Ligamentous and Tendon Injuries About the Ankle

Sohail Bajammal
Dec. 8, 2004

Brecht & Watnik 2004, OTA Presentations
Krause 2003, Miller’s Review Course
Mizel et al 2004, ICL 53
OKU Foot & Ankle 3
Outline

• Anatomy
• Sprains
• Syndesmotic Injuries
• Achilles Tendon
• Peroneal Tendon
• Posterior Tibial Tendon
Consequences

Injuries that leave the ankle unstable

change the ankle articulation

premature articular cartilage damage
Anatomy
Ankle Anatomy

- Bony mortise
- Talar body is wider anterior
  - less stability with plantarflexion and internal rotation
Medial Collateral Ligaments

• Superficial Deltoid
  ○ Superficial talotibial
  ○ Naviculotibial
  ○ Calcaneotibial fibers

• Deep Deltoid
  ○ Deep Anterior talotibial
  ○ Deep Posterior talotibial
Lateral Collateral Ligaments

- **Anterior Talofibular Ligament**
  - First injured in lateral sprain with plantarflexed ankle

- **Calcaneofibular Ligament**
  - Strongest lateral ligament
  - First injured in lateral sprain with dorsiflexed ankle

- **Posterior Talofibular Ligament**
Syndesmosis

1. Anterior inferior tibiofibular ligament
2. Posterior inferior tibiofibular ligament
3. Transverse tibiofibular ligament
4. Interosseous ligament
Anatomy

• Tendons
  ○ Achilles
  ○ Posterior Tibial
  ○ FDL and FHL
  ○ Tibialis Anterior

• Vessels
  ○ Saphenous vein
  ○ Posterior tibial artery

• Nerves
  ○ Tibial nerve posteriorly
Anatomy

- Tendons
  - Peroneus Brevis
  - Peroneus Longus

- Nerves
  - Superficial peroneal
  - Sural
Anatomy

- Extensor retinaculum
- Tendons
  - Tibialis Anterior
  - EHL
  - EDL
- Dorsalis Pedis Artery
- Deep Peroneal Nerve
Ankle - History

• Injury:
  ○ Description of the injury
  ○ Position of the ankle during the injury
  ○ Able to continue to play or bear weight
  ○ Previous injury
  ○ Site of injury

• Pain:
  ○ Exacerbation with weight bearing or different phase of gait (heel rise)
  ○ Morning pain (Achilles tendinitis, plantar fasciitis)
Ankle – Physical

• Look:
  ○ Standing & Sitting
  ○ Gait
  ○ Deformity, Alignment (hindfoot, midfoot, forefoot)

• Feel:
  ○ Medial and lateral malleoli
  ○ Deltoid ligament
  ○ ATFL, CFL, and PTFL

• Move:
  ○ ROM ankle, subtalar, midfoot, forefoot
  ○ Tightness of Achilles
Ankle – Physical

• Neurovascular exam
  ○ Pulses, cap refill, hair distribution, stocking sensation
  ○ Superficial and Deep Peroneal
  ○ Sural
  ○ Saphenous
  ○ Medial and Lateral plantar
  ○ Tibial nerves
Ankle – Physical

• Special Tests:
  ○ Anterior drawer test for ATFL
  ○ Talar tilt to assess CFL
  ○ Squeeze test to look for syndesmotic injury

• Shoe pattern
Anterior Drawer Test

- Sitting position
- Foot in 25° of plantarflexion
- Stabilize the tibia with one hand
- Grasp the heel with the other hand
- The foot is pulled anteriorly and allowed to rotate internally as it translates
- Positive:
  - $>10$ mm translation or $>3$ mm anterior translation compared with contralateral
Talar Tilt

- Foot in neutral position
- Inversion stress applied
- Compare with the other side
- Positive:
  - Talar tilt > 9° or >3° more than the contralateral side
Ankle Sprains

Acute Sprains

Chronic Ankle Instability
Ankle Sprains

- Most common ligamentous injury
- One sprain / day / 10,000 people
- 20-40% intermittent chronic problems
  (Garrick, Am J Sports Med, 1977)
- More common on the lateral aspect
Ankle Sprains

• Most common mechanism of ankle injury is inversion stress with plantarflexion
  ○ ankle fracture, sprain, or syndesmotic injury

• Abduction or adduction are other mechanisms
Common Ligaments Injured

- Anterior Talofibular Ligament (ATFL): 90%
  - Taut in Plantarflexion

- Calcaneofibular Ligament (CFL): 25%
  - Taut in Dorsiflexion

- Posterior Talofibular Ligament (PTFL)
Ankle Sprain – Missed Injuries

- Syndesmotic Injury
- Peroneal tendon subluxation
- Posterior tibial tendon tear/dysfunction
- Achilles tendon tear
- 5th metatarsal base fracture
- Midfoot injuries
- Lateral talar process/dome fracture
- Anterior process of calcaneus fracture
Ankle Radiographs

• AP of the Ankle
  ○ AB < 5mm is normal
  ○ BC > 10 mm is normal
Ankle Radiographs

- **Mortise View**
  - Ankle internally rotated
  - AB clear space
  - BC
  - Talocrural angle (83°)
  - Medial clear space <4 mm
Ankle Stress Radiographs

• Inversion Stress (Talar Tilt) view
  ○ Ankle in plantarflexion
  ○ Positive:
    ➢ Talar tilt > 9°
    or
    ➢ Talar tilt > 3° more than the contralateral side

• External rotation view
  ○ Useful in identifying syndesmotic injury
Ankle Stress Radiographs

- Anterior drawer stress view
  - Positive:
    - >10 mm translation
    - or
    - >3 mm anterior translation compared with contralateral
  - Incongruency of ankle
Fig. 2  The Telos device may be used to consistently measure talar tilt (A) and anterior talar translation (B). (Reproduced with permission from Colville MR: Reconstruction of the lateral ankle ligaments. Instr Course Lect 1995;44:341-348.)
Ankle Sprain Classification

• Histologic Classification
  ○ Grade I: Stretching, no tearing
  ○ Grade II: Partial macroscopic tearing
  ○ Grade III: Complete rupture
Ankle Sprain Classification

• **Anatomic Classification**
  ○ Grade I – ATFL disruption
  ○ Grade II – ATFL and CFL disruption
  ○ Grade III – Complete ligamentous disruption

• **Clinical Grading**
  ○ Grade I: Stress tests normal
  ○ Grade II: ↑ pain swelling, ± positive stress tests
  ○ Grade III: Severe pain swelling, +ve stress tests
Lateral Ankle Sprains

• Commonly missed diagnoses
  ○ Peroneal tendon injuries
  ○ Achilles injuries
  ○ FX’s
    ➢ Lateral process of talus
    ➢ Anterior process of calcaneus
    ➢ Fifth metatarsal
    ➢ Lisfranc injuries
  ○ Osteochondritis dessicans
Lateral Ankle Sprains

Lateral Process # of the Talus
Lateral Ankle Sprains

• X-rays are based on careful physical exam
• MRI rarely indicated in the acute setting
• Consider stressing syndesmosis and lisfranc joints if injury is suspected
Ankle Sprain Treatment

• RICE

• Immobilize:
  ○ ankle brace initially and protected weight bearing for Grade I & II
  ○ Bracing or taping for 4-6 weeks depending on activity
  ○ Severe sprain may require up to 6 months of protective bracing

• Physiotherapy:
  ○ ROM exercises
  ○ Peroneal strengthening and proprioceptive training

• Return to sports when able to cut without pain
Ankle Sprain Treatment
Grade III

- ? walking boot or a cast for 4 – 6 weeks
- Extended period of protective bracing
- Return to play criteria remain the same
- R/O syndesmosis injury (high ankle sprain)
Lateral Ankle Sprains
Surgical Treatment

• Acute repair: NO, unless other injuries

• Symptomatic chronic instability:
  ○ May require surgical intervention
  ○ Anatomic Brostrom repair favored over nonanatomic rerouting procedures
Medial Ankle Sprain

- 5% ankle sprains
- Forced eversion
- Injury to deltoid ligament
- Associated with syndesmotic injury and/or Weber C fibula #
Medial Ankle Sprain

- Tenderness/swelling over deltoid
- External rotation test elicits pain in the deltoid and possibly in syndesmosis
Medial Ankle Sprain

• AP, Lat, Oblique ankle x-rays to assess mortise and syndesmosis
  ○ Medial joint space widening
  ○ Syndesmotic widening
  ○ Presence fibula #

• Consider external rotation stress x-rays if syndesmotic disruption is suspected
Medial Ankle Sprain

• Management
  ○ Stable (no talar subluxation)
    ➢ Similar to lateral sprains
      – RICE, early wgt bearing, early ROM, functional brace, functional rehab
  ○ Unstable (talar subluxation)
    ➢ No talar subluxation is acceptable
    ➢ Anatomic reduction and surgical stabilization of syndesmosis
Chronic Ankle Instability

• Continued instability or recurrent injury despite rehabilitation and proprioceptive training

• Mechanical vs. Functional Instability

• Protective Bracing vs. Surgical treatments
  ○ Direct Repair
  ○ Nonanatomic Reconstruction
Direct Anatomic Repair
Gould Modification of Broström

- Repair of the ATFL
- Repair of the CFL
- Reefing of the lateral extensor retinaculum
- May be modified to advance the ligaments through drill holes or use of suture anchors
Figure 2-35. Modified Broström procedure for reconstruction of ankle ligaments. (From Scioti M: Injuries about the ankle: Instability of the ankle and subtalar joint. In Myerson MS (ed): Foot and Ankle Disorders. Philadelphia: WB Saunders, 2000, p 1412.)
Modified Broström

• Postoperative Protocol:
  ○ 2-3 weeks immobilization
  ○ Then, removable boot & active ROM
  ○ Strengthening exercise 4-6 weeks
Poor Outcome of Direct Repair

• Instability > 10 years
• Arthropathy
• Generalized Hypermobility:
  ○ Ehlers-Danlos syndrome
  ○ Marfan syndrome
  ○ Osteogenesis imperfecta
  ○ BJHS: Benign Joint Hypermobility Syndrome
• Rigid hindfoot varus (Coleman block test)
Nonanatomic Reconstructions

- These procedures use the peroneal tendons or other grafts to reconstruct the lateral ligamentous complex
- More restricted ankle and subtalar motion (Colville, JAAOS, 1998)
Syndesmosis Injury
Syndesmosis Injury

- 10% of ankle sprains
- Rupture of the interosseous ligaments between the tibia and fibula with or without fibular fracture
- Medial malleolar fracture or deltoid ligament rupture
- Persistent instability and gap in the joint after bimalleolar fixation
Syndesmosis Exam

- **Squeeze Test**
  - Squeeze the syndesmosis above the ankle → pain

- **Abduction-External Rotation Stress Test**
  - Further instability with external rotation (may be shown with x-ray)
Syndesmotic (High) Ankle Sprains

- AP/LAT/OBLIQUE ankle x-rays
  - Syndesmotic widening
  - Medial joint space widening
  - Presence of fibula FX

- External rotation stress x-rays
  - Severe pain associated with normal x-rays

- Must get tib/fib x-rays to rule out high fibula fracture
Syndesmosis Injury

• Classification
  ○ Type I – straight lateral talar subluxation
  ○ Type II – plastic deformation of the fibula with Type I
  ○ Type III – posterior rotatory displacement of the fibula and talus
  ○ Type IV – diastasis of the tibia and fibula with superior displacement of the talus
Syndesmosis Injury

• Treatment
  ○ Non-displaced without fracture
    ➢ May consider casting for 6 weeks (high ankle sprain)
    ➢ Surgical treatment with syndesmotic screws
  ○ Displaced
    ➢ Surgical treatment with syndesmotic screws
Syndesmosis Injury

- Reduce the syndesmosis with a large clamp under fluoro
- Place 1.5 cm proximal to the plafond
- Place with 30 degrees anterior angulation
- Do not use lag screw technique
Syndesmosis Controversies

• Number of Screws
  ○ One vs. two, 3.5 mm screw vs. 4.5 mm screw

• Number of Cortices
  ○ Three vs. four cortices

• Ankle position during placement
  ○ Classically dorsiflexion was advocated
  ○ Tornetta showed no difference with plantarflexion
Syndesmosis Post-Op

- Place in a cast or removable boot NWB for 6 weeks (43 days)
  - Premature weight bearing may break screws and lead to syndesmosis widening
  - Weight bearing will break screws, but does not cause clinical problems

- May consider screw removal after 3 months
Achilles Tendon

Tendonitis (Tendinitis)

Rupture (Acute & Chronic)
Achilles Tendon

• Anatomy
  ○ 10-12 cm long
  ○ 0.5-1.0 cm diameter
  ○ Avascular zone 2-6 cm proximal to insertion
  ○ Fibers rotate 90 degrees at insertion
Achilles Tendonitis

- Overuse
- Over-Pronation

- Non-Insertional
  - Athletes

- Insertional
  - Older, Sedentary Patients
  - Enthesopathy
Achilles Tendonitis Non-Insertional

• Paratendonitis (Paratenonitis)
• Paratendonitis (Paratenonitis) with Tendinosis
• Tendinosis

• Hypovascular Zone
  ○ 4 cm Proximal to Insertion
Treatment of Non-Insertional

• **Non-Operative:**
  ○ Activity/Shoe Modification
  ○ NSAIDs, Ice
  ○ Stretching, Heel Lift

• **Surgical:**
  ○ Paratenon Debridement
  ○ Achilles Debridement
  ○ +/- FHL Transfer
Achilles Tendonitis
Insertional

- Older Pts/Recreational Athletes
- Haglunds Deformity
  o Posterolateral Prominence
- Retrocalcaneal Bursitis
Treatment of Insertional

• Activity Modification
• Stretching
• Padding
• Shoe Adjustment
• Posterior Heel Debridement
• **NEVER EVER STEROIDS**
Achilles Tendon Rupture

• History
  ○ Acute pain in the back of the ankle with contraction
  ○ Average age 35
  ○ Steroids, fluorquinolones, and chronic overuse may predispose to rupture

• Pathology
  ○ Rupture occurs 2 – 6 cm above the Achilles insertion in a watershed area
Achilles Tendon Rupture

- Physical Exam
  - Tenderness over achilles tendon
  - Palpable defect
  - Positive Thompson’s test:
    - NO plantarflexion
Achilles Tendon Injury

• X-ray
  ○ Lateral ankle X-ray to exclude avulsion from the calcaneus

• MRI
  ○ May be useful to diagnose partial rupture only
Achilles Tendon Ruptures

• Nonoperative treatment
  ○ Weaker tendon
  ○ Higher risk rerupture (10-15%)
  ○ Slower return to sport
  ○ No surgical morbidity
  ○ Lower cost
Achilles Tendon Rupture

• Non-Operative
  ○ Splint in plantarflexion for 2 wk
  ○ Short leg cast or boot with progressive dorsiflexion and weight bearing starting at 4 – 6 weeks after injury
  ○ Heel lift used in boot and footwear
  ○ Resistance exercises started at 8 weeks
  ○ Return to sports in 4 – 6 months
  ○ May take 12 months to regain maximal plantarflexion power
Achilles Tendon Ruptures

• Surgical repair
  ○ Superior tendon strength
  ○ Lower risk rerupture (1-3%)
  ○ Quicker return to sport (3 months)
  ○ Surgical Complications (11%)
    ➢ Infection
    ➢ Dehiscence, Skin edge necrosis
    ➢ Sural nerve injury
  ○ Increased cost
Achilles Tendon Rupture

- **Surgical treatment**
  - Preferred for athletes
  - Medial incision avoids the sural nerve
  - Percutaneous vs. Open treatments described
  - Isolate the paratenon as a separate layer

![Diagram of Achilles tendon and incision]
Achilles Tendon Ruptures

• Surgical repair
  ○ Younger active patients

• Nonoperative treatment
  ○ Older sedentary patients
  ○ Patients with increased risk of soft tissue complications
    ➢ IDDM
    ➢ Smokers
    ➢ Vascular disease
Percutaneous Achilles Repair

A
B
C
D
E
F
G
H
Achilles Tendon Avulsion

- Treatment includes ORIF of avulsion or reinsertion on the calcaneus with suture anchors
Chronic Achilles Rupture

• Chronic rupture may be reconstructed with FHL, FDL, or slip from gastrocnemius
Achilles Tendon Ruptures

Reconstruction of neglected rupture with peroneus longus and plantaris weave
Peroneal Tendons

Tendinitis
Instability
Tears
Peroneal Tendinitis

• No peroneal sheath swelling
• Eversion → Pain

• Treatment:
  ○ NSAIDs
  ○ Stretching
  ○ Orthosis → Lateral Wedge
Peroneal Tendon Instability

- Peroneal tendons course behind the distal fibula
- The peroneus brevis may have degenerative changes if the injury is not identified in a timely fashion
Peroneal Tendon Instability

- The peroneal retinaculum may be avulsed from the fibula or calcaneus or lifted up enough to allow tendon dislocation.
Eckert Classification of Peroneal Tendon Instability

**FIG 19-6.**
Grades of dislocations of the peroneal tendons. A, retinaculum is still intact, although it is elevated from the underlying malleolus. B, retinaculum is torn from its anterior insertion on the malleolus, permitting dislocation of the peroneal tendons. C, retinaculum is avulsed from the insertion on the malleolus with a small fragment of bone. D, retinaculum is torn from its posterior attachment, permitting the tendons to dislocate over the retinaculum. (Redrawn from Oden RF: *Clin Orthop* 216:63–69, 1987.)
Peroneal Tendon Instability

- Forceful contraction of peroneals during sudden dorsiflexion and inversion
- Usually cutting sport
- Frequently misdiagnosed as ankle sprain
Peroneal Tendon Instability

- Tenderness/swelling retromalleolar area
- Active eversion may demonstrate subluxing tendons
- X-rays may reveal a small avulsion FX off the posterior lateral malleolus
- MRI may reveal subluxed tendons
Peroneal Tendon Instability

• Conservative treatment
  ○ Casting in slight plantarflexion and inversion for 6 weeks non weight bearing
  ○ Allows the retinaculum to heal if the tendons can be reduced closed
  ○ Successful if the injury is identified early
Peroneal Tendon Instability

- Surgery
  - ORIF bone fragment if possible
  - Repair retinaculum if possible
  - Soft tissue reconstruction with sling for retinaculum
  - ± Deepen groove
Peroneal Tendon Instability

• Bone block surgeries such as Kelly’s or DuVries modification

• Debridement of peroneus brevis may be necessary if degenerative changes are present and tenodesis
Peroneal Tendon Instability

• Surgery
  ○ Deepening of the groove has become more popular

• Post Operative Care
  ○ NWB for 6 weeks
  ○ Passive motion after 2 weeks
  ○ Strengthening after 6 weeks
Peroneal Tendon Tears

- Rare
- Peroneus longus is more common
- H/o Ankle Sprain
- Clinical / Subclinical Peroneal Instability
- Peroneal Sheath Swelling
- Retrofibular Tenderness

- MRI Useful
  - False Negatives
Peroneal Tendon Tears

- Immobilization

- Surgery
  - Repair: if < 50% tear
  - Tenodesis: if > 50%
  - Stabilize Tendons
Posterior Tibial Tendon Dysfunction (PTTDD)
Posterior Tibial Tendon Anatomy

- Arises from posterior aspect intermuscular septum
- Inserts on tarsal bones
- Avascular zone posterior to medial malleolus
- High frictional load posterior to medial malleolus
Posterior Tibial Tendon Functions

• Balances the pull of peroneals
• Inverts & stabilizes hindfoot during toe-off
• Protects the spring ligament
• Locks transverse tarsal joint
• Maintains height of longitudinal arch

What happens if it doesn’t work?
PTT Dysfunction

Attenuation of Medial Structures

Arch Failure $\rightarrow$ Hindfoot Valgus

Inability to Lock TT Joint

Gastrosoleus pulls through TT Joint

Unopposed P. Brevis $\rightarrow$ Forefoot Abduction

Calc-Fib Impingement $\rightarrow$ Lateral Hindfoot Pain

Hindfoot/Ankle Arthritis
Posterior Tibial Tendon Dysfunction

Theories

• **Intrinsic:**
  ○ Inflammatory
  ○ Degenerative
  ○ Vascular
  ○ Symptomatic accessory navicular

• **Extrinsic:**
  ○ Steroid injection
  ○ Traumatic
PTTD Typical Patients

- Middle Aged, Overweight, Females
- $\pm$ History of Trauma
- Pre-existing Flatfoot
- Infrequently Bilateral (?)
PTTD - History

• More commonly an attritional rupture over time than an acute rupture
• Flat foot and midfoot pain
• Sports with quick changes of direction may put increased force on tendon
• Late stages: sinus tarsi pain from impingement
PTTD - Physical

- Hindfoot valgus, midfoot collapse, forefoot abduction
  - “too many toes” sign
  - Achilles contracture

- Special Tests:
  - Inversion Strength Testing in Maximum Eversion:
    - Weakness & tenderness
  - Single-Limb Heel Rise:
    - Lack of supination of the foot and inversion of the heel while rising on toes

- Flexible vs. rigid deformity
“Too Many Toes” sign
Single-Limb Heel Rise

Sohail Bajammal
PTTD – X-rays

• Weight Bearing Lateral
  ○ Talus-1st MT Line

• Weight Bearing AP Foot
  ○ Talus-1st MT Line
  ○ TN Coverage Angle

• Standing AP Ankle

• MRI: method of choice in imaging posterior tibial tendon
PTT Disorders Classification
Johnston & Strom 1989

• Stage I: Pain and tenderness, no deformity
• Stage II: Flexible deformity
• Stage III: Rigid hindfoot deformity
PTT Disorders Classification
Myerson 1996

• Tenosynovitis: Medial pain, ✓ heel rise
• Stage I: Medial pain, flexible hindfoot, ✓ heel rise
• Stage II: Lateral pain, flexible valgus hindfoot, ✗ heel rise
• Stage III: Lateral pain, rigid valgus hindfoot, ✗ heel rise
• Stage IV: Lateral pain, rigid valgus hindfoot, valgus inclination of talus, ✗ heel rise
PTTD Stage I Treatment

• Non-operative:
  ○ Immobilization
  ○ NSAIDs
  ○ ± Steroid Injection
  ○ Arch Support

• Surgical:
  ○ Tenosynovectomy (be prepared to do FDL Transfer)
PTTD Stage III & IV Treatment

• Non-operative:
  ○ NSAIDs
  ○ Accomodative rigid ankle-foot orthosis (AFO)
  ○ Arizona brace

• Surgical:
  ○ Arthrodesis:
    ➢ Isolated Arthrodesis (TN)
    ➢ Subtalar Arthrodesis ± FDL Transfer
    ➢ Triple Arthrodesis ± TAL
PTTD Stage II Treatment
Controversial

• Non-Operative (⅔ effective):
  ○ Immobilization
  ○ Shoe Modification (Arch Support)
  ○ Hinged AFO

• Surgical (very controversial):
  ○ Soft tissue procedures
  ○ Bony procedures
PTTD Stage II
Surgical Treatment

Soft Tissue Procedures:
○ ? PTT Repair
○ FDL Transfer
○ FHL Transfer
○ ± Spring Ligament Imbrication
PTTD Stage II
Surgical Treatment

Bony Procedures:
- **Medial Displacement Calcaneal Osteotomy**
- Lateral Column Lengthening
  - Through Calcaneal Neck or CC Joint
- Isolated Arthrodeses
- ± TAL
PTTD Stage II
Surgical Treatment

• Combined Procedures
  ○ FDL/Medial Displacement Osteotomy
  ○ FDL/Lateral Column Lengthening
  ○ FDL/Double Calcaneal Osteotomy
  ○ FDL/ST Arthrodesis

• ± TAL

• ± Spring Ligament Repair