Ligamentous & Tendon Injuries about the Ankle

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Objectives

I. Low Ankle Sprains
II. High Ankle Sprains / Syndesmosis
III. Achilles Tendon Rupture
IV. Peroneal Tendon Injuries
V. Anterior Tibialis Tendon Injuries

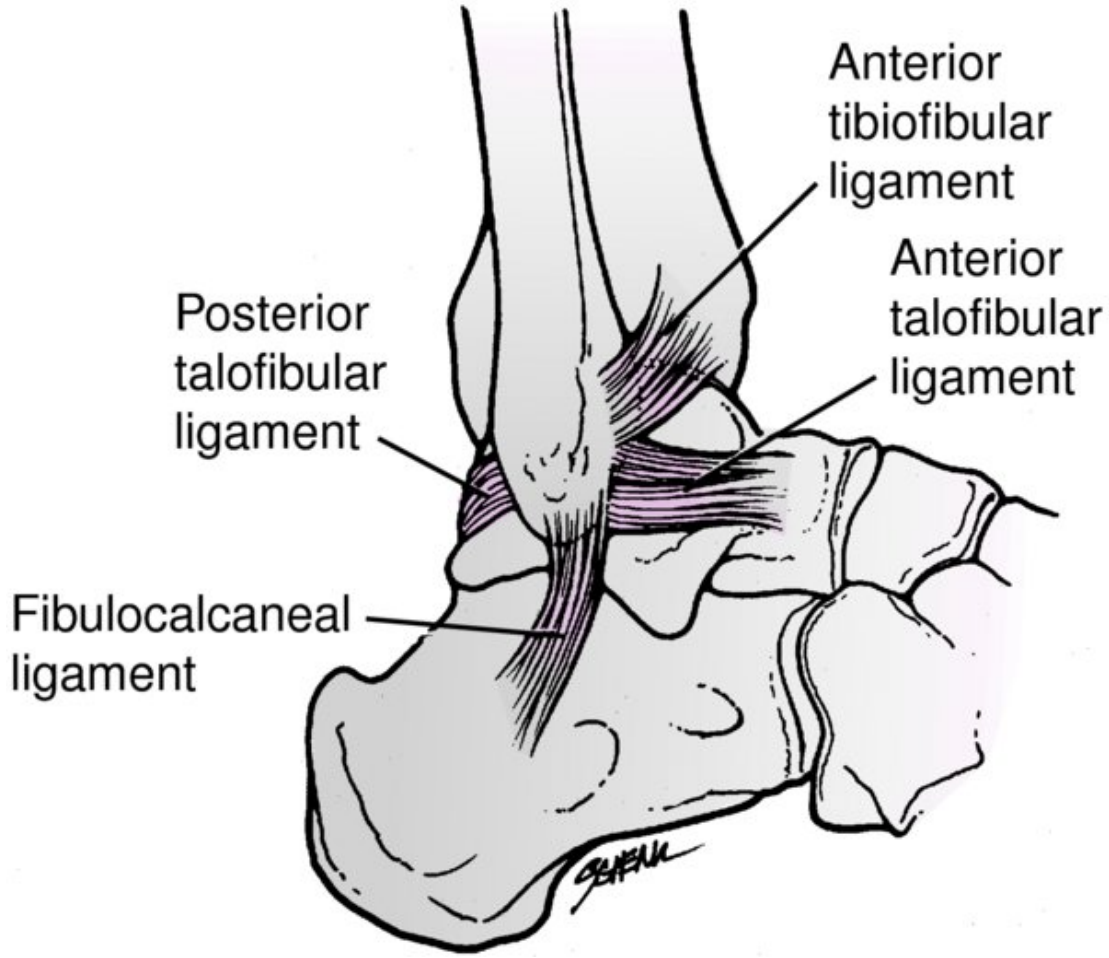
I. Low Ankle Sprains

Epidemiology / Etiology

- 14% of all athletic injuries – highest prevalence in college athletes, soccer/volleyball/basketball
- 80+% of all ankle sprains
- Mechanism: inversion ankle injury most common
  - ATFL, CFL most common.
- Associated injuries
  - osteochondral defects (talus), peroneal tendon injuries, deltoid ligament injury, fractures (base of 5th MT, anterior process calcaneus, lateral and posterior process of talus)

Anatomy

- Ligaments involved in low ankle sprains:
  - ATFL (anterior talofibular ligament)
  - CFL (calcaneofibular ligament)
  - PTFL (posterior talofibular ligament)
  - TFL + CFL: combined tear → varus tilt of talus
- Functional stability of ankle joint dependent on ligamentous reinforcement



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Anatomy

- ATFL
    - most commonly involved; weakest (140-300N), only crosses the ankle joint
    - Prevents ant displacement and IR of talus
    - Tears: usually midsubstance rupture or talar avulsion
    - Mechanism: **plantar flexion**, inversion
    - Exam: anterior drawer laxity in plantar flexion

Anatomy

- CFL
    - 2nd most common (50-75%) (260-400N); crosses both ankle and subtalar joints
    - Mechanism: **dorsiflexion**, inversion
    - Exam: anterior drawer laxity/talar tilt in dorsiflexion
- PTFL
    - less commonly involved in low ankle sprains (<10%)(310-345N)
- TFL + CFL: combined tear
    - Varus tilt of talus

Presentation / Exam

- Patient reports “rolling” ankle. pain with weight-bearing, difficulty returning to play
  - Severe injuries may have audible snap and increased pain/swelling
- Mechanical symptoms possible with recurrent injury

Exam

- Focal tenderness, edema, ecchymosis laterally over involved ligaments
- Exam: Palpate bony structures, then ligamentous structures, ROM, muscle testing, special tests
  - Normal ROM
    - 0-20 deg DF (ankle)
    - 40-50 deg PF (ankle)
    - 20-30 deg INV 10 deg EV

Exam

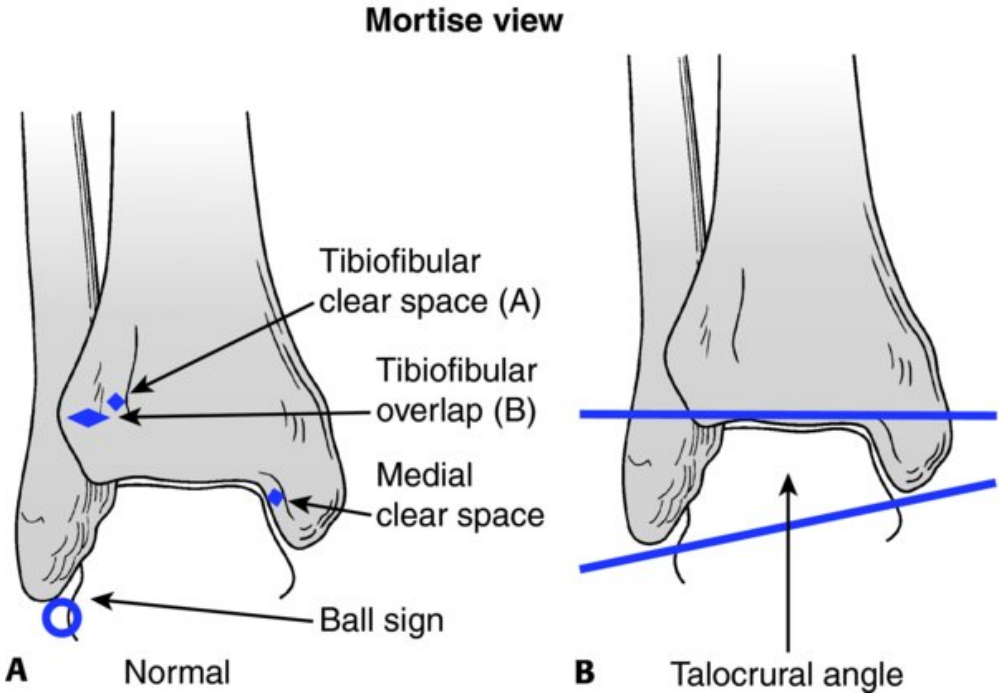
- Anterior drawer test – knee flexed 20 deg, hindfoot neutral.
    - in plantar flexion = indicates ATFL rupture
    - in dorsiflexion = indicates additional CFL rupture
- Talar tilt test (ATFL – PF; CFL – DF)- ankle in neutral invert the hindfoot and compare to contralateral

Imaging

- Ottawa ankle rules: obtain ankle xrays IF… (100% sensitivity)
  - Inabilty to bear weight x4 steps
  - Medial / lateral malleolus point tenderness
  - 5th MT base tenderness
  - Navicular tenderness

Imaging

- X-Rays- which ones to obtain?
  - **Varus stress**
    - Talar tilt- varus tilt indicates low ankle sprain
  - **Ankle series: AP, Mortise, Lateral (weight bearing if possible)**



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Imaging

- **MRI**
  - sensitive for ligamentous and syndesmotic injuries
  - NOT predictive of functional instability
  - When to obtain? - consider if pain >8 wk and management not resolving pain
    - evaluate peroneal tendons, osteochondral injury, coalition, bone bruise
- **CT-** rarely indicated acutely
  - potentially useful post-op to assess quality of reduction of syndesmosis

Classification systems (multiple)

- **Anatomic system –** 3 grades according to ligaments damaged

	Ligament disruption	Ecchymosis, Swelling	Pain with WB
Grade I	ATFL stretched	Minimal	Occasional
Grade II	ATFL tear + CFL stretch	Moderate	Mild-moderate
Grade III	Complete tear	Severe	Severe

- **Kaikkonen** – dynamic functional grading scheme; performance test protocol w associated scoring scale based on subjective responses, clinical measurements, muscle strength, functional stability and balance.
- **Clanton –** stable vs unstable, athlete vs non. Therapeutic implications

Prevention

- Handoll et al, Cochrane Review, 2001
  - Meta-analysis of 14 RCTs – supports external ankle orthotics (semi-rigid) to prevent ligamentous injuries in high risk athletics

Treatment

- **Nonoperative:**
  - Acute: RICE, NSAIDs
  - Early WBAT in boot or cast (esp for grade 3 sprains) for early mobilization
    - Grade 3 sprains rest in boot 3-7 days before starting rehab
    - Meta-analysis of 21 RTS functional tx > immobilization
  - Therapy (after acute swelling/pain subside)
    - focuses on motion, peroneal strengthening, and proprioception training
    - functional brace during rehab and early return-to-play

Treatment

- Majority will return to normal activity by 8 wks
  - incomplete rehab is most common cause of persistent loss of motion/proprioception/strength
  - Estimated 10-30% incidence of functional instability
  - If persistent pain, swelling, and limitations after 6-8 wk, repeat imaging is indicated

Treatment

- **Operative:**
  - Rare indications
    - Continued pain and instability despite extensive non-op therapy
    - Inability to tolerate bracing (e.g. skin problems/work issues)
    - Recurrent instability with daily activities
    - Scope at time of surgical repair to address intra-articular lesions as up to 93% can have associated lesions requiring intervention with chronic ankle instability
      - Arthroscopic debridement AITFL impingement/posteromedial impingement removal of loose bodies
      - Not always detected on MRI (40% sensitivity)
    - Don’t forget to examine the hindfoot for VARUS
      - Correcting cavovarus foot deformity can reduce instability and potentially delay post traumatic arthritis

Treatment

- **Anatomic repair: acute**
  - **Brostrum repair** - ATFL/CFL imbrication and suture repair of ligaments
  - **Gould modification** - Mobilization of lateral portion of inferior extensor retinaculum and attachment to distal fibular periosteum
    - Functional results = very good in 90% of patients
  - **Karilson modification** – reattach ligaments to fibula through drill holes in addition to suture repair

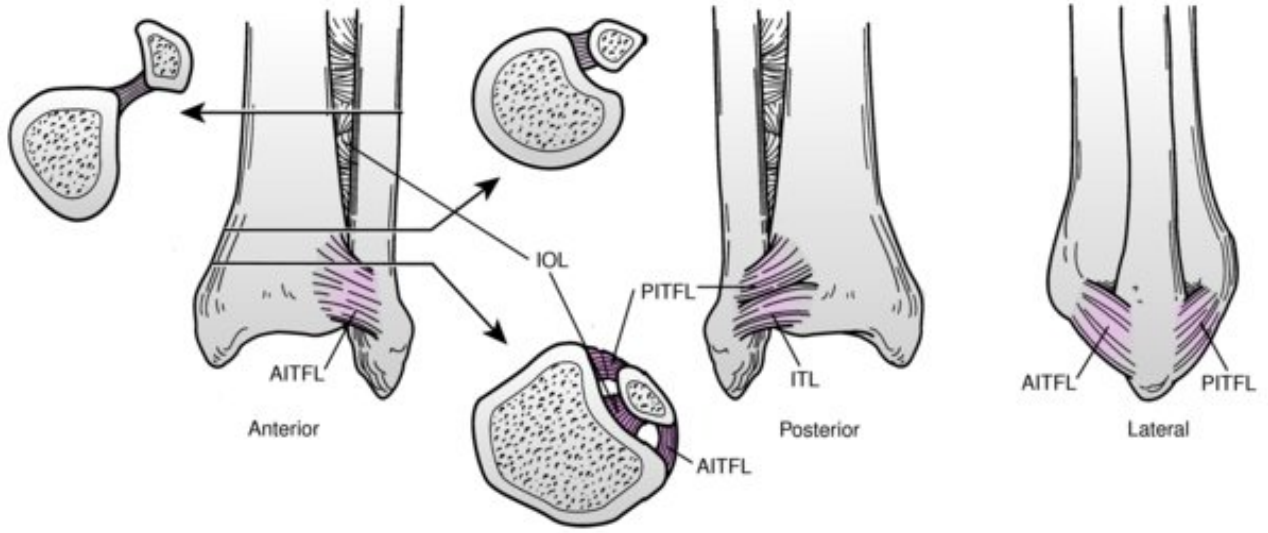
Treatment

- **Tendon transfer / Tenodesis stabilization (non-anatomic reconstruction)**
    - **Evans procedure**
        - transposition of peroneus brevis tendon through oblique posterior superior drill hole in distal fibula in between CFL and ATFL
        - can be used to augment Brostrom repair
    - **Watson-Jones procedure**
        - Lateral ligament reconstruction with peroneus brevis tenodesis through talus and fibula to replace ATFL leaving distal part of peroneus brevis intac
    - **Chrisman-Snook procedure**: split peroneus brevis to reconstruct ATFL and CFL so some peroneus brevis function maintained
- Main complication is subtalar stiffness and results are not as good as anatomic

II. High Ankle Sprains / Syndesmotic Injuries

Ligamentous Anatomy

- **Anterior Inferior Tibiofibular (AITFL)**
- **Posterior Inferior Tibiofibular (PITFL)**
- **Transverse Tibiofibular**
- **Interosseous Ligament (IOL)**



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Anterior Inferior Tibiofibular (AITFL)

- Originates on anterolateral tibial tubercle (Chaput's)
- inserts on anterior fibular (Wagstaffe's) tubercle
- Contributes 35% stability of the syndesmosis (Ogilvie-Harris Arthroscopy 1994)
- Superior and inferior insertions of AITFL 22.7 and 3.4mm prox to distal tibia articular cartilage, respectively
- Typically the first ligament to fail

Posterior Inferior Tibiofibular (PITFL)

- Originates on posterior tibial tubercle (Volkmann's)
- Inserts on posterior lateral malleolus
- Deep portion: runs transversely, stronger- 33% of stability
- Superficial portion – runs obliquely from lat mal to tibia ("upward direction") 9% of stability
- Sup insertion of PITFL 15.2mm proximal to articular cartilage
- Strongest syndesmotic ligament

Transverse Tibiofibular

- Either separate ligament or deep component of PITFL (present as discrete structure in 70% of specimens)

Interosseous Ligament (IOL)

- Limits lateral translation
- Distal thickening of interosseous membrane
- Contributes 22% of stability
- Superior and inferior insertions of 31.8 and 9.2mm from distal articular cartilage

Biomechanics

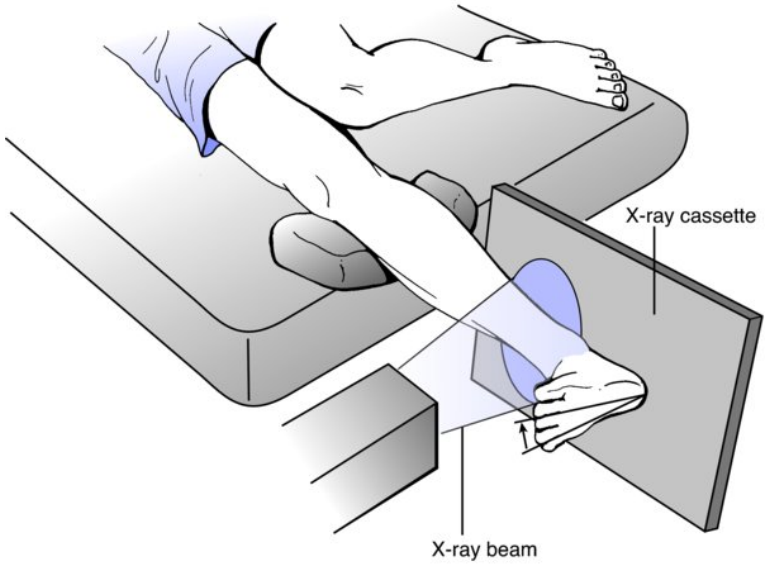
- DF -> fibula ER, migrates proximally and posterolaterally
- PF -> fibular IR, migrates distally and anteromedially

Presentation

- Injury – ER force applied to a DF ankle while foot is planted
- Difficulty weightbearing
- Ankle pain over syndesmosis > lateral joint
- Assess medial ankle and prox fibular tenderness to rule out Maissoneuve injury
- Swelling and ecchymosis may be minimal or late in presentation
- Assess deltoid ligament – TTP or pain w/valgus stress
- Provocative testing
  - Squeeze test (above mid-point of calf)
  - External rotation (DF foot with knee flexed to 90)
    - → anterior/posterior fibular translation and pain
  - Fibular translation test -> apply A-P force

Imaging

- Indications of syndesmotic injury
  - Tibiofibular overlap
    - Measured 1 cm proximal to plafond on AP
    - normal AP >6 mm/42% fibular width; normal mortise >1 mm
  - Tibiofibular clear space
    - Measured 1 cm proximal to plafond on mortise
    - normal <6 mm in AP and mortise views
    - **most reliable indicator of syndesmotic injury
  - Medial clear space
    - Measured at level of talar dome on mortise
    - equal or less than superior clear space
  - Important to note that normal values do not preclude syndesmotic injury
- **External rotation stress/gravity stress**
  - Rule out syndesmotic injury



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Imaging

- **Tibia films**- if concerned for syndesmotic injury (Maissonueve)

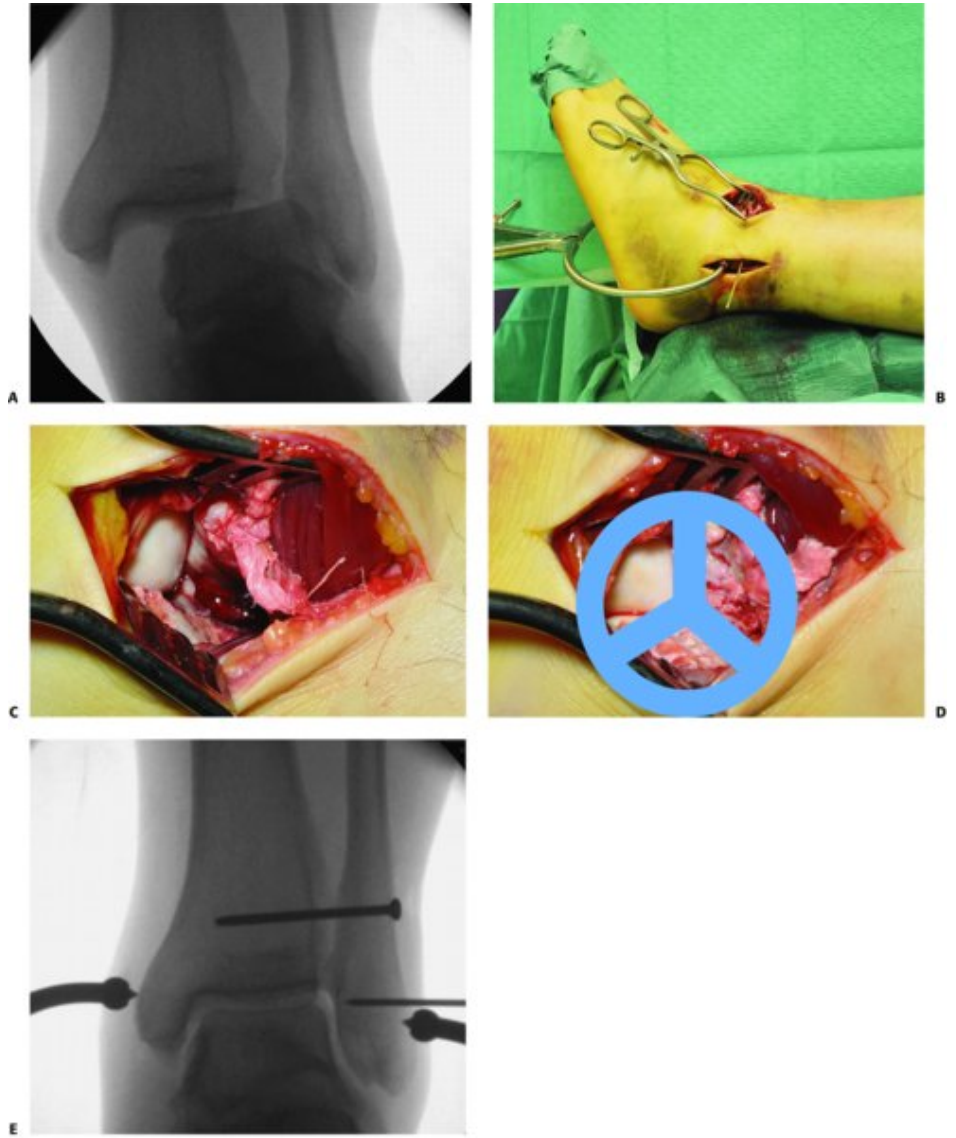
- Advanced imaging
  - Consider MRI in equivocal cases

Treatment

- **Non-operative**
  - Indications
    - syndesmotic sprain without diastasis/instability
  - RICE
  - WBAT vs NWB
    - CAM boot/cast (limits external rotation) until asymptomatic
  - Therapy, strengthening, proprioception, limiting external rotation
  - Recovery may take much longer than low ankle sprain

Treatment

- **Operative**
  - **Syndesmotic fixation: screws (static) vs. tightrope (dynamic)**
    - Indications
      - Diastasis with/without fracture
      - Sprain that failed conservative management
    - Options
      - Direct versus indirect visualization
      - 1 screw vs 2 screws, 3 cortices vs 4 cortices, suture button alone, hybrid construct
  - Considerations
    - **Screw removal**
      - 10-12 wks after fixation
      - return to full play 4-8 wks after ROH



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Outcomes

- **Return to play in elite athletes: high vs low ankle sprains**
  - Boytim et al AJSM 1991
    - NFL players- 15 syndesmotic sprains vs 28 lateral ankle sprains over 6 year period
    - Practice
      - Syndemosis = missed/limited 6.3
      - Low sprain = missed/limited 1.1
    - Games
      - Syndesmosis = missed 1.4 games
      - Low sprain = missed 0.04 games
    - Both significantly different

Outcomes

- **Return to play in elite athletes: high vs low ankle sprains**
  - Wright et al. AJSM 2004
    - Retrospective review of Blues and Dallas Stars players between 1991 and 2001- 14 high ankle sprains and 5 lateral ankle sprains
    - Initial treatment = WBAT
    - Exception: 1 who had syndesmosis screw fixation due to mortise diastasis on stress view c subsequent screw removal at 6 weeks and RTP at 137 days
- Return to game time
  - High ankle sprains = 45 days (range: 6-137 days)
    - 38 days if exclude surgical stabilization patient
  - Low ankle sprains = 1.4 days (range 0-6 days)
- No player sustained subsequent injury of other type
- Rigid hockey skate and decreased impact loading with skating compared to running appears to offer advantage to low ankle sprains but not to syndesmosis sprains as syndesmosis injuries represented 74% of all ankle sprains and NHL league wide database has 50% of all ankle sprains

III. Achilles Tendon Rupture

Acute Rupture

- **Mechanism**: traumatic, sport injuries; reported ‘pop’
  - Sudden forced plantarflexion (PF)
  - Acute dorsiflexion (DF) from plantarflexion
- **Demographics**: male, ages 30-40
- **Risk factors**:
  - ‘Weekend warriors’ / recreational athletes
  - Fluoroquinolone antibiotics
  - Steroid injections

Anatomy

- Confluence of soleus tendon + medial and lateral gastrocnemius tendons
- **Blood supply**: posterior tibial artery

- Rupture typically at **4-6cm** above calcaneal insertion (**hypovascular**)

Evaluation

- **Exam**:
  - Weakness walking, heel pain
  - Increased resting ankle DF when prone with knees bent
  - Palpable gap
  - Weakness to active PF, increased passive DF

  - **THOMPSON TEST**:
    - Lack of PF when examiner squeezes calf

Evaluation

- **Imaging:**
  - **XRs:** rule out any other injuries
  - **US:** to determine complete vs partial ruptures
  - **MRI:** for equivocal exam / chronic injuries; assess retraction

Management

- **GOALS:**
  - restoration of physiologic tendon length and tension
    - maximize strength and function
  - Return to work / activity

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Short period of immobilization followed by early ROM and progressive WB
    - Outcomes:
      - Equivalent PF strength compared to operative
      - With **functional rehab**, similar risk of re-rupture (~equivalent to operative mgt)
      - Fewer complications (ex. Risk of rerupture, skin infection / impaired wound healing and nerve complications)
    - Historical 'nonop' = immobilized in cast 6-8weeks → higher rate of re-rupture compared to operative (12.6% v 3.5%)
    - Newer studies show re-rupture rates ~3-5% with early functional rehab

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Typical protocol:
      - Initial immobilization x1-2 weeks
      - Transition to controlled ankle motion (CAM) walker + progressive stretching and resistance training
        - Permissive WB
      - RCTs show improved ankle ROM, decreased stiffness, better health-related QoL (but no effect on rerupture, functional outcomes or biomechanical tendon properties)
        - No difference in heel-rise work (PF strength), or rate of re-rupture at 1 year
          - Those with earlier WB had improved health-related QoL scores at 1yr FU

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Functional rehab versus surgical repair
      - **Lower complication rates in nonop vs op**
        - **With operative fixation, 12.5% risk of complications**
          - **Superficial + deep infection, hypertrophic scar, tendon tethering, wound dehiscence (Willits et al., 2010)**
      - **No clinically important LT (>1yr) outcome differences** re:
        - Ankle ROM
        - Strength
        - Calf circumference
        - Functional outcome scores *(*some studies show improved ST function (6mos) that becomes negligible at 1yr)*
      - **Surgical treatment may lead to improved return to work, PF strength** (questionable clinical relevance)
        - Meta-analysis by Soroceanu et al. (2012)
        - Willits et al. (2010), showed small yet statistically significant increase in PF at 1-2 years postop
      - **Caveat**: existing RCTs comparing surgical + nonsurgical
        - Lack adequate power

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Functional rehab versus surgical repair
      - Risk of re-rupture often correlated to patient compliance, often occur earlier in treatment
        - Long-term re-rupture (i.e. up to 2 yrs) quoted at 2.8% (Wallace et al., 2011)
      - Low nonoperative risk profile (Wallace et al., 2011)
        - Heel pain (2.2%)
        - Numbness (0.7%)
        - DVT (1.1%)
        - PE (0.2%)
        - Orthosis-related discomfort (0.4%)
      - One study show skin-related complications with nonremovable dynamic orthosis (31.7% v 4.7% post-MIS surgical repair)

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Ex: Willits et al., 2010 - functional rehab protocol post surgical OR nonsurgical mgt

PostOp / Injury week	Protocol
0-2	• Posterior slab/splint • NWB with crutches when surgical OR immediately after injury when nonop
2-4	• CAM boot with 2cm heel lift • Protected WB with crutches • Active PF and DF to neutral; inversion / eversion below neutral • Swelling control • Incision mobilization PRN • Knee/hip exercises without ankle involvement • NWB fitness / CV exercises • hydrotherapy

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Ex: Willits et al., 2010 - functional rehab protocol post surgical OR nonsurgical mgt

PostOp / Injury week	Protocol
4-6	• WBAT • Continue protocol from wk 2-4
6-8	• Remove heel lift • WBAT • Slow DF stretching • Graduated resistance (open + closed kinetic chain exericises + functional activities) • Proprioceptive + gait training • Ice, heat, + US therapy PRN • Incision mobilization PRN • Fitness / CV exercises with WBAT

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
    - Ex: Willits et al., 2010 - functional rehab protocol post surgical OR nonsurgical mgt

PostOp / Injury week	Protocol
8-12	• Wean out of boot • Return to crutches +/- cane PRN, then gradually wean • Continue to progress ROM, strength + proprioception
12+	• Continue to progress ROM, strength and proprioception • Retrain strength, power + endurance • Increase dynamic WB exercises (include plyometrics) • Sport-specific retraining

Management

- **Nonop:**
  - **Functional bracing / early range of motion protocols**
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Management

- **Operative:**
  a) Open end-to-end repair (acute <6 wk)
  b) Percutaneous repair
  c) Reconstruction with VY advancement
  d) FHL transfer +/- VY advancement of gastroc

Management

a) Open end-to-end repair

- **Indications**: acute ruptures (<6 weeks)
- **Incision**: posteromedial incision
  - Medial to AT to protect sural nerve
  - Vascular mapping shows least amount of vascularization of skin and subcut tissue directly posteriorly; best between axis of medial mal and medial border of AT (Yepes et al., JBJS 2010)
  - Similar wound complications to midline (7% posteromedial; 8.3% for midline)
    - Risk factors: smoking, steroid use, female sex
- **Technique**: incise paratenon, expose tendon edges, repair with heavy non-absorbable sutures

Management

a) Open end-to-end repair

- Variation = limited open repair
  - Combined open and perc technique to allow surgeon to visualize tendon ends
  - Small incision over site of AT repair and perc suture repair
  - Vertical posteromedial incision over rupture to be extended proximally or distally as needed
    - Suture repair placed deep to paratenon to protect sural nerve

Management

b) Percutaneous AT repair

- Some studies point to higher risk sural nerve damage (entrapment) vs. open
  - must protect through medial + lateral incisions proximally
- Lesser risk wound complications / infections vs. open
  - No postop wound infections v 21% infection rate in open (Lim et al.)
  - Some concern for wound puckering (9%), adhesions (6%) in percutaneous
- No difference in… (vs. open)
  - re-rupture rates
  - Return to work
  - Clinical outcomes: PF strength, ROM, calf / ankle diameter or single heel-raise testing

Management

c) Reconstruction with VY advancement

- When defect <3cm (chronic)
- Technique:
  - V cut at apex of musculotendinous junction
  - Leave muscle fibers intact

Management

d) FHL transfer +/- VY advancement

- Indications: chronic ruptures with defect >3cm
  - Need tibial nerve to be intact
- Technique: excise degenerative tendon edges, release FHL at Knot of henry and transfer through calc
  - Some residual PF weakness at hallux

Management

Postoperative protocol: functional rehab (same as nonop)

- Variations in WB vs NWB
  - Often 2 week period of NWB to allow for soft tissue healing
  - Transition to removable CAM walker, transition to WBAT and functional rehab

Management

Biologic adjuncts

No level I evidence to suggest improvement

- Some studies in athletes show faster recovery ROM and return to sports in PRP, though no difference at 1yr
- Stem cells – no clinical translational data

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 1:
  - Physical exam should include 2+ for dx (consensus)
    - Clinical Thompson test
    - Decreased ankle PF strength
    - Presence of palpable gap
    - Increased passive ankle DF

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 2:
  - Unable to recommend for or against MRI/US and xray (inconclusive)
- RECOMMENDATION 3:
  - Nonsurgical treatment is an option (weak)
- RECOMMEDATION 4:
  - When treated nonsurgically, unable to recommend for or against immediate functional bracing (inconclusive)

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 5:
  - Surgical treatment is an option in patients with acute AT rupture (weak)
- RECOMMENDATION 6:
  - In absence of reliable evidence, although surgical treatment is an option, should be approached cautiously in setting of patients with…(consensus)
    - DM / neuropathy
    - immunocompromised states
    - ages >65 years
    - Smokers
    - Sedentary lifestyle
    - Obese (BMI >30)
    - PVD
    - Local/systemic dermatologic disorders

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 7:
  - When treated surgically, unable to recommend for or against pre-surgical immobilization or restricted WB (inconclusive)
- RECOMMENDATION 8:
  - Open, limited open and percutaneous techniques are options for management of acute AT rupture (weak)
- RECOMMENDATION 9:
  - Cannot recommend for / against allograft, autograft, xenograft, synthetic tissues, or biologic adjuncts in surgical management

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 10:
  - Cannot recommend for/against use of antithrombotic treatment (inconclusive)
- RECOMMENDATION 11:
  - Suggest early (</= 2 wk) postop protected WB (limited DF) for those with acute AT rupture treated surgically (moderate)
- RECOMMENDATION 12:
  - Suggest use of protective device allowing mobilization by 2-4 wks postop (moderate)

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 13:
  - Unable to recommend for/against postop physical therapy for acute AT rupture (inconclusive)
- RECOMMENDATION 14:
  - Irrespective of treatment type, unable to recommend specific time to return to ADLs (inconclusive)
- RECOMMENDATION 15:
  - For those who participate in sports, option to return to sport at 3-6months after surgical treatment of acute AT ruptures (weak)

SUMMARY

AAOS Clinical Practice Guidelines (2010)

- RECOMMENDATION 16:
  - With acute AT rupture treated nonsurgically, unable to recommend timeframe to return to athletic activity (inconclusive)

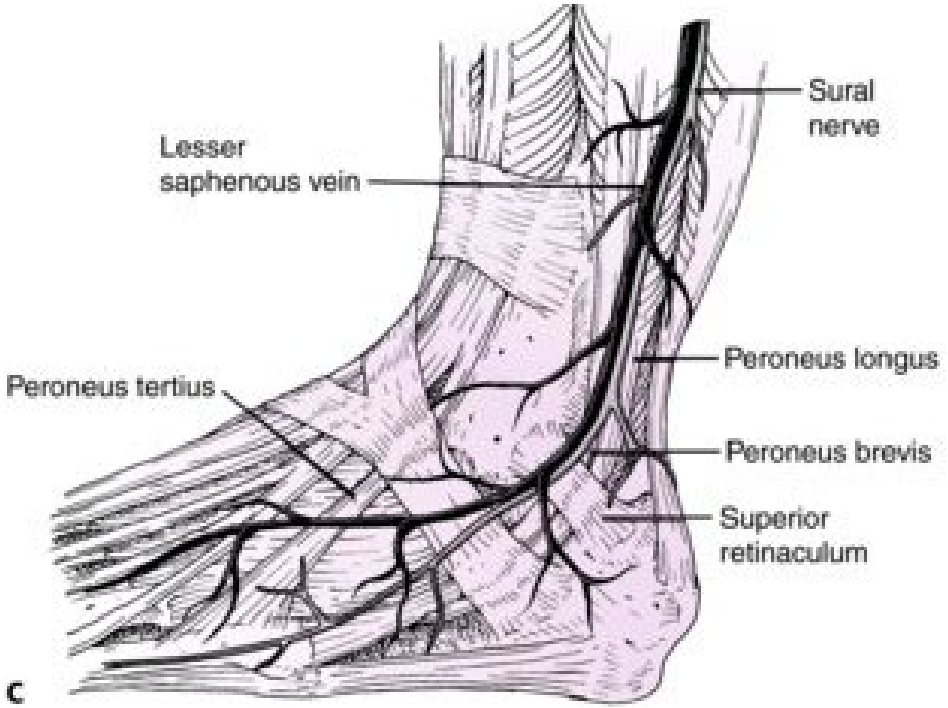
IV. Peroneal Tendon Injuries

Anatomy

- **Peroneus Longus (PL)**
  - Innervated by SPN
  - **Role**: plantar **flexion** of foot + 1st MT
  - May have os peroneum within the tendon body at CC joint
  - At level of peroneal tubercle of calc, PL is **INFERIOR**
    - Covered by inferior peroneal retinaculum
- **Peroneus Brevis (PB)**
  - Innervated by SPN
  - **Role**: primary **evertor** of foot
  - Tendinous 2-4cm proximal to tip of fibula
  - Anterior and medial to PL at level of lateral mal
  - At level of peroneal tubercle of calc, PB is **SUPERIOR**
    - Covered by inferior peroneal retinaculum

Anatomy

- Contained within synovial sheath split at level of peroneal tubercle
  - Within retromalleolar groove in fibula
    - PL is ***POSTERIOR*** in sulcus
    - PB is ***ANTERIOR*** in sulcus
  - Covered by **superior peroneal retinaculum (SPR)**
    - From fibula inserting onto peroneal tubercle of calc
    - Primary restraint of tendons within retromalleolar sulcus
    - Degree of tearing of SPR determines grade of injury, and subluxation of tendons
  - **Inferior peroneal retinaculum** cover tendons at level of tubercle
- **Vascular supply**: branches of anterior and posterior tibial arteries
  - Entirety of tendons vascularized



Mechanism of Injury

- Spectrum of injuries: often longitudinal in young athletes
  - Tenosynovitis
  - Tendinopathy
  - Tendon tears
  - Tendon instability

Mechanism of Injury

- Rapid forced DF of inverted foot
  - Report ‘pop’
  - Most often longitudinal tear in PB
- Instability of tendons occurs when superior peroneal retinaculum tears
  - Subluxation
  - Dislocation

Presentation

- C/O lateral / posterolateral ankle pain (towards fibular tip)
- Worsened with active eversion / PF; or passive DF
- Exam:
  - Swelling posterior to lateral mal
  - Tender over tendons
  - +/- cavovarus alignment
  - +/- popping with subluxation of tendons

  - TESTS:
    - **Apprehension**: sensation of subluxation / discomfort with active DF + eversion against resistance
    - **Compression**: pain w/passive DF + eversion
    - **Active circumduction**: recreates instability of tendons
    - Ankle drawer test: for other ligamentous instability

Imaging

- **X-Rays**: Weightbearing if possible
  - +/- Harris to assess tubercle
  - +/- ‘fleck sign’ = cortical avulsion off of distal tip of lateral mal (SPR avulsion)
  - Assess for cavovarus foot
- **U/S**: for suspicion of tears / instability
  - Dynamic: for assessment of tendon subluxation

Imaging

- **CT**: unique situations…
  - for calc malunion / lateral wall impingement
  - For retromalleolar groove abnormality / enlarged tubercle
- **MRI**: for suspicion of tears / instability or other pathology (ATFL / CFL insufficiency, talar osteochondral injuries, etc.)
  - Tendons best assessed with ankle in PF (axial cut)
  - Look for
    - edema, tendon thickening (tendinopathy)
    - Circumferential fluid within sheath (tenosynovitis)
    - Intra-substance tears
    - Fatty infiltration into muscle belly
    - Accessory tendons / low lying PB belly

Classification of injury patterns

- Anatomic classification of SPR tears
- Raikin classification of intra-sheath subluxation of tendons
- Peroneal Tendon Tears
  - Type I: both intact, partial tearing
  - Type II: one torn, other inact
  - Type IIIa: both mostly torn but muscle belly has no excursion
  - Type IIIb: both mostly torn, with excursion of muscle belly

Treatment

- **Nonop:**
  - Activity modification +/- boot immobilization → PT
    - First line for PB/PL tendinopathy, tenosynovitis + tears
    - Begin PT when pain resolved
    - Consider shoe orthosis for any hindfoot / forefoot varus
  - Immobilization (SLC) and protected WB x 6 weeks
    - All acute PB/PL instability in nonprofessional athletes
    - High failure rates (>80%) for tendon tears
    - Ensure tendons reduced and maintained (foot in slight PF, inversion)

Treatment

- **Operative:**
  1. **Repair SPR and deepening of retromalleolar groove**
     - Indications:
       - Acute tendon dislocations in high level athletes
       - Longitudinal tear
  2. **Groove-deepening + soft tissue transfer +/- osteotomy**
     - Indications: chronic / recurrent dislocations w/bony abnormalities
     - OR incompetent SPR
  3. **Tenosynovectomy + tendon debridement w/ or w/o tubularization**
     - Indications: recalcitrant PB/PL tears <50-60% of width of tendon
  4. **Debridement of tendon, tenodesis of distal + proximal ends of PB to PL**
     - Indications: complex tears, significant tendinosis (>50%)
  5. **Debridement of tendons, interposition auto- or allograft**
     - Indications: complex tears (>50%) with preserved muscle excursion
  6. **Debridement of tendons, FHL/FDL transfer**
     - Indications: same as above without muscle excursion

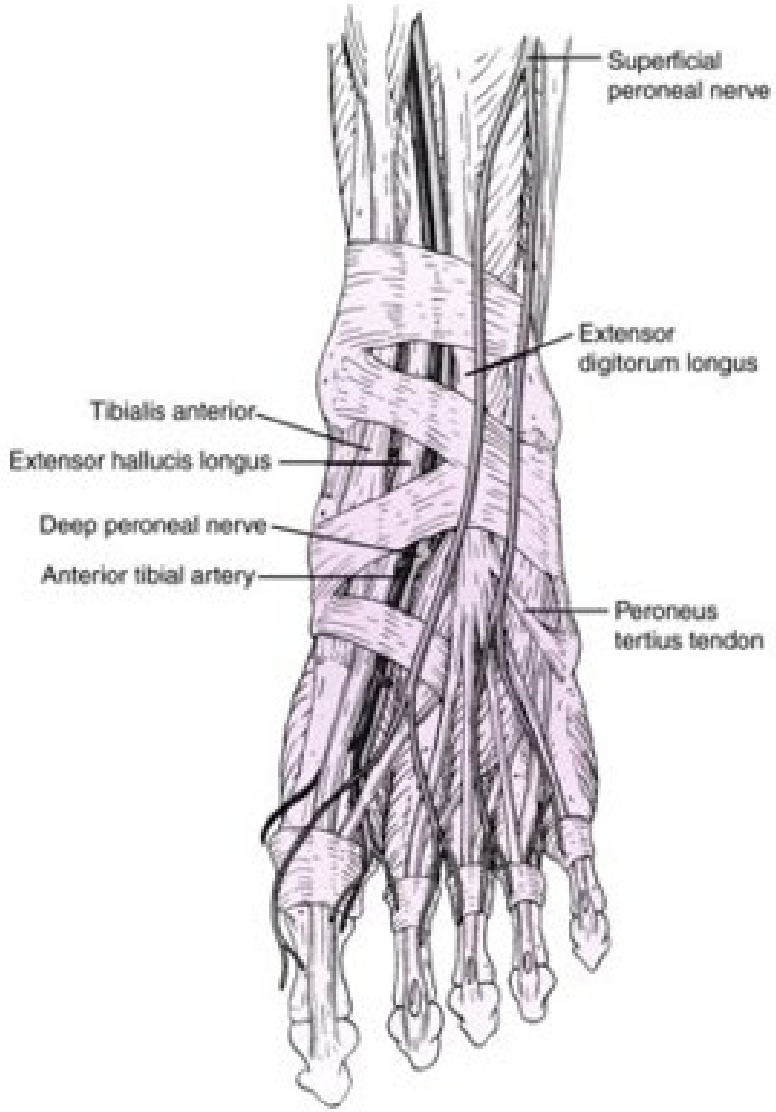
+ Hindfoot corrective osteotomy

- Indication: when any rigid hindfoot-driven varus/valgus

V. Anterior Tibial Tendon Injuries

Anatomy – tibialis anterior

- **Primary ankle dorsiflexor**
- Secondary ankle dorsiflexors:
  - EHL
  - EDL



Mechanism of Injury

- Laceration
- Closed rupture
  - Strong eccentric contracture
- Risk Factors:
  - DM
  - Inflammatory arthritis
  - Older (often attritional)
  - Fluoroquinolone use
  - Local steroid injection

Presentation

- Acute injury: reports ‘pop’, pain and anterior ankle swelling
- Chronic injury: foot drop / difficulty lifting toes to clear for gait
  - May be painless

Examination

- Pain + swelling in anterior ankle
  - If chronic, may palpate mass at anteromedial aspect of ankle
  - Lack of palpable tendon
- Weakness in DF of ankle
  - May have intact DF with secondary ankle DFs
- **Steppage gait**: hip flexed in swing phase, foot slaps after heel strike

- To rule out:
  - L4 radiculopathy: differentiate from TA rupture by…
    - Intact palpable tendon
    - No ankle mass
    - Dermatomal abnormalities
    - Spine MRI findings
  - CPN compression neuropathy: differentiate from TA rupture by…
    - EDL + EHL affected
    - Sensory abnormalities
    - Compression history at level of CPN

Imaging

- **XR**: 3 views of ankle to rule out acute osseous injury
- **MRI**: to assess if complete / partial

Management

- **Nonoperative**:
  - AFO: low demand patient
  - Casting: partial ruptures
- **Operative**:
  1. **Direct repair**: use laceration OR longitudinal incision over palpable defect; primary end-to-end repair
     - Indications: acute (<6 week – 3 months) in active, high demand patient
     - NOTE:
       - if <5° ankle DF with knee extended, need to perform gastroc recession PRIOR to tensioning repair
       - Oversew ends with monofilament layer if frayed to create smooth gliding surface
       - If avulsed, use bone tunnels / anchors
  2. **Reconstruction**: various options
     - Indications: chronic injuries
     - EHL tenodesis or EHL transfer (distal EHL stump tenodesed to EHB, proximal stump used as graft to repair TA insertion)
     - Sliding tendongraft: harvest ½ width TA tendon proximally, turn down to span gap; strengthen by securing tendon to medial cuneiform or dorsal navicular
     - Free interpositoinal autograft / allograft

Summary

- Detailed knowledge of foot and ankle anatomy is key to the diagnosis of ligamentous injury
  - Informs physical exam findings to lead you to diagnosis
- Imaging work up should start with weight bearing films whenever possible
  - Advanced imaging with MRI is helpful in equivocal or refractory cases
- Most ligamentous injuries can be treated nonoperatively

Summary

- Nonoperative treatment of achilles tendon ruptures with early functional rehab has equivalent functional outcomes to operative repair but may have a higher rerupture rate

- Consider early acute repair of extensor or evertor tendon injuries in high demand patients

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