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

northcoastfootcare.com
Sensory Nerve Distributions

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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 5\textsuperscript{th} 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

Arya 2010
Maffulli 2004
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
Lisfranc Injury

• Lisfranc ligament between medial cuneiform and 2nd 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

Gupta 2008
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

- 1\textsuperscript{st} 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

Hauser 2012
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)

Burge 2012
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

• Hall, MM. Lower Leg, Ankle and Foot Injuries and Conditions. Lecture presented at Fourth Annual Comprehensive Sports Medicine Update and Board Review 2015.
• Schuenke M et al. Thieme Atlas of Anatomy: General Anatomy and Musculoskeletal System. 2014. 2nd Ed.
• Van Heest TJ, Lafferty PM. Injuries to the Ankle Syndesmosis. JBJS. 2014;96:603-613.