Review of Lower Extremity
Foot & Ankle

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Overview

• Review of Ankle & Foot Anatomy
• Injuries/Pathology & Differential Diagnosis by Region
Ankle Anatomy

• Two Joints
  – Distal tibiofibular (syndesmosis)
  – Talocrural (tibiotalar, mortise)
Distal Tibiofibular Joint

• Small amount of rotation
• Syndesmosis
  – Anterior tibiofibular ligament
  – Posterior tibiofibular ligament
Talocrural Joint

- Stability
  - Primary: bones
  - Secondary: ligaments

- Most stable in dorsiflexion

- Least stable in plantarflexion
  - More prone to injuries
Talocrural Joint Ligaments - Lateral

- **Anterior Talofibular Ligament**
  - Tight in plantarflexion
  - Resists anterior displacement of talus

- **Calcaneofibular ligament**
  - Tight in dorsiflexion
  - Resists excessive supination

- **Posterior talofibular ligament**
  - Tight in extreme dorsiflexion
  - Resists inversion and internal rotation
Talocrural Joint Ligaments - Medial

- Deltoid Ligament
  - Tibiotalar (anterior and posterior)
  - Tibionavicular
  - Tibiocalcaneal
- Deep and superficial layers
- Injured infrequently
Foot Anatomy

- Hindfoot
  - Talus, Calcaneus
- Midfoot
  - Tarsals
- Forefoot
  - Metatarsals, Phalanges
Subtalar Joint

• Anterior & Posterior Components
• Separated by sinus tarsi
• Function:
  – Shock absorption
  – Accommodate to uneven surfaces
Subtalar Joint Movements

• Inversion
  - 20-30°

• Eversion
  - 10-15°
Transverse Tarsal Movements

- Inversion
- Eversion

40°  20°
Combined Foot & Ankle Movements

• Pronation:
  – Ankle dorsiflexion
  – Subtalar eversion
  – Forefoot abduction

• Supination:
  – Ankle plantarflexion
  – Subtalar inversion
  – Forefoot adduction
Sensory Nerve Distributions

Femoral nerve (saphenous nerve)

Common fibular nerve (lateral cutaneous of calf)

Common fibular nerve (superficial branch)

Tibial nerve (sural nerve)

Medial plantar nerve

Lateral plantar nerve

Femoral nerve (saphenous nerve)

Tibial nerve (medial calcaneal branches)

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Lateral Ankle Pain
Differential Diagnosis

- Lateral Ankle Sprain
- Fibularis Tendinopathy
- Osteochondral Injury
- Lateral Impingement
- Sinus Tarsi Syndrome
- Fractures
- S1 Radiculopathy
Lateral Ankle Sprain

- Mechanism: Inversion + plantarflexion
- ATFL injured before CFL
- Grades:
  - I: ligament stretch without tear
    - No laxity on exam
  - II: partial ligament tear
    - Laxity on exam
  - III: complete ligament tear
    - Laxity, no end point on exam
    - ATFL only 65%
    - ATFL + CFL 20%
Lateral Ankle Sprain - Exam

• Palpate for tenderness
• Special Tests (most valid 4-7 days post-injury)
  – Anterior Drawer (evaluates ATFL)
  – Talar Tilt (evaluates CFL)
Ottowa Ankle Rules

- Indications for Ankle X-rays
  - Tenderness over distal 6cm of posterior medial (B) or lateral (A) malleolus
  - Inability to take 4 steps at time of injury and in ED
Ottowa Foot Rules

• Indications for Foot X-rays
  – Tenderness over base of 5th metatarsal (C)
  – Tenderness over navicular (D)
  – Inability to take 4 steps at time of injury and in ED
Lateral Ankle Sprain - Treatment

• Initial Treatment
  – Goal: reduce pain and swelling
  – Analgesics or NSAIDs as needed
  – **Protection, Rest, Ice, Compression, Elevation**
    • Protection:
      – Air splint if needed
      – Weight bearing as tolerated (crutches if needed)
Lateral Ankle Sprain - Treatment

• Rehabilitation
  – Restoring ROM
  – Restoring neuromuscular control
    • Especially fibularis longus/brevis
  – Strengthening
    • Isometrics then isotonics
  – Proprioception
    • Single leg and wobble board exercises
Lateral Ankle Sprain - Treatment

• Functional Training:
  – Plyometrics, agility drills

• Return to Sport
  – Consider bracing for up to 12 months

• Surgery
  – Indicated if recurrent instability or persistent pain despite appropriate rehab
Chronic Pain after Ankle Sprain

- Inadequate rehabilitation
- Fractures
  - Anterior process calcaneus
  - Lateral process talus
  - Posterior process talus (or os trigonum)
  - Base 5th Metatarsal
- Osteochondral lesion
- Chronic synovitis

- Impingement
  - Anterior, Posterior, Anterolateral
- Tendon Injury
  - Fibularis longus/brevis
  - Tibialis posterior
- Sinus tarsi syndrome
- Complex regional pain syndrome
Osteochondral Lesion – Talar Dome

- Due to compression by tibial plafond
- Most commonly superomedial corner
- Symptoms: aching, locking/catching
- Exam: tender over talus
- Imaging:
  - X-ray may reveal lesion
  - MRI best
- Treatment:
  - Conservative: small stable lesions
  - Surgical: large lesions, loose bodies, failed conservative treatment
Fibularis Tendinopathy

- Most cases fibularis brevis
- Etiology: repetitive inversion injury or overuse
- Pain walking on uneven surfaces
- Exam: pain with resisted eversion, passive inversion
- MRI or Ultrasound to diagnose
- Treatment: rehabilitation, orthoses
Fibularis Subluxation

• Superior fibular retinaculum torn from lateral malleolus
• Tendons sublux anteriorly over lateral malleolus
• Etiology: forceful passive dorsiflexion
• X-rays may show fracture
• Treatment: often surgical
Medial Ankle Pain
Differential Diagnosis

• Medial Ankle Sprain
• Tibialis Posterior Tendinopathy
• Flexor Hallucis Longus Tendinopathy
• Tarsal Tunnel Syndrome
• L4 Radiculopathy
Medial Ankle Sprain

- Mechanism: eversion
- More likely to occur with medial malleolus fracture
- Treatment: similar to lateral
- Rehab takes about 2x as long (or more)
Tibialis Posterior Tendinopathy

- **Etiology:**
  - Overuse, such as running or walking
  - Excessive subtalar pronation
  - Restricted ankle ROM

- **Symptoms:**
  - Medial ankle pain
  - Pain may radiate along tendon
  - Dropped medial arch/pes planus
  - Pain with resisted inversion, heel raise

- **MRI or Ultrasound to confirm diagnosis**

- **Treatment:** ice, strengthening, orthotics
Flexor Hallucis Longus Tendinopathy

• Often seen in ballet dancers

• Symptoms:
  – Posteromedial ankle pain
  – Pain with toe-off or forefoot weight-bearing
  – Pain with resisted flexion or stretch into dorsiflexion

• MRI or Ultrasound to confirm diagnosis

• Treatment: ice, rest, stretching/strengthening exercises, subtalar mobilization, correcting technique
Tarsal Tunnel Syndrome

- Entrapment of posterior tibial nerve
- Etiology:
  - Idiopathic, Trauma, Overuse
  - Excessive pronation
  - Pes planus
- Symptoms: burning or tingling in plantar foot
- NCS to evaluate
- Treatment: depends on etiology
Anterior Ankle Pain
Differential Diagnosis

- Anterior Ankle Impingement
- High Ankle Sprain
- Tibialis Anterior Tendinopathy
- Extensor Hallucis Longus Tendinopathy
- Osteochondral Injury
- L5 Radiculopathy
Anterior Ankle Impingement

- Entrapment of bony or soft tissue
- Occurs during dorsiflexion
- More common in soccer, ballet
- Symptoms: ankle stiffness, pain, reduced dorsiflexion

Robinson 2002
Anterior Ankle Impingement

- Evaluate with x-rays, MRI if necessary
- Treatment: rest, heel lift, NSAIDs, PT in mild cases
  - May require surgical excision of exostosis
Syndesmosis “High Ankle” Sprain

• Mechanism: dorsiflexion with external rotation
  – Stepping in a hole
  – Landing on someone’s foot
• AITFL injured before PITFL
• Complete rupture associated with other injuries:
  – Deltoid ligament, fracture of fibula or posterior and medial malleoli
Syndesmosis “High Ankle” Sprain

• Exam:
  – Marked medial swelling and pain
  – + external rotation test
  – + squeeze test
  – Palpate proximal fibula

• Imaging:
  – MRI best for ligaments
  – X-rays to evaluate stability
Syndesmosis “High Ankle” Sprain

• X-rays:
  – Widening of medial clear space (C) – Normally ≤ tib/talar space
  – Widening of tibiofibular clear space (B) – Normally < 6mm
  – Decrease in tibiofibular overlap (A) – Normally > 6mm AP, 1mm mortise
Syndesmosis “High Ankle” Sprain

• Treatment:
  – Stable (Grade I/II): conservative
    • Initial NWB boot
    • Early mobilization at 3-6 weeks
    • Begin with ROM, progress to strengthening
  – Unstable (Grade II/III): surgery for stabilization

• Up to 20% have chronic symptoms
• Increased risk of post-traumatic OA
Maisonneuve Fracture

- Proximal fibula fracture
- Occurs with distal tib-fib joint sprain and medial malleolus fracture or deltoid ligament injury
- Treatment: surgical repair of syndesmosis; non-op management of fibula
TA & EHL Tendinopathy

- **Etiology:** overuse (downhill running), direct pressure
- **Pain, swelling, stiffness** – increase with activity
- **Imaging:** Ultrasound or MRI
- **Treatment:** eccentric strengthening, correction of biomechanics
Posterior Ankle Pain
Differential Diagnosis

• Posterior Ankle Impingement
• Achilles Tendinopathy
• Achilles Rupture
• Retrocalcaneal Bursitis
• Accessory Soleus
• S1 Radiculopathy
• Sever’s Disease
Posterior Ankle Impingement

• Impingement of posterior bony or soft tissues between talus and posterior tibia
  – Can have prominent lateral talar process (Stieda) or os trigonum
  – Seen in ballet dancers, gymnasts, soccer players
  – Due to extreme plantarflexion

• Symptoms: pain and tenderness posterior ankle

• Pain with passive ankle plantarflexion
Posterior Ankle Impingement

- Imaging: X-ray, MRI
- Treatment: rest, NSAIDs, mobilization, technique correction, steroid injection if needed
  - May require surgery

Robinson 2002
Achilles Tendinopathy

- Non-inflammatory degeneration
- Most common 2-6 cm proximal to insertion
- Risk Factors: abnormal biomechanics, calf weakness or tightness, male, obesity, menopause, diabetes, years of running
- Contributing Factors: reduced recovery time, change in training or footwear
- Pain worse with activity
Achilles Tendinopathy

- Exam: swelling, crepitus, tenderness, ± nodule
- Imaging: MRI or Ultrasound

Maffulli 2004
Arya 2010
Achilles Tendinopathy

• Treatment:
  – Rest, immobilization, ice, NSAIDs or analgesics
  – Physical therapy: Eccentric exercises or heavy slow resistance training
    • Modified for insertional vs mid-portion
  – Correct biomechanical factors
  – Nitroglycerin patches
  – Injections/percutaneous procedures if needed
  – Surgery for Haglund’s deformity (spur)

Alfredson 1998
Achilles Tendon Rupture

• Occurs during activity
• Feel a “hit” or “kick” to back of leg
• Difficulty walking
• Exam:
  – Palpable defect
  – + Thompson test
• Treatment:
  – Often surgical
  – Can consider non-surgical
Heel (Rearfoot) Pain
Differential Diagnosis

• Plantar fasciitis
• Calcaneal stress fracture
• Fat pad contusion
• Nerve
  – Tarsal tunnel syndrome
  – Medial calcaneal nerve entrapment
Plantar Fasciitis/Fasciosis

- Forms longitudinal arch of foot
- Insidious onset of pain due to overuse (running, dancing, walking)
- Risk Factors: pes planus or cavus, poor footwear, obesity, calf tightness, excessive standing
- Pain worse in the morning or after inactivity
- Tender at medial process of calcaneal tuberosity (plantar fascia origin)
Plantar Fasciitis/Fasciosis

- X-ray may reveal calcaneal spur
- Ultrasound: thickening of fascia
- Treatment: ice, stretching, massage, NSAIDs, gel heel pad, strengthening, night splint, supportive footwear
- Steroid or PRP injections or surgery if needed
Calcaneal Stress Fracture

- Due to overuse, heavy landing, over-striding, poor cushioning
- Worse with weight-bearing
- X-rays may be negative, MRI better
- Treatment: NWB if needed, gradual increase in weight-bearing activity, soft heel pads
Midfoot Pain
Differential Diagnosis

• Navicular stress fracture
• Lisfranc joint injury
  – Sprain, dislocation, fracture
• Extensor tendinopathy
• Midtarsal joint sprain
• Tarsal coalition
Navicular Stress Fracture

- Sprinters, jumpers, hurdlers
- Most commonly middle 1/3 (avascular)
- Pain with activity, weightbearing
- Vague/diffuse midfoot pain
- Tender to palpation on exam
- Imaging: MRI or bone scan + CT
- **High risk** of nonunion or AVN
Navicular Stress Fracture
Treatment

• Stress Reaction:
  – Rest until pain free, boot, gradual return to play

• Stress Fracture:
  – 6-8 weeks strict NWB in cast
  – Gradual rehab over 6 weeks
  – Surgical referral for delayed or nonunion

sportsmedicinephysiotherapy.com
Lisfranc Injury

• Lisfranc ligament between medial cuneiform and 2\textsuperscript{nd} metatarsal
• Etiology: direct or indirect
• Midfoot pain with weightbearing
• Bruising/swelling dorsal midfoot
• Imaging:
  – X-ray & MRI
• Grading/Treatment:
  – I: non-displaced – NWB cast x 6+ weeks
  – II & III: displaced – surgery
Lisfranc Injury
Forefoot Pain
Differential Diagnosis

• First MTP sprain (turf toe)
• Morton’s neuroma
• Sesamoiditis/stress fracture
• Metatarsal stress fracture
• Metatarsalgia
• Hallux valgus
• Hallux rigidus
Turf Toe

• 1st MTP joint sprain
• Involves plantar capsule and ligaments
• Mechanism: forced hyperextension
• X-ray may show avulsion; MRI more detailed
• Grading/Treatment:
  – I: sprain of ligaments; symptomatic
  – II: partial rupture; walking boot, crutches
  – III: complete rupture; boot/cast or surgery
Morton’s Neuroma

- Swelling of interdigital nerve and bursa
- Most common between 3rd and 4th MTs
- Pain can radiate into toes
- “Pebble in shoe”
- Exam: + Mulder’s sign/click
- Treatment: metatarsal padding, strengthening, orthotics, ± injection, surgery
Sesamoiditis & Sesamoid Stress Fractures

• Usually involves medial sesamoid
• X-rays with sesamoid view for fracture
• MRI to detect early bone stress
• High risk of delayed or nonunion
• Treatment:
  – Up to 6 weeks NWB short leg cast
  – May require surgery (sesamoidectomy)
Metatarsal Stress Fractures

- Most common: Neck 2\textsuperscript{nd} MT
  - Higher risk if 2\textsuperscript{nd} MT longer than 1\textsuperscript{st} MT
  - Treat with relative rest, gradual return to activity

- Base 2\textsuperscript{nd} MT
  - 4+ weeks NWB in short-leg cast
  - High Risk

- Jones Fracture: Proximal diaphysis 5\textsuperscript{th} MT
  - 6-10 weeks NWB cast or screw fixation
  - High Risk
Higher Yield for Exams

• Anatomy
• Physical exam special tests
• Ottawa foot/ankle rules
• Common injuries/pathology
• High risk stress fractures
Questions?
References