non-Op Treatment

- Early mobilization
- Ankle support
  - Taping
  - Semirigid (air-stirrup) brace
  - Lace-up brace
Non-Op Treatment

- **Rehab:**
  - Motor strengthening
    - Peroneals in particular
  - Proprioception training
    - ↑ balance & neuromuscular control
    - Tilt board
    - Trampoline
  - Coordination

Surgical Indications

- Indicated for patient with chronic injuries that remain symptomatic after a focused rehab program.
  - Instability ± pain
- Contraindications:
  - Pain without instability
  - Instability due to neuropathy

Chronic Lateral Ankle Instability

- Assoc w/ apprehension, discomfort, swelling, weakness, tenderness, & loss of coordination
- Worse on uneven surfaces
- Develops in 20% of patients after acute injury
- Brand et al: reported 10% prevalence of “functional” lat ankle instability among 1300 Naval academy freshmen
  - May be related to prior ankle sprain, chronic instability or peroneal weakness
- Impaired proprioception, neuromuscular control

Anatomic Repair

- Brostrom: 1st to describe a midsubstance repair of the ATFL & CFL in 1966 after reporting on a series of 60 patients
- Gould Modification:
  - Reinforce the repair using the inferior extensor retinaculum to help ↓ inversion & correct ST instability
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Approach
Post-op Course

- Splint with ankle in neutral DF & eversion
- Changed to cast at 7 days (x3 weeks)
- Begin ROM at 4 weeks
  - Avoid inversion stretching
- Strengthening at 6 weeks
  - Proprioception, balance
- Return to Play: 3-6 months post-op
  - Ankle bracing for 1 year +

Conclusions

- Ankle sprains and lateral ankle instability are extremely common injuries in athletics.
- Initial treatment should focus on R.I.C.E. with progressive weightbearing and proprioception training physical therapy.
- Chronic instability may require bracing, longterm therapy, or even surgery.
- Prophylactic strengthening is the key to injury prevention.
- Return to play should be a team decision between the player, coaches, and medical staff.

Return to Play Guidelines

- Initial injury is resolved.
- Pain and swelling are resolved.
- The injured joint has a full range of motion.
- There is full or close to full (90-percent) strength.
- Patients feel they can “trust” the injured leg.
- Sense of instability has resolved.
- The athlete and family understand the risk of reinjury associated with returning to sports.

Achilles Tendon Ruptures
### Achilles Anatomy

- Achilles tendon is the strongest + largest tendon in the body
- Begins at junction of gastrocnemius and soleus tendons in middle of calf
- Typically 3 to 11 cm in length
- AT is subjected to the highest loads in the body - up to 10x body weight

### Common Sites of Rupture

- Myotendinous Junction
- Midsutance 2-6 cm proximal to insertion
- Avulsion

### Achilles Tendon Rupture:

- Antecedent tendinitis/tendinosis in 15%
- 75% of sports-related ruptures happen in patients between 30-50 years of age.
- Most ruptures occur in watershed area 2-6cm proximal to the calcaneal insertion.

### Achilles Tendon Rupture

- History
  - Feels like being kicked in the leg
- Mechanism
  - Eccentric loading (running backwards in tennis)
  - Sudden unexpected dorsiflexion of ankle
  - (Direct blow or laceration)
### Diagnosis

<table>
<thead>
<tr>
<th>Physical Exam</th>
<th>Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palpable defect</td>
<td>Xrays</td>
</tr>
<tr>
<td>Thompson Test</td>
<td>Avulsion suspected</td>
</tr>
<tr>
<td>Bruising/Swelling</td>
<td>Preoperative MRI/US</td>
</tr>
<tr>
<td>Weakness with plantar flexion</td>
<td>used to assess:</td>
</tr>
<tr>
<td></td>
<td>Condition of tendon ends</td>
</tr>
<tr>
<td></td>
<td>Orientation of the torn fibers</td>
</tr>
<tr>
<td></td>
<td>Width of diastasis</td>
</tr>
</tbody>
</table>
### Management Achilles Tendon Ruptures

- Management depends on surgeon and patient preference
- Surgery treatment of choice for athletes, young patients and delayed rupture
- Acute rupture in non-athletes can be treated nonoperatively

### Surgical Management

- Bunnell Suture
- Modified Kessler
- Many techniques available

### Nonsurgical: Cast or Bracing

- Start early
- Prevent Dorsiflexion
- Plantarflexion Casts
  - 4 weeks
- Bring to neutral
  - 4 to 6 weeks
- Heel lift
- Physical therapy
Open Technique

- Medial Incision
- +/- Debride mop ends
- Direct suture repair
  - Krackow
  - Nonabsorbable
- Repair paratenon
- Augmentation
  - Turn down flap
  - FHL transfer
  - Plantaris

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Surgical Management: Post-op Care

- Assess strength of repair, tension and ROM intra-op.
- Apply splint with ankle in the least amount of plantarflexion that can be safely attained.
- Nonweightbearing for 3 weeks
- Patient returns to clinic 7-10 days post-op and is placed into a plantarflexed cast for 2 weeks.
- At 3 weeks, removable boot with heel wedges to be removed weekly. Progressive weightbearing.
- PT for ROM and progressive strengthening to begin at 6 weeks post op.
- Return to full activity at 6-9 months.

Osteochondral Injuries

- Definition:
- Injury or disease process affecting the articular surface and/or subchondral bone of the tibiotalar joint. Stone, 1996
- …Most commonly due to trauma and/or ischemic injury, … comprise a spectrum of injuries related to location, architecture, and size. Mitchell et al., 2009.

Achilles Tendon Rupture Recommendations

- Individualize patients
- Determine patient goals
- Increased strength and lower risk of rerupture with surgical repair.
- Conservative Treatment
  - Functional bracing and early rehab

Ankle Cartilage Biology

- Talar articular cartilage is thinner than cartilage in the knee and hip.
- Mean thickness of talar articular cartilage = 0.89 mm.
- Femur, patella, and tibial plateau = 2.0, 3.33, and 2.92 mm, respectively.
- Mechanical properties better maintained with age than knee and hip.
### Classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Subchondral bone compression</td>
</tr>
<tr>
<td>II</td>
<td>Osteochondral fragment partially detached</td>
</tr>
<tr>
<td>III</td>
<td>Osteochondral fragment completely detached but not displaced</td>
</tr>
<tr>
<td>IV</td>
<td>Osteochondral fragment completely detached</td>
</tr>
</tbody>
</table>

### Surgical Indications

- Symptomatic focal lesions that fail to respond to nonsurgical measures.
- Lesions with loose or unstable fragments.
- Contraindications to surgical management of CIA’s include infection and medical comorbidities.
- Lesions associated with diffuse ankle arthrosis.
- Lesions that are identified incidentally or not confirmed to be the source of the symptoms.

### Diagnostic Imaging

#### Microfracture Drilling

- Unstable cartilage is removed using a curet, shaver, and grasper.
- Create a stable, contained defect.
- Calcified cartilage layer is removed with a curet.
- Subchondral plate of the defect is penetrated in multiple locations.
<table>
<thead>
<tr>
<th>OATS/ Mosaicplasty</th>
<th>OATS/ Mosaicplasty</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Image 1" /></td>
<td><img src="image2" alt="Image 2" /></td>
</tr>
<tr>
<td><img src="image3" alt="Image 3" /></td>
<td><img src="image4" alt="Image 4" /></td>
</tr>
</tbody>
</table>
• When nonsurgical measures fail, osteochondral lesions of the ankle can be managed effectively in most cases with arthroscopic débridement and drilling/microfracture.

• Larger-diameter lesions, those associated with subchondral cysts, and those that have failed arthroscopic treatment are candidates for OAT or ACI.

• These techniques have the potential to restore hyaline cartilage in the lesion.
Stress Fractures

- Common overuse injuries in running athletes.
- After ankle sprains, 2nd most common injury among track and field athletes.
- The Female Triad

High-risk stress fractures:
- Anterior Tibial Cortex
- Medial Malleolus
- Navicular
- 5th Metatarsal Base
- Sesamoids
Stress Fractures

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5th Metatarsal Base Stress Fractures

- Jones Fracture
### Presentation
- Prodromal activity-related pain associated with varying amounts of swelling.
- Untreated, progresses to affect ADL’s.
- Associated with an abrupt change in the training regimen.
- Increased frequency or intensity of training.
- Point tenderness often develops at the site of the stress fracture.
- Positive hop test, percussion test, tuning fork test.

### Imaging
- Plain radiographs often negative.
- Bone scan is sensitive but not specific.
- MRI is preferred test because of high sensitivity and specificity.
**Stress Fracture Classification**

- Clinical and Radiographic Classification System
- Based on grade, anatomic site, and imaging modality.
- 15 Sports Medicine clinicians reproduced the classification system from memory with 97.3% accuracy.
- Substantial to “almost perfect” interobserver reliability. (K> 0.6 and 0.8)
- Kaeding, Miller, 2012.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Pain</th>
<th>Radiographic Findings (CT, MRI, Bone Scan or X-ray)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>-</td>
<td>Imaging evidence of Stress FX No fracture line</td>
</tr>
<tr>
<td>II</td>
<td>*</td>
<td>Imaging evidence of Stress FX No fracture line</td>
</tr>
<tr>
<td>III</td>
<td>*</td>
<td>Non-displaced fracture line</td>
</tr>
<tr>
<td>IV</td>
<td>*</td>
<td>Displaced Fracture (&gt; 2 mm)</td>
</tr>
<tr>
<td>V</td>
<td>*</td>
<td>Nonunion</td>
</tr>
</tbody>
</table>

**High Risk Stress Fractures - Treatment**

- Anterior tibial cortex - Prolonged immobilization and protected weight bearing until symptoms resolve. Intramedullary nailing when no healing is evident within 4-6 months.
- Medial malleolus - Open reduction and internal fixation with a one-third tubular plate and 3.5-mm screws. Bone graft for nonunion.
- Navicular - Two 4.0-mm partially threaded, cannulated, or solid compression screws.
- Fifth metatarsal - (ie, Jones) Solid 4.5+ mm intramedullary screw.
- Sesamoids - Excision.

Optimize nutrition, hormonal status, and shoe wear!

**38 year old male runner with lateral foot pain x 5 weeks, worse with running.**

Turf Toe
Turf Toe

- Result of a 1st MTP hyperextension injury with axial loading.
- Incompetent plantar plate/ sesamoid complex.
- Tear of the plantar plate from the distal insertion at the 1st proximal phalanx.

Turf Toe - Taping

- Prevent MTP joint hyperextension.
- Allow moderate MTP flexion and minimal extension.
- Create an 'X' of tape with the cross passing over the great toe MTP joint.

Turf Toe - Grading and Treatment

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Treatment</th>
<th>RTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Attenuation of plantar structures. Localized swelling</td>
<td>Individualized based on the symptoms</td>
<td>As tolerated</td>
</tr>
<tr>
<td>II</td>
<td>Partial tear of plantar structures Moderate swelling Restricted motion because of pain</td>
<td>Walking boot, crutches as needed, Carbon fiber orthotics.</td>
<td>Taping may be required for ≥2 wk</td>
</tr>
<tr>
<td>III</td>
<td>Complete disruption of plantar structures Hallux flexion weakness Frank instability of the Hallux MTP joint</td>
<td>Long-term immobilization in a boot or a cast or surgical Reconstruction repair.</td>
<td>10-16 wk, depending on sport and position Taping or bracing likely needed</td>
</tr>
</tbody>
</table>

Turf Toe - Surgery

- Plantar Capsuloligamentous Complex Repair.
- Indications: Grade III injuries with refractory symptoms in a high-level athlete.
- RTP: 6-12 months without orthosis or taping.
- Late sequelae: Hallux Rigidus

Common Foot and Ankle Conditions

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Objectives

- Top 5 conditions
  - Heel pain
  - Bunions
  - Neuroma
  - Digit deformities
  - Verruca
- Basic evaluation and overview
- Basic treatment

Heel Pain

- Plantar fasciitis
- Heel spur syndrome
  - Misnomer
- Post static dyskinesia
- Plantar heel pain
  - Medial calcaneal tubercle

Etiology

- Flat foot
- Overpronation
- Weight gain
- Exercise regimen
- Poor shoe gear
- Barefoot walking

Image from Wikipedia
### Spur Comparison

<table>
<thead>
<tr>
<th>Physical Exam</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Pronated foot</td>
<td>- Stretching</td>
</tr>
<tr>
<td>- Obese</td>
<td>- Home cryotherapy</td>
</tr>
<tr>
<td>- Edema to plantar/medial heel</td>
<td>- Avoid barefoot walking</td>
</tr>
<tr>
<td>- Pain with palpation</td>
<td>- NSAIDs</td>
</tr>
<tr>
<td>✓ Lateral compression</td>
<td>- Activity modifications</td>
</tr>
<tr>
<td></td>
<td>- Support</td>
</tr>
</tbody>
</table>

### Physical Exam

- Pronated foot
- Obese
- Edema to plantar/medial heel
- Pain with palpation
  ✓ Lateral compression

### Treatment

- Stretching
- Home cryotherapy
- Avoid barefoot walking
- NSAIDs
- Activity modifications
- Support
Secondary Treatment

- Injections
  - Steroid
- Night splint
  - Windlass
- Immobilization
- Custom orthotics
- Formal physical therapy

Surgical Treatment

- Surgery
  - Failed conservative treatment >6 mos
    - Plantar fasciotomy
    - ESWT (extracorporeal shockwave therapy)
    - Coblation

Bunion/Hallux Valgus

- Bump pain
- Etiology
  - Family history
  - Shoe wear
  - Hyperpronation

Symptoms

- Medial prominence
- Lateral deviation
- Range of motion
- Bursitis
- Callus
- Central metatarsalgia
- Hammertoe
Radiographic Evaluation
• IM angle
• HA angle
• Joint evaluation
• Congruency
• Bone stock
• Metatarsal length

Treatment
CONSERVATIVE
• Shoe modifications
• NSAIDs
• Orthotics
• No EBM
• Brace/Padding

Surgical Options
• Osteotomy
• Fusion

Distal Osteotomy
<table>
<thead>
<tr>
<th>Lapidus Fusion</th>
<th>Proximal Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Image" /></td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Lapidus Fusion</td>
<td>Phalangeal Osteotomy</td>
</tr>
<tr>
<td><img src="image3.jpg" alt="Image" /></td>
<td><img src="image4.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>
**Neuroma/Morton’s Neuroma**

- Burning pain
- Numbness/Tingling
- Sharp radiating pain
- “Wrinkled-sock sensation”

**Treatment**

- Shoe modifications
- Orthotics
- Padding
- Injections
  - Steroid
  - EtOH
- Surgery
  - Excision
  - Decompression

**Exam**

- Pain with palpation
- Mulder’s click
- Radiating sensation
- Radiographs
  - R/O differentials
- Ultrasound
- MRI

**Neuroma Excision**
## Digital Deformities

- Hammertoe
- Claw toe
- Mallet toe
- Crossover toe
- Adductovarus
- Contracture

## Polydactyly

## Exam

- Radiographs
- Pain with palpation
- Callus
- ROM
- Stability/push up/WB

## Conservative Treatment

- Shoe modifications
- Padding
- Debridement
- Taping
- Injections
**Surgery**

- Arthroplasty
- Arthrodesis
  - Fixation
- Osteotomy
- Tendon transfer
  - Soft tissue balance

**Physical Exam**

- Hyperkeratotic tissue
- Pinpoint bleeding
- Divergent skin lines
- Pain with lateral compression
  - Differentiates

**Verruca**

- Human papilloma virus
  - 1,2,4,63
- Verruca plantaris
- Benign epithelial tumor
- 7-10% of population
- Moist surfaces
- Difficult to treat

**Not a Wart**
Treatment

- Keratolytics
  - Salicylic Acid (60%)
  - Canthiridin
- Cryotherapy
- Laser treatment
  - Leaves a wound
- Excision

Conclusion

- Exhaust conservative treatment
  - Shoe modifications
- Realistic goals
  - Patient expectations
- Surgical treatment options