Foot and Ankle Injuries in Athletics

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Today's lecture can be viewed at the following URL address:
http://sites.udel.edu/chs-atep/lectures/

We most likely will not get through all these slides today, however the presentation is thorough and complete and will make for an excellent study guide for the BOC examination! Good Luck!

Learning

“All of life should be a learning experience, not just for the trivial reasons but because by continuing the learning process, we are challenging our brain and therefore building brain circuitry”

Arnold Scheibel

A First State Fact!

Delaware is 96 miles long and varies from 9 to 35 miles in width.
Perhaps ATC’s Need to Incorporate this Into Their Assessment Scheme?

Anatomical Review

“Diagnosis is only a matter of applying one’s anatomy.”
Clinical PEARL: Navicular Palpation

- Palpated 2-3 cm anteroinferior to the medial malleolus
- More prominent with foot adducted
Radiographically Viewed
Ankle Joint (Medial View)

Challenge yourself to identify the anatomical structures?

Articulations

The Ankle Mortise

Major Lateral Ligaments
The Medial “Deltoid” Complex

Ankle Syndesmosis

The Subtalar Joint

The Ligaments of the Subtalar Joint

IOM = Interoosseous membrane
IOL = Interoosseous ligament
AITFL = Anterior inferior Tibiofibular Ligament
PITFL = Posterior inferior Tibiofibular Ligament

IOM
IOL
AITFL
PITFL
Muscular Anatomy

Compartments of the Leg

- **Anterior**
  - Medial (Tibial Bone)
  - Lateral (Peroneal/Fibularis Region)

- **Posterior**
  - Superficial
  - Deep
Lower-Leg Compartment Contents

<table>
<thead>
<tr>
<th>Lower-Leg Compartment Contents</th>
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<tbody>
<tr>
<td>Lower Leg Musculature</td>
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<table>
<thead>
<tr>
<th>Muscle</th>
<th>Nerve</th>
<th>Vascular</th>
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<tbody>
<tr>
<td>Anterior</td>
<td>Deep peroneal nerve</td>
<td>Anterior tibial artery</td>
</tr>
<tr>
<td>Lateral</td>
<td>Superficial peroneal nerve, posterior part of deep peroneal nerve</td>
<td>Peroneal artery</td>
</tr>
<tr>
<td>Posterior superficial</td>
<td>Tibial nerve branches</td>
<td>Posterior tibial artery, popliteal artery, peroneal artery, and anterior tibial artery</td>
</tr>
<tr>
<td>Posterior deep</td>
<td>Tibial nerve</td>
<td>Posterior tibial artery, peroneal artery</td>
</tr>
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Tibialis Anterior

Extensor Digitorum Longus
At what bony landmark do they bifurcate?

Can you tell which one?

Peroneals

Posterior Compartment (S)

Plantaris

Posterior Compartment (S)

Posterior Compartment (D)

TOM

DICK
HAS ANYONE SEEN FERRIS???

Can anyone name this voice?

Ben Stein!

Posterior Compartment (D)

Talocrural and Subtalar Joint Motion

Talocrural Joint

Subtalar Joint

Selected Injuries Involving the Ankle Region

 Circa 1986
Inversion/Lateral Sprains

- 85-95% of all ankle sprains
- lateral malleolus extends further
- medial acts as a fulcrum
- weaker lateral ligs

**MOL:**
- inversion (CF lig)
- inv + pl (ATF/CF/TibFib ligs)
- most common mechanism

**R/O:**
- "push-off" fx’s of medial malleolus
- other associated fx’s & acceve injury

Ankle Sprain - Risk Factors

Consequences of an Acute Ankle Sprain

Most commonly injured structures in 547 patients with soft tissue injuries due to an acutely twisted ankle:
- Presented to emergency room or occupational medicine clinic
- "Injury" based on pain at site of structure
  - Anterior Talofibular Lig. (83%)
  - Calcaneofibular Lig. (67%)
  - Posterior Talofibular Lig. (34%)
  - Deltoid Lig. (32%)
  - Ankle joint capsule (32%)
  - Dorsum of foot (20%)
  - Sinus tarsi (16%)
  - Peroneals (12%)
  - Bifurcate Lig. (8%)
  - Syndesmosis (6%)

Most common clinical presentations:
- ATFL + CFL = 34%
- ATFL + CFL + PTFL = 31%
- ATFL only = 16%
- Other = 14%
- PTFL only = 2%
- CFL only = 1%

Most common primary diagnoses:
- Grade 1 sprain = 71%
- Other = 15%
- Grade 2 sprain = 10%
- Grade 3 sprain = 3%
- Syndesmotic sprain = 1%

Fallet et al, J Foot Ankle Surg 1998

Journal of Athletic Training

National Athletic Trainers’ Association Position Statement: Conservative Management and Prevention of Ankle Sprains in Athletes

Thomas W. Kangrovi, PhD, ATC, FNATA, FACSM; Jay Harrel, PhD, ATC, FNATA, FACSM; Nat Ateniolas, MB, Carrie L. Gendron, PhD, ATC, FNATA; Nwafor E. K. Nwafor, PhD, ATC, Kinesiology, and Mark S. Peterson, PhD, ATC, FNATA. Eur Neuromuscul Disord, West J Med, Department of Physical Therapy, University of California, San Francisco, CA 94143.

National Athletic Trainers Association, 8240 Higgins Road, Park Ridge, Illinois 60068-7044
Recommendations

The purpose of this position statement is to present recommendations for certified athletic trainers and other allied health professionals in the conservative management and prevention of ankle sprains in athletes. Our recommendations will be reinforced by relevant scholarly evidence currently available in peer-reviewed publications and graded according to the Evidence Category Taxonomy (SORT) Evidence Based Scale.

Recommendations from Five (5) Different Categories

- Diagnosis
- Treatment and Rehabilitation
- Return-to-Play Considerations
- Prevention
- Special Considerations

What is Evidence-Based Practice

Current State of AT Practice
Clinical assessment of acute lateral ankle sprain injuries: consensus statement and recommendations of the International Ankle Consortium

Authors: Delahunt E 1,2, Bleakley CM 3, Bossard DS 1,2, Caulfield BM 1,4, Docherty CL 5, Doherty C 6, Fourchet F 6, Fong DT 7, Hertel J 8, Hiller CE 9, Kaminski TW 10, McKeon PO 11, Refshauge KM 9, Remus A 4, Verhagen EA 12, Vicenzino BT 13, Wiktrom EA 14, Gribble PA 15

Clinical Diagnostic Assessment

- **Mechanism of injury**
  - Be aware of mechanisms characteristic of lateral ankle sprain
  - Syndesmotic sprain

- **Why?**
  - Guide assessment of appropriate treatment

- **Assessment of ligaments**
  - **ATFL (Anterior talo-fibular ligament)**
    - anterior drawer test
    - palpation & manual stress testing
    - Symptomatic (dysfunction)
  - **CFL (Calefarocalateral ligament)**
    - anterior drawer test
    - palpation & manual stress testing
    - Symptomatic (dysfunction)

- **Why?**
  - Establish the likelihood of ankle fracture
  - (via use of Ottawa Ankle Rules)

- **Establish history of previous lateral ankle sprain**

- **Why?**
  - Primary risk factor for subsequent injury
  - May indicate increased mechanical & non-mechanical factors

- **Assessment of bones & weight-bearing status**

- **Why?**
  - Establish likelihood of ankle fracture

*Authors & references for the clinical assessment of acute lateral ankle sprain injuries: consensus statement and recommendations of the International Ankle Consortium*
Implementing the Position Statement Recommendations

https://www.nata.org/news-publications/pressroom/statements/position

Helpful Resource

- Section I Risk and Risk Reduction of Ankle Sprains
- Section II Diagnosis
- Section III Treatment and Rehabilitation
- Section IV Surgical Considerations

Did This 2012 JAT Article Make You Stop and Think About Current Ankle Sprain Management?

What is the Evidence for Rest, Ice, Compression, and Elevation Therapy in the Treatment of Ankle Sprains in Adults?

Michelle J. van den Berge, MD, Peter A.A. Staal, MD, PhD, Leonard P. van Brakel, PhD, Lies Verhagen, MD, PhD, C. Richard van Dieijen-Visser, MD, PhD

A Systematic Review, Meta-Analysis, and Commentary

OBJECTIVE: To systematically evaluate the quality of scientific evidence on whether the use of Rest, Ice, Compression, and Elevation (RICE) therapy has a positive impact on functional recovery, pain, swelling, and re-injury risk in acute ankle sprains.

METHODS: A systematic review and meta-analysis of randomized controlled trials of 399 patients with acute ankle sprain, using the Cochrane Collaboration Risk of Bias tool.

MAIN OUTCOMES MEASURED: Functional recovery, pain, swelling, and re-injury risk following treatment with RICE therapy.

RESULTS: RICE therapy significantly decreased pain and swelling in acute ankle sprain (SMD = 0.52, 95% CI: 0.32-0.72) compared to control. RICE therapy did not significantly affect functional recovery or re-injury risk.

CONCLUSIONS: RICE therapy is effective in reducing pain and swelling in acute ankle sprain, but does not have a significant impact on functional recovery or re-injury risk.
An Interesting Take on an Old Practice

POLICE = Protection, Optimal Loading, Ice, Compression, and Elevation

PRiCE needs updating, should we call the POLICE?

BJSM 2016

2016 consensus statement of the International Ankle Consortium: prevalence, impact and long-term consequences of lateral ankle sprains

Phillip A Gibble, 1 Chris M Bleakley, 2 Brian M Caufield, 3 Carrie L Docherthy, 4 François Fourchet, 5 Daniel T-Pui Fong, 6 Jay Hertel, 7 Claire E Hilger, 8 Thomas W Kaminski, 9 Patrick O McIlvene, 10 Kathrynn M Nofzinger, 9 Evert A Vehagen, 11 Bill T Vicenzino, 12 Erik A Wikstrom, 13 Eamonn Delahunt 14

While the direct costs for treatment of an isolated lateral ankle sprain are relatively low, compounding these costs are the indirect costs from follow-up care and injury-associated time loss. With a large percentage of the population experiencing this injury, the societal costs are high. As these treatment costs for lateral ankle sprains are combined with the costs of managing the loss of physical activity, and treatments for onset and care for post-traumatic osteoarthritis of the ankle, it becomes apparent that the healthcare burden that emerges from a ‘simple’ lateral ankle sprain is substantial.

BJSM 2016

Athletic Training Service Characteristics for Patients With Ankle Sprains Sustained During High School Athletics

Janet E. Simon, PhD, ATC; Erik A. Wikstrom, PhD, ATC, FACSMT; Dustin R. Grooms, PhD, ATC, CSCS; Carrie L. Docherthy, PhD, ATC, FNATA; Thomas P. Dempier, PhD, ATC; Zachary Y. Kerr, PhD, MPH

Conclusions: The ATs provided a variety of services to treat high school athletes who had sustained ankle sprains, including therapeutic exercises and neuromuscular reeducation, which were supported by research. However, ATs should consider using manual therapy (use supported by grade B evidence) and therapeutic exercise more (use supported by grade A evidence).

BJSM 2016

Ankle Sprains Can Lead to Cancer? I Didn’t Know That

Ankle sprains are a musculoskeletal injury and need to be treated as such; if not, they become a huge public health burden in the long term and, through decreased physical activity levels, may even lead to certain types of cancer.
The Future of Acute Ankle Sprain Treatment Intervention?

Footbeat in Action

International Ankle Consortium Rehabilitation-Oriented ASessmenT (ROAST)

- The International Ankle Consortium ROAST will help clinicians identify mechanical and/or sensorimotor impairments that are associated with chronic ankle instability (CAI).

- This consensus statement from the International Ankle Consortium aims to be a key resource for clinicians who regularly assess individuals with acute lateral ankle sprain injuries.
OTTAWA ANKLE RULES

• Developed to reduce the use of unnecessary radiographs in the diagnosis of acute foot and ankle injuries in emergency departments
• Estimated only 15% of foot/ankle injuries presenting to emergency departments are fractures
• Use of these diagnostic rules have significantly reduced unnecessary x-rays

Clinical PEARL:
Ottawa Ankle Rules Palpation Points

• Medial
• Lateral

Ankle Instability
Overview – Ankle Instability

• Inversion ankle sprains are a frequent orthopedic injury

• The majority of appropriately rehabilitated ankle sprains will do well . . . , but saying “they all do well” is a misnomer!

• Symptoms:
  – pain
  – feeling of giving way
  – swelling
  – recurrent injury

Ankle Instability (Mechanical)

• Definition:
  – lateral ligament laxity (Freeman et al. - 1965)
  – joint motion that exceeds physiologic motion (Tropp - 1985)

• Assessment Tools:
  – anterior drawer test
  – talar tilt
  – roentgenographic studies (Telos Stress)

Hertel, J Athletic Training, 2002

Now This Takes Some Coordination!
Instrumented Ankle Arthrometry

Ankle Instability (Functional)

- **Definition:**
  - disability to which patients refer when they say the foot tends to “give way” (Freeman et al. - 1965)
  - joint motion beyond voluntary control, but not necessarily exceeding physiologic ROM (Tropp - 1985)
Ankle Instability (Functional)

- **Assessment Tools:**
  - muscular strength
  - isometric
  - isokinetic
  - stabilometry
  - peroneal reaction times

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Cumberland Ankle Instability Tool (CAIT)

- Designed to measure functional ankle instability
- 9 questions related to subjects’ perception of ankle stability during various activities
- Shown to be valid and reliable
- **How do you score?**
  - Maximum score = 30
  - Scores < 25 = ankle instability

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**APPENDIX 1: THE CAIT QUESTIONNAIRE**

<table>
<thead>
<tr>
<th>Item</th>
<th>Left</th>
<th>Right</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I have pain in my ankle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. During sport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Running on uneven surfaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Walking on uneven surfaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Walking on level surfaces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. My ankle feels UNSTABLE when</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sometimes when running</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. When walking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. If I go feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Occasionally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Always</td>
<td></td>
<td></td>
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</tbody>
</table>

**Scores:**
- Never = 0
- Sometimes = 1
- Often = 2
- Frequent = 3
- Always = 4

**Selection Criteria for Patients With Chronic Ankle Instability in Controlled Research: A Position Statement of the International Ankle Consortium**

[Selection Criteria Document]
Eversion/Medial Ankle Sprains

- less common (5 - 15% prevalence)
  - strong deltoid complex
  - bony structure of ankle mortise
- **MOI:**
  - eversion + df (ruptures deltoid + tibfib ligs.)
  - R/O associated fx’s
  - rotation + eversion (fx fibular shaft + sprain of deltoid complex)

Syndesmotic Ankle Sprains

- uncommon injury, the “high ankle sprain”
- more disabling with prolonged recovery time
- **MOI:**
  - forced df
  - talus located between malleoli forces bones apart
  - damage to syndesmosis (fibrous sheath)
  - forced rotation with a fixed foot
  - shape of the talus acts as a fulcrum forcing the tibia and fibula apart

17% - 74% of ankle injuries among young athletes!

Syndesmotic Ankle Sprains

- **Sx:**
  - point tenderness and swelling localized over the anterior + posterior tibiofibular ligaments
  - bilateral compression increases pain
  - walk on toes
  - inability to push off
- **Tx:**
  - ICERS²
    - immobilization usually for a period of 2-3 weeks
      - depends on the severity of mortise separation
    - NSAID’s

Clinical PEARL: Syndesmosis Palpation

- Anterior Inferior Tibiofibular Ligament
- Interosseous Membrane
- Posterior Inferior Tibiofibular Ligament
Radiological View

Radiograph showing widening of the tibiofibular "clear space" (arrows) as a result of disruption of the syndesmosis. The clear space is normally less than 5 mm wide.

Ankle Fractures

Radiographs showing widening of the tibiofibular "clear space" (arrows) as a result of disruption of the syndesmosis. The clear space is normally less than 5 mm wide.

Ankle Fractures

- Ankle fractures are usually defined as single malleolar, bimalleolar, or trimalleolar
- Trimalleolar involves med/lat and posterior tibial malleolus
- Isolated fibular fractures are the most common type of fracture and, without displacement, usually requires 4-6 weeks to heal
Ankle Dislocation

- Ankle dislocation results from complete disruption of articular elements in the ankle
- An isolated ankle dislocation without associated fracture is quite rare

Acute Ankle Dislocation
England’s Physiotherapist (Gary Lewin) Dislocates Ankle during 2014 World Cup --- Ughhh!

(Landed on a water bottle celebrating a goal!)

Achilles Tendon Injuries

- Common tendon of the triceps surae (2 heads of gastrocnemius & soleus) inserting into the calcaneus
- Receives its greatest stress during knee extension/ankle dorsiflexion
- Tendinitis (aka tendonitis)
  - Most common form of tendinitis seen in athletics
  - Et:
    - Overuse
  - Sx:
    - Crepitus
    - Inflammatory rxn

Can you think of a MOI?

Triceps Surae

Tendinitis (cont’)
- Tx:
  - Cryotherapy
  - NSAID’s
  - Heel lifts
  - Decrease/modify activity
  - Stretching/strengthening of gastroc/soleus
  - Orthotics
  - Gradual return to activity

Ruptures
- 75% seen in males 30-40 yr. old who participate in intermittent activities

Chauncey Billups NBA ----
https://www.youtube.com/watch?v=qGwnFAbDOZ8
Clinical PEARL: Gastrocnemius/Soleus Stretch

Gastrocnemius Stretch (Straight Knee)  
Soleus Stretch (Bent Knee)

Achilles Tendon Injuries

• Ruptures (con’t)
  – Factors Contributing to Ruptures
    • microtrauma/inflammation
    • dominant extremity
    • age
    • steroid usage
  – Signs/Sx:
    • painful, swollen calf
    • ecchymosis
    • palpable deformity
    • pf MMT = weakness
  – Tx:
    • pf splint 10°-15°, NWB, transport, surgery

Achilles Tendon Injuries

• Ruptures (con’t)
  – Sites:
    • calcaneal insertion
    • 2-6 cm above insertion pt (poor vascularity)
      – most common site of injury
    • MT junction
  – MOI:
    • forced pf during knee extension
      – common move during propulsion activities
    • sudden, forced df of an already pf foot
      – return from a jumping movement
      – most common mechanism

Side View of Ruptured Achilles’ Tendon. Notice depression at site of rupture (red circle).

https://www.instagram.com/p/BjvyDOphcnT/
Os Trigonum Syndrome (Posterior Ankle Impingement)

- **Os Trigonum** - Δ bone, posterior stylus of the talus
  - 7% of population has a free os trigonum (non-union)
- **Path:**
  - Traction apophysitis during early childhood caused the separation
  - FHL irritates the bone as it passes by
  - PF motions impinge the posterior process

Differential Diagnosis

A Shepherd’s fracture (avulsion fracture of the posterolateral process of talus), which is often difficult to differentiate radiographically from an os trigonum.

Os Trigonum Syndrome

- **Sy:**
  - Painful & limited pf
  - Pain on great toe flexion
- **Dx Tests:**
  - Bilateral x-rays (feet pf)
  - Bone scans or MRI
- **Tx:**
  - Symptomatic therapy (conservative)
  - Surgical intervention in some cases

Distal Fibular Fracture
Proximal Tibia Fracture

Foot Injuries

Every Athletic Trainer’s Worst Nightmare

Arch Injuries

- **Longitudinal Arch**
  - know anatomy
  - sprain - intertarsal ligaments
  - pes planus - flat foot
  - pes cavus – high arch

- **Transverse Arch**
  - know anatomy
  - sprain - intertarsal ligaments
  - look for callosities under 2nd metatarsal head

http://teachmeanatomy.info/lower/limb/misc/foot-arches/
Morton’s Neuroma

- **Definition** - a type of metatarsalgia (pain in the metatarsals) associated with a localized thickening (neuroma) at the point where the medial & lateral branches of the plantar nerve join between the 3rd & 4th metatarsal heads
  - **Sx**
    - pinpoint tenderness between 3rd & 4th metatarsal heads
    - decreased sensation in 3rd and 4th toes

- **Hx**
  - complain of sprained transverse arch, sharp-shocklike pain during activity that is relieved when the shoe is removed, numbness in the 3rd & 4th toes

- **Tx**
  - transverse arch pad
  - proper shoes
  - NSAID’s
  - RICE

Plantar Fascitis

- **Definition** - inflammation of the fascia covering the plantar aspect of the foot, most common site is from the attachment off the medial tubercle of the calcaneus

  *Note* - the long plantar ligament is found laterally and connects to the cuboid is part of the plantar fascia

- **Clinical PEARL: Plantar Fascia Palpation**
  - Passively extend hallux
  - Palpate starting at the medial tubercle of calcaneus
Turf Toe

- **Definition** - sprain of plantar capsuloligamentous complex of the great toe
- **MOI:**
  - hyperextension
  - hyperflexion + valgus stress (uncommon!)
- **Predisposing Factors:**
  - artificial turf
  - flexible footwear
  - pes planus
  - decreased ankle or MP joint motion

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**Turf Toe**

- graded according to sx’s (I, II, III)
- **Sx:**
  - inflammatory signs
  - ecchymosis
  - tenderness
- **Tx**
  - ICERS:
    - rigid foot insole
    - taping
    - restricted activity
    - crutches NWB in severe cases

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Lisfranc Injury

- The injury is named after Jacques Lisfranc de St. Martin, a French surgeon and gynecologist who described the injury in 1815.
- **Lisfranc Ligament**
  - ligament between the 2nd metatarsal and the medial cuneiform (oblique fashion)
- **MOI:**
  - axial load of pf foot
    - usually traumatic
- **Sx:**
  - swelling & tenderness midfoot
  - ecchymosis late
  - pain on stress of 1st/2nd metatarsal bases

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Lisfranc Fracture

AP radiograph of the forefoot. There is homolateral Lisfranc fracture-dislocation.
Lisfranc Injury

- **Tx:**
  - no flattening of long. arch
  - NWB cast 6 wks
  - walking cast 2 wks
  - flattening of long. arch
    - ORIF
    - poor prognosis
- 14.5 wks return to sports on average!

Foot Fractures

- neck of talus (forced DF)
- calcaneus (crush injury/compression)
- avulsion of base of 5th metatarsal (strong contraction of peroneus brevis)
- metatarsal fractures (direct trauma)
- Jones fracture (just distal to the base of the 5th metatarsal)

Calcaneal Fracture

- Lateral radiograph of the ankle. There is a hatchet injury to the calcaneus.

5th Metatarsal Tuberosity Fracture

- most common
- "tennis fracture"
- **MOI:**
  - inversion force with pull by lateral plantar fascia
- **Tx:**
  - undisplaced
    - wooden sole shoe
    - symptomatic care
    - union in 8 wks
  - > 2 mm displacement = ORIF
1902 Sir Robert Jones described 4 cases.

**Definition** -
- Transverse fx at the junction of the diaphysis and metaphysis
- Intraarticular fx (between 4th & 5th)
- Distal to base of 5th
  - @ a pt between insertions of peroneus brevis & tertius

**MOI:**
- Pl ankle with a large adduction force to forefoot

**Tx:**
- SL.C for 6-8 wks.
- ORIF in competitive athletes

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**Classification Scheme**

Characterization of Proximal 5th Metatarsal Fractures by Location

- Avulsion fracture
- Jones fracture
- Stress Fracture

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**Jones Fracture**

Lateral radiograph of the foot. A patient stepped off a curb and sustained a fracture of the proximal aspect of the fifth metatarsal.
Neuropathies and Compartment Syndromes

Definitions

- **Neuropathy** - any disorder affecting the nervous system.
- **Radiculopathy** - disorder of the spinal nerve roots
- **Compartment Syndrome** - condition in which increased intramuscular pressure in a confined anatomical space brought on by overactivity or trauma impedes blood flow and function of tissues within that space.
LE Neuropathies – Foot

• **Tarsal Tunnel Syndrome:**
  - Tunnel formed by the flexor retinaculum (lacinate ligament), medial wall of the calcaneus, posterior talus, distal tibia, and medial malleolus.
  - Structures include:
    - Posterior tibial nerve
    - PT tendon
    - FDL tendon
    - FH tendon
    - Posterior tibial artery & vein

Clinical PEARL: Tarsal Tunnel Palpation

- Passively dorsiflex the ankle and extend the toes.
- Palpate between the medial malleolus and Achilles tendon.
- Tinel’s Sign – tapping over the tarsal tunnel.

LE Neuropathies – Foot

• **Tarsal Tunnel Syndrome:**
  - Uncommon in athletes.
  - Etiology:
    - Vascular compromise of the nerve (sensory).
    - Direct compression neuropathy (sensory + motor).
    - Abnormalities of the tunnel.
    - Extrinsic factors that compress.

LE Neuropathies – Lower Leg

• **Entrapment of the SPN:**
  - Etiology:
    - Facial impingement as it exits the deep fascia, approx. 6 cm above the lateral malleolus.
    - Chronic ankle sprains subject the nerve to recurrent stretching.

Compressed tibial nerve in tarsal tunnel

Compression of tibial nerve in tarsal tunnel
LE Neuropathies – Lower Leg

• **Sural Nerve Entrapment:**
  - Secondary to 5th met fx’s
  - Recurrent sprains (PF/inv)
  - Ganglions
  - Extrinsic compression (tight ski boot)

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Thank You

Former VP Joe Biden

Former NJ Governor – Chris Christie

Bill Prentice – Principles of Athletic Training

Our Famous Delawareans!

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Wake Up!

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Review of the Clinical Foot and Ankle Assessment

Clinical assessment of acute lateral ankle sprain injuries (ROAST): 2019 consensus statement and recommendations of the International Ankle Consortium

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Anterior Talofibular Ligament (ATF)

**Anterior Talofibular Ligament palpation**

Recommended position for palpating the anterior talofibular ligament (Figure 5).

The ankle joint is plantar flexed and the foot inverted and externally rotated. The examiner can palpate the anterior talofibular ligament at its attachment to the distal tip of the lateral malleolus.

**Clinical examination**

The ligament is palpable and can be palpated at the distal aspect of the lateral malleolus.

**Clinical interpretation**

Implication of the patient’s “tender point” upon palpation of the anterior talofibular ligament is indicative of injury to this ligament.

**Figure 3**. The left index finger of the clinician is positioned at the distal tip of the lateral malleolus and is palpating the fibular attachment of the anterior talofibular ligament. The ankle joint is plantar flexed while the foot is inverted and externally rotated.

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Calcaneofibular Ligament (CF)

**Calcaneofibular ligament palpation**

**Recommended position for palpating the calcaneofibular ligament (Figure 7)**

The patient is positioned in sitting. The calcaneofibular ligament is palpated deep to the lateral malleolus to the posterior-lateral edge of the calcaneus.

**Clinical examination**

The palpation of the ligament is subcutaneous and is performed best by the examiner's fingers.

**Clinical interpretation**

Implication of the patient’s “tender point” upon palpation of the calcaneofibular ligament is indicative of injury to the ligament.

**Figure 7**. The index finger of the clinician is positioned on a portion of the calcaneofibular ligament just distal to the peroneal tendons.
Range of Motion Testing

- AROM
- PROM
- RROM
  - MMT
  - “Break Test”

AROM

- Plantar Flexion
  - Note that PF is two words!!

AROM

- Dorsiflexion

AROM

- Inversion
AROM

- Eversion

Weight Bearing AROM

Plantar and Dorsiflexion

Weight Bearing AROM

Inversion and Eversion

RROM

- Plantar Flexion
RROM

• Dorsiflexion

RROM

• Inversion

RROM

• Eversion

Show Me the Evidence!

• Sensitivity – those people correctly identified by the test as having the condition of interest (Positive (+) Predictive Value)
• Specificity – those people correctly identified as NOT having the condition of interest (Negative (-) Predictive Value)
Special Tests for Ligamentous and Capsular Laxity

Anterior Drawer Test

Sensitivity 32% - 80%

Anterior Drawer Schematic

Anterior Drawer Schematic

Anterior translation is > when the ankle is in 15° of plantar flexion
Anterior Drawer Test (variation)

Talar Tilt (Inversion Stress)
Sensitivity 52%

Talar Tilt Schematic

Talar Tilt (Eversion Stress)
Medial Subtalar-Glide Test

Used to assess laxity of the subtalar joint resulting from lateral ligament injury.

Test is performed by translating the calcaneus medially on the talus in the transverse plane—excessive laxity is a (+) test.

Ankle Syndesmosis

Risk Factors for Syndesmotic Ankle Sprains

- Prospective cohort (USMA) study examining the causes of SAS and medial ankle sprains (11.8% of all ankle sprains) over a 4 yr. period.
- Gender
  - ♂ more medial sprains vs. ♀
  - ♀ longer recovery time vs. ♂
- Sport
  - FB, soccer, team handball, basketball
- Level of Competition
  - Intercollegiate > intramural
- Body Mass Index (BMI)
  - > BMI is associated with more SAS and medial sprains
Mechanism of Injury – Ice Hockey Video

Assessment of Pain

• Patient complaints of pain include:
  – Anteriorly between distal fibula and tibia (AITFL)
  – Posteromedially at level of the ankle
  – Pain with WB and "pushing-off"
  – Some may complain of pain extending proximally (interosseous membrane?)
    • The “high ankle sprain”

Assessment Considerations

• Evaluation usually involves:
  – Location and extent of pain
  – Anatomic palpation
  – Various stress tests
  – Differential diagnosis:
    • Medial (Deltoid) ligament involvement
    • Associated fractures of either the tibia or fibula
    • Lateral ankle sprain

Palpation

• Evidence of swelling?
  – Severe swelling usually not present, if it is may take on a "rectangular" appearance!
• Tenderness between fibula and tibia (AITFL and PITFL)
• Tenderness over the medial malleolus
  – Isolated syndesmotic ligamentous injury is rare, may have lesions of deltoid ligament too
• Depends on evaluators ability to find ligament/IM
• Pain on palpation is the most frequent positive test
  – Alonso- JOSPT, 1998
  – Nussbaum, AJSM 2001
**Palpation – “Tenderness Length”**

  - Measure length of tenderness from distal tip of fibula to the most proximal portion of tenderness
  - Made along anterior portion of interosseous membrane (space between lateral palpable border of tibia and the medial palpable border of fibula)
  - “Tenderness Length” can be used to predict time lost from competition (> the distance = more time lost)

  \[
  \text{Days Lost} = 5 + (0.93 \times \text{tenderness length in cm}) \\
  \pm 3.72 \text{ days}
  \]

**Gait Assessment**

- Normal heel-toe walking gait may be replaced by a heel-raise gait.
  - Used to avoid excessive ankle DF and pain during “push-off”
- Antalgic gait with short duration of “stance” phase on the injured foot may also be present

**Hopping Assessment**

- Perform a single-leg hop pushing off from the toes
  - Performed only after R/O evidence of fracture
  - 10 reps?
- Inability to perform the hop or hopping with extreme pain is indicative of SAS.
  - Rising on the toes produces hindfoot inversion which stresses the syndesmosis

**Special Tests: Kleiger Test** (aka External Rotation Test)

- Externally rotate the foot while holding the ankle in a neutral position (can be performed either seated or supine)
  - Doesn’t measure instability
    - If (+) in the early stages (first few weeks) indicative of damage to syndesmotic ligaments
    - Best interrater reliability (0.75)
  - Alonso, JORPT, 1998
  - 55/60 patients in Nussbaum et al. (2001) study had (+) tests
Kleiger Test
(External Rotation Test)

- Described by Hopkinson et al. *Foot Ankle*, 1990
- Compress “cup” tibia/fibula together at mid calf moving upward proximally
  - Can also be performed seated
- Causes separation of distal tibiofibular syndesmosis
  - Teitz & Harrington *Foot Ankle Int*, 1998
- Not sensitive to minor or partial injuries of the syndesmotic ligaments.
  - 20/60 - Nussbaum et al. *AJSM* 2001
- Interrater reliability is low (0.50)
  
- (+) Test correlates w/ longer return

Special Tests: Squeeze Test

- Described by Hopkinson et al. *Foot Ankle*, 1990
- Compress “cup” tibia/fibula together at mid calf moving upward proximally
  - Can also be performed seated
- Causes separation of distal tibiofibular syndesmosis
  - Teitz & Harrington *Foot Ankle Int*, 1998
- Not sensitive to minor or partial injuries of the syndesmotic ligaments.
  - 20/60 - Nussbaum et al. *AJSM* 2001
- Interrater reliability is low (0.50)
  
- (+) Test correlates w/ longer return

Special Tests: Cotton Test
(aka Lateral Talar Glide)

- Used to evaluate lateral translation of the talus in the ankle mortise
- Performed with the patient supine
- Stabilize the distal leg but do not compress syndesmosis while opposite hand cups the calcaneus and talus
- (+) Test is lateral translation of the talus relative to the opposite uninjured limb and ↑ PAIN!

Special Tests: Fibular-Translation Test

- Described by Ogilvie-Harris et al. *Arthroscopy*, 1994
- Performed by translating the distal fibula anteriorly and posteriorly on the tibia
- (+) test results when pain is produced at the syndesmosis or when fibular displacement is > the uninjured limb
Special Tests: Point Test (aka Palpation Test)
- Supine or sitting
- Pressure with finger directly over the anterior aspect of the distal tibiofibular syndesmosis
- ↑ pressure gradually
- (+) test involves a report of pain by the patient

Special Tests: Dorsiflexion Maneuver
- Performed to force the wider anterior portion of the talar dome into the ankle mortise, thus inducing separation of the distal tibia and fibula
- Patient is seated, passive movement into DF
- (+) test is pain experienced in the distal tibiofibular syndesmosis
- Interrater reliability is low (0.36)

Special Tests: Crossed-leg Test
- Kiter E. *Foot Ankle Int.* 2005
- Mimics the squeeze test and attempts to induce separation of the distal syndesmosis
- Resting point should be mid-calf
- Pt applies a gentle force on medial knee
- (+) test is pain in distal syndesmosis

Special Tests: Heel Thump Test
- Described by Lindenfeld & Parikh, *Foot Ankle Int.* 2005
- Performed to force the talus into the ankle mortise
- Patient is seated
- Examiner applies a gentle but firm thump on the heel with their fist
- Force applied at center of heel and in line with long axis of tibia
- (+) test is pain in distal syndesmosis
**Special Tests: Stabilization Test**

- Apply several layers of tape (tightly) above the ankle joint to “stabilize” the distal syndesmosis
- Patient is then asked to stand, walk, perform a toe raise, and jump
- (+) test if these maneuvers are less painful with the tape in place

![Figure 2. The stabilization test is performed by applying tape, allowing the patient to walk, and determining if this tape stability improved symptoms.](image)

**Special Tests: Malleolar Compression/Rebound Test**

- Compress malleoli and look for pain with rebound
- Hard, frequently very sore
- Not well publicized or investigated yet.

**What Does the Evidence Suggest?**

- None of the syndesmotic stress tests could distinguish which ligaments were sectioned. Furthermore, the small displacements measured during the stress tests (with the exception of the external rotation test) suggest it is unlikely that the displacement induced in injured syndesmoses can be clinically differentiated from normal syndesmoses. Therefore, pain, rather than increased displacement, should be considered the outcome measure of these tests.

Ankle Joint Swelling

Ankle Joint Swelling

Clinical assessment

The measurement is performed as follows: (1) The beginning of the measuring tape is placed across the bony prominence of the lateral malleolus; (2) The arm of the tape is then placed across the instep just distal to the malleolus; (3) The tape is then placed in position over the foot to measure the ankle joint; and (4) The ankle joint is measured using a flexible tape and divided by the total number of joints.

Weight-Bearing Lunge Test

Weight-Bearing Lunge Test

Clinical assessment

The patient is in a standing position with the foot on the ground. The leg to be tested is then placed on the floor, with the knee flexed to 90 degrees. The patient is then asked to lunge forward, and the examiner notes the distance the patient can lunge forward.

Ankle Joint Strength Testing

Ankle Joint Strength Testing

Clinical assessment

Symmetry of ankle joint strength can be assessed by utilizing the non-injured leg as a comparator.

Ankle Joint Strength Testing

Clinical assessment

Symmetry of ankle joint strength can be assessed by utilizing the non-injured leg as a comparator.
Ankle Joint Strength Testing

Assessing Dynamic Ankle Stability: Isotonic Strength

- Isotonic activities are dynamic and involve both ECC and CON muscle actions.
- 1 RM is commonly used to measure strength in larger muscle groups, however rarely used in the ankle.
- Some examples of isotonic exercises are shown here.

Assessing Dynamic Ankle Stability: Isokinetic Strength

- Isokinetic Dynamometry
  - objective
  - quantifiable
  - quasi-CKC assessment
  - reliable
- Capable of measuring both ECC and CON muscle actions

Kin Com 125 AP Isokinetic Dynamometer

- Contemporary dynamometers enable the researcher to gather both CON and ECC data.
- Allows for the examination of reciprocal muscle group ratios (knee, shoulder, ankle)
BESS Testing

**Balance Error Scoring System**

- Double leg stance (firm surface)
- Tandem stance (firm surface)
- Single leg stance (firm surface)
- Double leg stance (blind surface)
- Tandem stance (blind surface)
- Single leg stance (blind surface)

**Clinical interpretation:**
Each of the test positions requires the patient to maintain the specified stance position for 20 seconds. During the 20-second test, the clinician counts the number of deviations (steps) from the specified stance position.

<table>
<thead>
<tr>
<th>Deviation (steps)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Moving the hands off the hips.</td>
<td>1</td>
</tr>
<tr>
<td>2. Reaching the hips</td>
<td>2</td>
</tr>
<tr>
<td>3. Sliding the feet</td>
<td>3</td>
</tr>
<tr>
<td>4. Touching the floor for more than 2 sec.</td>
<td>4</td>
</tr>
<tr>
<td>5. Lifting the foot off the support surface</td>
<td>5</td>
</tr>
<tr>
<td>6. Becoming out of the specified stance position in 2.5 seconds</td>
<td>6</td>
</tr>
</tbody>
</table>

The maximum number of errors for any single stance position is 30.

If a patient commits excessive deviations (steps) in any given time, any one deviation (step) is recorded.

One Leg Stance Testing

**Foot Lift Test**

- **Foot Lift Test (Figure 24)**
  - **Clinical assessment:**
    - The patient maintains the specified stance position on one leg with the eyes closed for 30 seconds.
  - **Clinical interpretation:**
    - During the 30-second test, the clinician counts the number of times any part of the heel is off the floor, and any touch down on the other foot.

Y-Balance Testing

- Developed & described by:
  - Functional Movement Systems
  - Plisky et al.
- Reliable dynamic balance assessment tool
- Cut-off = 89.6% for the composite score, relative to limb length
  - Sensitivity of 100% and specificity of 71.7%
  - Males < 89.6% are 3.5X more likely to obtain a noncontact lower extremity injury
  - Female < 94% are 6.5 times as likely to sustain a musculoskeletal injury
- In the ANT reach, a difference > 4 cm between the limbs is associated with an elevated risk of injury

Assessing Activity Levels

**Target Activity Level Scale**

<table>
<thead>
<tr>
<th>Level</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Skiing, tennis, swimming, running, resistance training</td>
</tr>
<tr>
<td>2</td>
<td>Cycling, aerobic dance, sports dance, calisthenics, light weight training</td>
</tr>
<tr>
<td>3</td>
<td>Heavy weight training, aerobic dancing, tennis, golf, moderate exercise</td>
</tr>
<tr>
<td>4</td>
<td>Competitive sports, boxing, basketball, soccer, football, volleyball, running, swimming</td>
</tr>
<tr>
<td>5</td>
<td>Competitive sports, soccer, football, rugby, hockey, tennis, badminton, squash, bowling, track, field</td>
</tr>
<tr>
<td>6</td>
<td>Competitive sports, baseball, softball, basketball, volleyball, soccer, football, track, field</td>
</tr>
</tbody>
</table>

Before injury:

- Level: __________

Currently:

- Level: __________
Assessing Foot/Ankle Function (FAAM)

Squeeze Test
(Potts Compression Test)

Bump Test
(Heel Tap or Percussion Test)

Pott’s Fx = fx distal fibula and medial malleolus, Sir Percival Potts identified this compound fx in 1756

Special Tests - Fracture Identification

Pott’s Fx = fx distal fibula and medial malleolus, Sir Percival Potts identified this compound fx in 1756

Squeeze Test
(Potts Compression Test)

Bump Test
(Heel Tap or Percussion Test)

Pott’s Fx = fx distal fibula and medial malleolus, Sir Percival Potts identified this compound fx in 1756
Special Tests - Thompson Test (Achilles Tendon Rupture)

Special Tests - Homan’s Sign

Dr. Homan (of “Homan’s sign” fame) discredited his own test as being useless in the evaluation of DVT and admitted he was sorry he ever published its description.

On-Field Assessment Review

- **History**
  - MOL, location, pain
  - Unusual sounds/sensations
  - Information from others

- **Observation/Inspection**
  - Deformity, swelling, ecchymosis
  - Positioning
  - Skin color
On-Field Assessment Review

• **Palpation**
  - Tenderness, crepitation, deformity:
    - distal tibia
    - distal fibula
    - ligamentous structures
    - syndesmosis
    - Achilles tendon
    - foot region

• **Neurovascular**
  - Dorsalis pedis pulse
  - Sensation over foot (dorsum and lateral border), calcaneus

• **Special Tests**
  - Pott’s Compression Test
  - Anterior Drawer Test

• **AROM Tests**

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**A Cool Web Site**

http://ahn.mnsu.edu/athletictraining/spata/

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**Today’s lecture can be viewed at the following URL address:**

http://sites.udel.edu/chs-atep/lectures/

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