Case-Based Approach to Foot and Ankle Exam

ACP Washington Chapter Scientific Meeting
November 2019
Greg Nakamoto MD
Leslie Yen MD
Workshop Outline

• Cases w/ exam highlights:
• Additional info in handout. Management will not be presented in depth.
• Anatomy overview
• Systematic physical exam
• Break-out for physical exam – 20-30 minutes
• Ultrasound as time allows
Foot & Ankle Topics

- **Bones, Ligaments, Tendons, Cartilage and Nerves (BLT CaN!)**
- Fractures: Ottawa foot and ankle rules
- Lisfranc injury
- Ankle ligament sprain
- Tendon and plantar fascia
- Nerves – brief mention
Case 1: The Inverted Ankle

• 55 yo patient reports rolling her ankle with a pop.
• She is unable to bear weight.
• There is bruising and pain at the lateral ankle
• What next?
Ankle Inversion Exam

• Where do you poke?
• What’s the differential diagnosis?
  – BLT CaN!
• When do you refer to specialist (sports med vs. ortho)?
  – Ask about lateral knee or lower leg pain
Lateral Ligaments

![Diagram of the lateral ligaments of the ankle](image)

- Posterior talofibular ligament (a component of the lateral collateral ligament)
- Calcaneofibular ligament (a component of the lateral collateral ligament)
- Anterior talofibular ligament (a component of the lateral collateral ligament)
- Intertarsal ligament
- Dorsal talonavicular ligament
- Calcaneonaviclar part of bifurcate ligament
- Calcaneocuboid part of bifurcate ligament
- Dorsal cuboideonaviclar ligament
- Dorsal cuneonavicular ligaments
- Dorsal intercuneiform ligaments
- Dorsal tarsometatarsal ligaments
- Lateral talocalcaneal ligament
- Long plantar ligament
- Peroneus longus tendon
- Peroneus brevis tendon
- Cuboid bone
- Dorsal calcaneocuboid ligament
- Dorsal metatarsal ligaments
Medial Ligaments
Ankle Surface Anatomy

A. Superior View

B. Superior View
Bones: Ottawa Ankle Rules

- Indication for xray:
- Any pain in malleolar zone and any of these findings:
  - bone tenderness at A;
  - bone tenderness at B;
  - inability to bear weight both immediately and in the ED
Xray

- Weightbearing preferred
- AP
- Lateral
- Mortise

https://radiopaedia.org/articles/ankle-series?lang=us
Ankle Fractures

- Generally stable if:
  - Isolated to one malleolus (lateral, medial, posterior)
    - Don’t forget proximal fibula!
  - Nondisplaced
  - No associated medial ankle ligamentous injury
Stable if Distance Superior Ankle Joint = Medial
Distal Fibular Fracture Types

- Normal
- Weber A
- Weber B
- Weber C
Weber Fracture Types
Weber A – Generally Stable
Below Level of Talar Dome
Weber B = May be Unstable
At Level of Talar Dome – Look for Medial Injury
Unstable Weber B
Weber C = Often Unstable Above Talar Dome. Look For Medial, Syndesmotic or Proximal Fibular Injury
Maisonneuve Fracture

- Fracture of proximal fibula with unstable ankle injury (widening of ankle mortise)
- Ligament injury at syndesmosis or deltoid and/or fracture of medial malleolus

https://radiopaedia.org/articles/maisonneuve-fracture?lang=us
Gravity Stress Ankle Xray
Evaluates Deltoid, Ankle Stability

Case 1, continued

- The patient does not meet Ottawa foot and ankle criteria for an x-ray
- How to differentiate ligament injury vs. tendon?
- Palpation
- Resistive Testing
- Stress testing
  - Anterior drawer (ATFL)
  - Talar tilt (ATFL, CFL)
  For syndesmosis:
  - Squeeze test
  - External rotation stress test
Ankle Sprains: Lateral

Talar Tilt

Anterior Drawer
Ankle Sprains: Medial

Limited sensitivity acutely. Palpation of deltoid is not reliable.
→ Xray medial gravity stress testing
Syndesmosis

https://www.nuemblog.com/blog/high-ankle-sprain

https://www.researchgate.net/figure/Anatomical-illustration-of-the-tibiofibular-syndesmosis_fig1_324160037
Lateral tendons

- Soleus muscle
- Fibularis (peroneus) longus muscle
- Fibularis (peroneus) brevis muscle
- Calcaneal (Achilles) tendon
- Common tendinous sheath of fibularis (peroneus) longus and brevis
- Subcutaneous calcaneal bursa
- (Subtendinous) bursa of calcaneal tendon
- Superior and inferior fibular (peroneal) retinacula
- Calcaneus
- Extensor digitorum brevis muscle
- Abductor digiti minimi muscle
- Extenor digitorum longus muscle
- Superior extensor retinaculum
- Tendinous sheath of tibialis anterior
- Lateral malleolus and subcutaneous bursa
- Inferior extensor retinaculum
- Tendinous sheath of extensor digitorum longus and peroneus tertius
- Tendinous sheath of extensor hallucis longus
- Tuberosity of 5th metatarsal bone
Lateral Ankle Surface Anatomy
Medial Ankle Tendons

Tendon Sheaths of Ankle
Medial View

- Calcaneal (Achilles) tendon
- Sheath of flexor digitorum longus tendon
- Posterior tibial artery and tibial nerve
- Sheath of flexor hallucis longus tendon
- Flexor retinaculum
- Subtendinous calcaneal bursae
- Calcaneus
- Abductor hallucis muscle (cut)
- Plantar aponeurosis (cut)
- Flexor digitorum brevis muscle
- Sheath of flexor digitorum longus tendon
- Medial plantar nerve
- 1st metatarsal bone
- Sheath of flexor hallucis longus
- Tibialis posterior tendon
- Superior extensor retinaculum
- Medial malleolus of tibia and subcutaneous bursa
- Tibialis anterior tendon and sheath
- Sheath of tibialis posterior tendon
- Inferior extensor retinaculum
- Sheath of extensor hallucis longus tendon
Strength Testing

Inversion – Posterior Tibial, Tib Ant

Eversion – Peroneal Tendons
Dorsiflexion, Plantarflexion Strength Testing

• Dorsiflexion: Tibialis anterior
  – Commonly weak with nerve injury (L4, L5, sciatic, deep peroneal nerve)

• Plantarflexion
  – Soleus, gastrocnemius, posterior tibial tendon
Physical Exam

Inspection: bruising, swelling, deformity

Function: walking gait
• Single leg balance
• Single leg heel raise

Sensation

Palpation – BLT CaN

Stability testing

Strength testing: DF, eversion, inversion, PF
Case 2: Ankle Inversion and Foot Pain

- 35 yo presents the next week with foot pain and bruising after rolling ankle while trail running.
- Unable to bear weight
- Pain is at medial midfoot
- What’s your differential?

Bone, Ligament, Tendon, Cartilage, Nerve
Ottawa Foot Rules: Foot Xrays

- Xrays required only if there is any pain in midfoot zone and any of these findings:
  - Bone tenderness at C
  - Bone tenderness at D
  - Inability to bear weight both immediately and in the emergency department.
Foot Bony Anatomy

(a) Superior view
- Medial cuneiform
- Intermediate cuneiform
- Navicular
- Talus
- Trochlea of talus
- Calcaneus

(b) Medial view
- Sustentaculum tali (talar shelf)
- Facet for medial malleolus
- Navicular
- Intermediate cuneiform
- First metatarsal
- Medial cuneiform
- Calcaneus
- Calcaneal tuberosity

(c) Lateral view
- Facet for lateral malleolus
- Navicular
- Intermediate cuneiform
- Lateral cuneiform
- Calcaneus
- Cuboid
- Fifth metatarsal
Surface Anatomy

Fifth Metatarsal

Navicular Tubercle
Navicular Avulsion Fracture

https://radiopaedia.org/cases/dorsal-avulsion-fracture-of-the-navicular-bone-2?lang=us
Navicular Body Fracture

https://www.orthobullets.com/foot-and-ankle/7033/tarsal-navicular-fractures
Lisfranc Ligament Injury

- Disruption between medial cuneiform and base of 2nd metatarsal
- Can be sprain or severe dislocation
- Ligament only or fracture dislocation
- Lisfranc ligament
- Dorsal and plantar tarsometatarsal ligaments
Lisfranc Injury = Tarsometatarsal Fracture Dislocation
Lisfranc: Severe Pain, Unable to weightbear.

- Bruising, swelling.
- Usual films PLUS bilateral weightbearing AP views
- Usually surgical
- Post-traumatic severe arthritis if not treated
Lateral Midfoot Pain after Inversion

Fifth Metatarsal
Pain at Base of 5th Metatarsal
5th Metatarsal Styloid Avulsion Fracture → Shoe or Boot
Jones Fracture ➔ Ortho
When Pain and Dysfunction Persist, Low Threshold to Refer or Image (MRI, usually)
Don’t Forget Nerves
Resources

Useful Textbooks

• Physical Examination of the Spine & Extremities, Stanley Hoppenfeld.
• Fracture Management for Primary Care, M. Patrice Eiff, Robert Hatch

Useful Websites:

https://www.physio-pedia.com/home/
https://www.orthobullets.com
https://radiopaedia.org/
Case 3: Posterior heel and calf pain

- 40 y/o male, inconsistent exerciser, reports sudden pain and disability of left calf while playing basketball. Felt as if kicked in back of leg despite lack of contact with another player. Heard/felt an associated pop.

- PE: bruising to posterior calf and ankle. Unable to rise up on toes. Palpable defect in distal Achilles. Thompson squeeze test of the calf results in no plantar flexion of the foot.
Achilles Tendon Rupture

- Most often occurs in 3rd through 5th decades.
- Patients might have a prodrome of mild symptoms, suggesting underlying tendinopathy.
- Risk factors include poor conditioning before sports participation, and lack of warm up before exertion.
Achilles Tendon Rupture

- Physical examination is consistent with disruption of the plantar flexor muscle-tendon unit
  - Ecchymosis due to bleeding
  - Palpable defect at site of tear
  - Weakness in plantar flexion (unable to rise up onto toes)
Achilles Tendon Rupture

Thompson test – patient placed in prone position, foot off the end of the table. Squeeze of the calf in this position should result in pull on the intact Achilles tendon, resulting in plantar flexion of the foot. Absence of plantar flexion implies disruption of the integrity between the calf and Achilles due to Achilles tendon rupture.
Achilles Tendon Rupture

- Thompson test
Achilles Tendon Rupture

Treatment

• Surgical repair vs. non-surgical treatment results in equivalent plantar flexion strength at long term follow up

• Non-surgical treatment is associated with lower complication rate, and is often chosen for patients who are sedentary, have medical comorbidities, poorer soft tissue quality, or present late after injury

• Surgical treatment is associated with the possibility of earlier return to activity and a lower re-rupture rate, but places patients at risk of surgical complications
Achilles Tendon Rupture

Physical Examination Practice Goals

• Identify the Achilles tendon by palpation
• Perform a Thompson test
Achilles Tendon Rupture

Citations


Case 4: Hind/midfoot pain

• 55 y/o female reports gradually progressive pain in her right medial heel and arch.

• PE: Standing examination reveals flattening of the arch of the right foot compared to the left. Rising up onto the toes of the right foot (“heel rise”) results in medial sided right foot pain.
Tendinopathies of the foot and ankle

Medial
- Posterior tibialis tendonopathy

Lateral
- Peroneal tendonopathies
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Posterior tibialis muscle and tendon functions:

1. primary inverter of the foot
2. assists in plantar flexion of the foot
3. provides dynamic support of the medial arch of the foot
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

- Most common cause of adult acquired flatfoot deformity
- Classic presentation is a female in 6th decade
- Risk factors include hypertension, diabetes, arthritis, obesity, previous trauma, steroid exposure
- At particular risk of failure due to relative hypovascularity just as it makes a sharp turn around the medial malleolus
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

- As it fails, loss of its inversion functionality results in unopposed eversion stress and abnormal motion. Coupled with loss of its medial arch support functionality, the resulting strain on the static stabilizing ligaments leads to their eventual failure and the resulting flat foot deformity.
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical examination findings

- Medial hindfoot swelling
- Loss of medial longitudinal arch
- “Too many toes” sign
- Loss of inversion on heel rise
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical examination findings

- Medial hindfoot swelling and loss of medial longitudinal arch
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical examination findings

- Medial hindfoot swelling

Area of pain, swelling, and tenderness
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical examination findings

• Loss of medial longitudinal arch (flat foot deformity)
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical examination findings
• “Too many toes sign”
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical examination findings

- Loss of inversion on heel rise
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Treatment

• Goal is to allow recovery of the overused tendon before it fails and results in consequent loss of the medial longitudinal arch and associated arthritis and pain

• Initial trial of conservative management over 3-4 months
  – NSAIDS
  – Activity modification
  – Immobilization in walking boot for 3-4 weeks followed by PT
  – Orthotics

• Consultation with podiatry or foot/ankle surgery
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Physical Examination Practice Goals

- Medial hindfoot swelling
- “Too many toes” sign
- Loss of medial longitudinal arch
- Loss of inversion on heel rise
Tendinopathies of the foot and ankle - medial: posterior tibialis tendonopathy

Citations


• Ross MH et al. Reported selection criteria for adult acquired flatfoot deformity and posterior tibial tendon dysfunction: are they one and the same? A systematic review. PLoS One 2017 Dec 1;12(12):e0187201
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Peroneal muscle and tendon functions:

1. Primary everters of the foot
2. Principal dynamic lateral ankle stabilizers
3. Assist in plantar flexion

Anatomy:

1. P. brevis – inserts on base of 5th metatarsal
2. P. longus – inserts on base of 1st metatarsal and medial cuneiform
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

- Pathologies of the peroneal tendons include peroneal tendonopathy, peroneal tendon tears, and peroneal subluxation.
- Most often seen in young, active patients such as dancers, runners, skiers, and those at risk for chronic ankle instability.
- Atraumatically, chronic ankle instability can result in peroneal tendonopathy. Chronic peroneal subluxation can result in degenerative peroneal tendon tears.
- Traumatically, forceful passive ankle dorsiflexion with the foot in slight inversion can result in strong reflex contraction of the peroneals, leading to tendinitis, tear, subluxation, or avulsion of its insertion on the base of the 5th metatarsal.
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Physical examination findings

- Lateral hindfoot tenderness, swelling, crepitation
- Pain, weakness, and/or subluxation with resisted ankle eversion and/or big toe plantarflexion
- Consider peroneal tendon injury in any patient who presents with a lateral ankle sprain
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Physical examination findings

- Lateral hindfoot tenderness, swelling, crepitation
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Physical examination findings

- Pain, weakness, and/or subluxation with resisted ankle eversion
  - also test big toe plantarflexion if suspect P. longus pathology
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Physical examination findings

- Consider peroneal tendon injury in any patient who presents with a lateral ankle sprain
  - palpate for base of 5th metatarsal tenderness
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Treatment - Tendinopathy and Tears

• Initial trial of conservative management over 4-6 months can include some combination of rest and/or immobilization; NSAIDS; PT; and corrective orthotics (if hindfoot malalignment). Steroid injections run the risk of rupture.

• Consultation with podiatry or foot/ankle surgery if not improving
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Treatment – Tendon subluxation/dislocation

- Initial trial of conservative treatment can be considered after an acute tendon subluxation/dislocation episode
  - Reduce the tendons into the retromalleolar groove
  - Immobilize for 6 weeks with foot in slight plantarflexion and inversion
- For chronic dislocations, or when acutely dislocated tendons cannot be reduced into position, proceeding directly to surgical management is recommended
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Physical Examination Practice Goals

- Palpate the course of the peroneal tendons posterior and inferior to past the lateral malleolus
- Eversion testing of the foot/ankle
- Palpate the base of the 5th metatarsal
Tendinopathies of the foot and ankle - lateral: peroneal tendon injuries

Citations


Case 5: Plantar heel pain

- 45 y/o female presents with 3 months of daily pain at the bottom of her heel. First step out of bed is especially painful; may occur again multiple times a day upon standing after prolonged sitting; often worse at end of the day

- PE: slight pes planus and overpronation. Exquisite tenderness to palpation of the medial plantar heel, mild extension of palpable tenderness into arch of the foot. Passive dorsiflexion of the toes also causes heel pain. Decreased Achilles flexibility
Plantar Fasciitis

• Most common cause of plantar heel pain
• Lifetime prevalence of 10% in the general population
• Affects both sedentary and active people
• Thought to result from chronic overload of the fascia, either from lifestyle or exercise
• Current science suggests it is more correctly termed plantar fasciosis because of histological evidence of degeneration rather than inflammation
Plantar Fasciitis

Heel spurs and plantar fasciitis

• While heel spurs are associated with pain, they are not causative of pain in PF, and PF can be treated without removing the spur
• Heel spurs are present in 45-85% of persons with plantar fasciitis
• Common risk factors such as obesity and advancing age suggest PF and heel spurs may be linked etiologically
• The plantar fascia inserts into the periosteum of the spur in 46% of cases; more often, the plantar fascia inserts plantar to the spur
• Some theorize that heel spurs are an adaptive response to reduce plantar fascial failure
Plantar Fasciitis

Physical Examination

- Most exquisite tenderness to palpation over medial calcaneus
- Tenderness can extend into the midfoot arch
- May have findings of risk factors for plantar fasciitis
  - Obesity
  - Pes planus
  - Overpronation
  - Tight Achilles tendon/calf
Plantar Fasciitis

Physical Examination

• Most exquisite tenderness to palpation over medial tubercle of the calcaneus
Plantar Fasciitis

- Differential diagnosis: tarsal tunnel syndrome (posterior tibial nerve impingement)
  - Associated with numbness, tingling, or burning paresthesias
  - Tinel sign at the posterior medial malleolus may provoke paresthesias
  - Dorsiflexion (with or without eversion) may worsen symptoms
Plantar Fasciitis

Treatment

- 80% improve within 12 months with conservative treatment
- Initial treatments include relative rest and activity modification; PT for stretching as well as strengthening of the intrinsic muscles of the foot; ice massage; NSAIDS; over-the-counter heel cups or orthotics; weight loss
- Secondary treatments include cortisone injections; ultrasound guided platelet-rich plasma injections; night splints; extra-corporeal shock wave therapy
- Surgery usually reserved for patients with symptoms that limit activity and are not manageable by conservative treatments
Plantar Fasciitis

Physical Examination Practice Goals

- Assess for pes planus
- Palpate for tenderness at the medial tubercle of the calcaneus
- Ankle dorsiflexion to assess flexibility of the Achilles tendon
Plantar Fasciitis

Citations


• Schwartz EN and Su J. Plantar fasciitis: a concise review. *Perm J* 2014 Winter; 18(1);e105-e107

• Tu P. Heel pain: diagnosis and management. *Am Fam Physician* 2018 Jan 15;97(2):86-93A
Foot and Ankle Exam Practice
(See Handout)

- Ankle and foot position, pes planus, “too many toes” sign
- Gait, balance, heel raise
- Skin: swelling, bruising
- Sensation, pulses
- Seated strength: DF, PF, inversion, eversion

Palpation:
- Medial malleolus (posterior)
- Lateral malleolus (posterior)
- Calcaneus – squeeze; tenderness at medial plantar tubercle
- Base of 5th metatarsal
- Navicular

- Ligaments:
  - Lateral, deltoid, syndesmosis
- Tendons:
  - Posterior tibial
  - Peroneal tendons
  - Achilles
  - Thompson test

Cartilage: tibiotalar joint

Stress testing:
- Anterior drawer, talar tilt
- Syndesmotic squeeze test
- External rotation stress test
The End