Ankle sprain

by

Waleed saber

Orthopedic physical therapy lecturer

s.v.u.

Importantly for clinicians who work in sport, a ‘sprained ankle’ can mask damage to other structures, such as subtle fractures around the ankle joint, osteochondral fractures of the dome of the talus, and dislocation or longitudinal rupture of the peroneal tendons. Such injuries and their complaints persist longer than would be expected with a straightforward lateral ligament sprain. This is often referred to as ‘the difficult ankle’

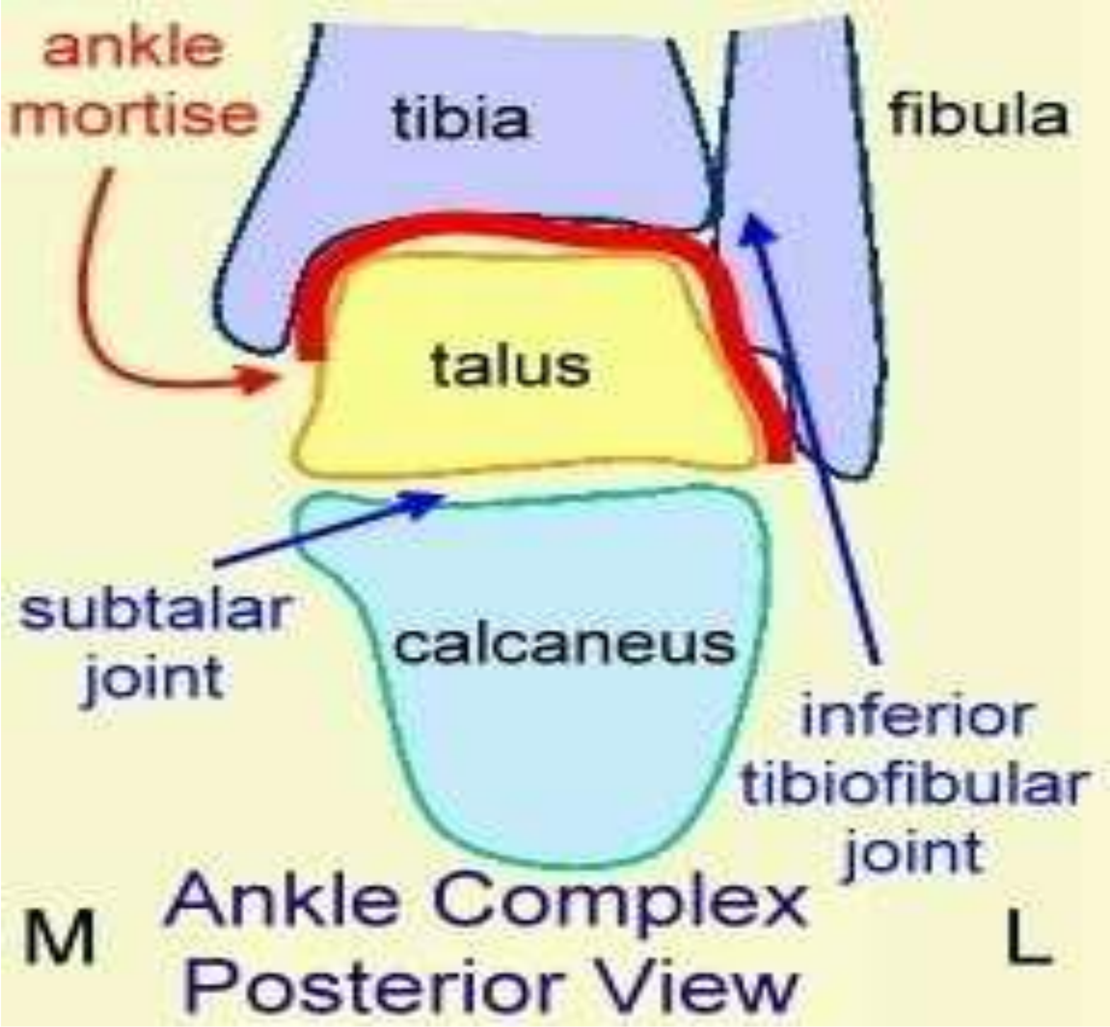
Functional anatomy

Function of ankle and foot

1. functions as a rigid structure for weight bearing and it can also function as a flexible structure to conform to uneven surfaces
2. Providing balance.
3. Shock absorption.
4. Transferring ground reaction forces.
5. provide stable base of support.
6. acting as a rigid lever for effective push off during gait.
7. Absorbs the rotation imposed by the more proximal joints.
8. Compensating for proximal malalignment.

Joints of ankle complex

A. **Inferior tibiofibular joint** (syndesmosis)
B. **Talocrural (ankle) joint**
C. **Subtalar joint**



Inferior tibiofibular joint

- Articulation

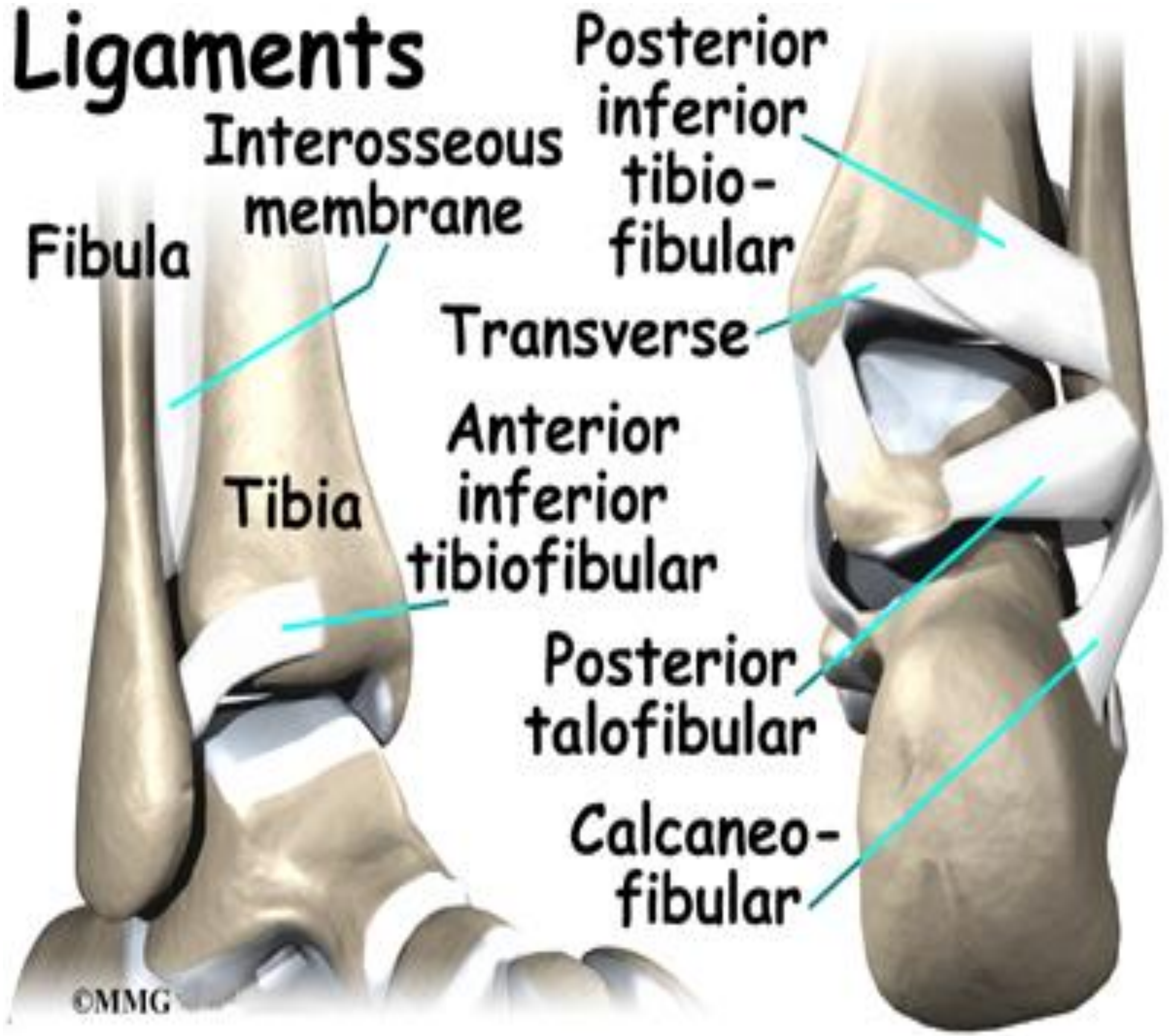
medial convex surface on distal end of fibula. concave surface on fibular notch of tibia.

- Type

Fibrous syndesmotic joint.

- Ligaments

1. Anterior tibiofibular
2. Posterior tibiofibular
3. transverse tibiofibular ligament
4. Interosseous membrane



Talocrural (ankle) joint

- Articulation

The distal and inferior aspect of the tibia (plafond) – connected to the fibula mortise which articulates with the talar dome distally

- Type

Synovial hinge joint

- Motion

Extension (dorsiflexion) and flexion (plantar flexion)

- Closed Packed Position

Maximum Dorsiflexion

- Open Packed Position

10° Plantarflexion

lateral collateral ligaments

Anterior talofibular ligament (ATFL)

- Flat Weak Band that extends Anterio-medially.
- Attached from the anterior margin of the lateral malleolus to neck of Talus
- The Most commonly damaged ligament of the ankle.
- commonly compromises a double-banded morphology(may be single)
- The anterior talofibular ligament (ATFL) is an intracapsular structure

Motions Limited

- resist anterior displacement of the talus relative to the ankle mortise
- Resists Inversion in plantarflexion.
- Internal rotation of the talus

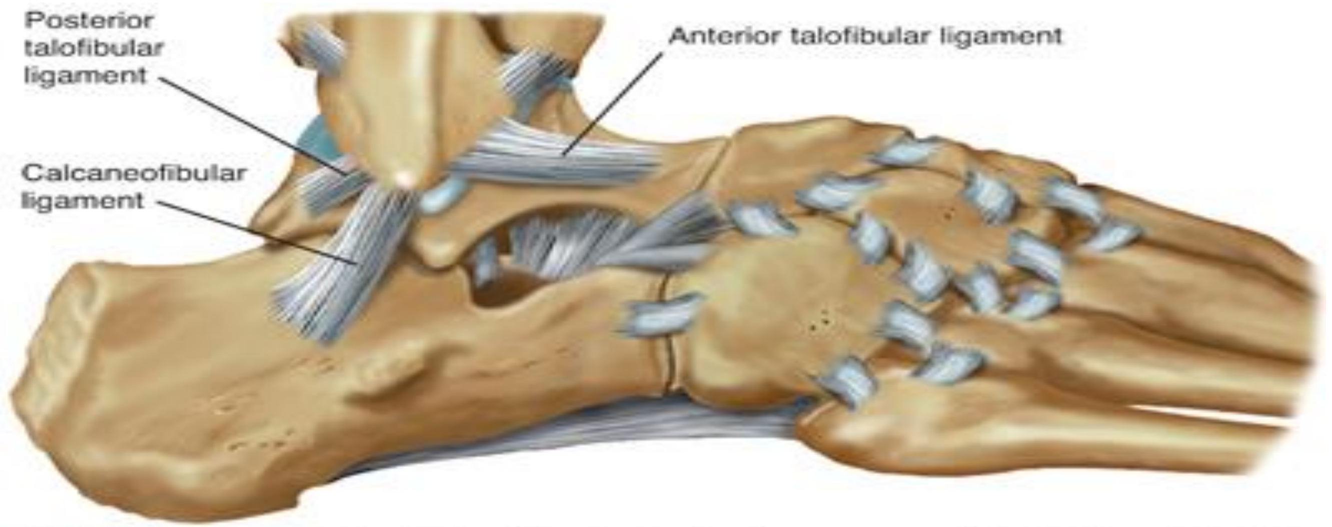
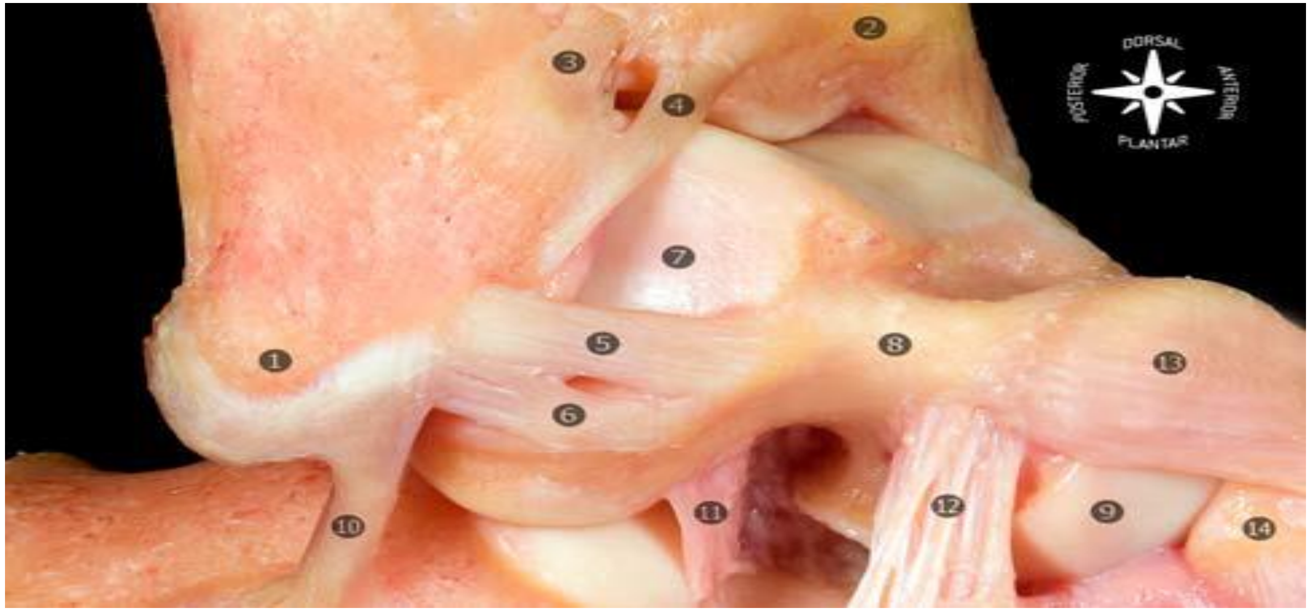


FIG 1 • Anatomy of the lateral ankle showing the three ligaments: ATFL, PTFL, and the CFL



Calcaneofibular ligament (CFL)

- Thick, a fairly strong band
- Attached from tip of the fibular malleolus to the lateral side of the calcaneus
- an extra-articular structure
- calcaneofibular ligament becomes horizontal during extension and vertical in flexion, remaining tense throughout its entire arc of motion

Motions Limited

- calcaneal adduction
- Inversion and dorsiflexion

FIG 1 • Anatomy of the lateral ankle showing the three ligaments: ATFL, PTFL, and the CFL.

Posterior talofibular ligament (PTFL)

- Its attachment on the talus involves nearly the entire non-articular portion of the posterior talus to the digital fossa of the fibula
- intracapsular but extrasynovial
- The PTFL is rarely injured except in severe ankle sprains. Commonly injuried in extreme ankle dorsiflexion, foot external rotation

Motions Limited

- Dorsiflexion
- Posterior displacement of foot
- Inversion

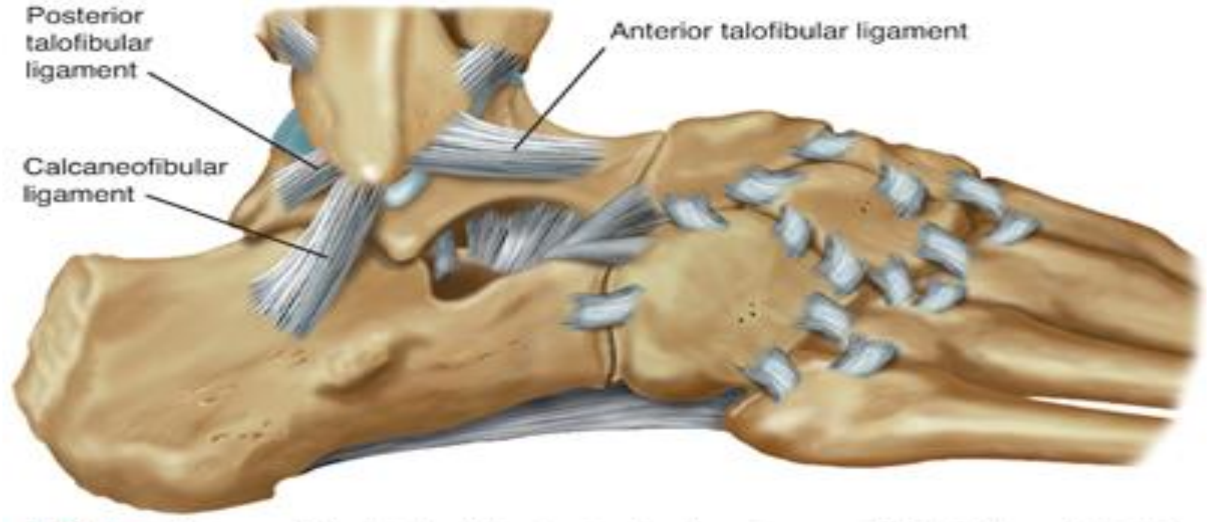
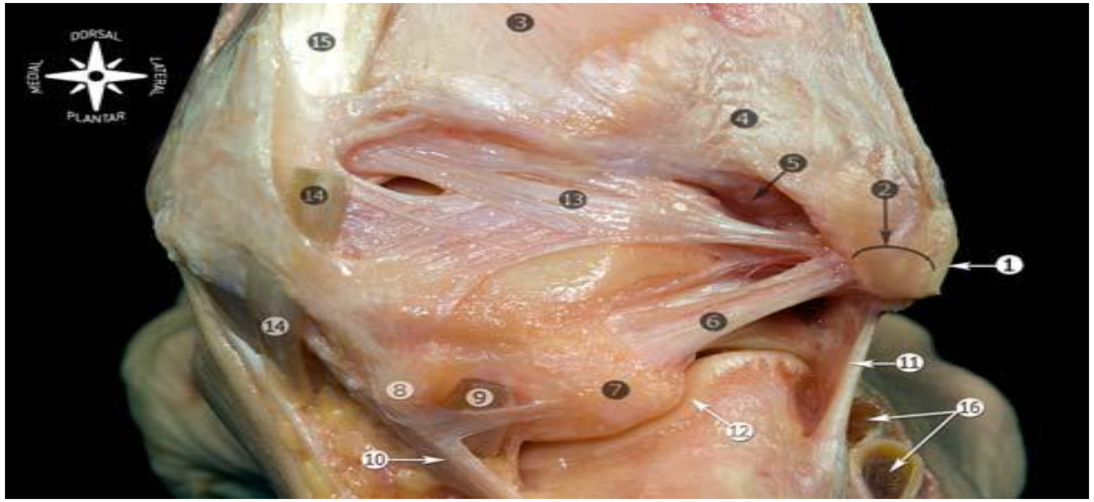


FIG 1 • Anatomy of the lateral ankle showing the three ligaments: ATFL, PTFL, and the CFL



CLINICAL PEARL

In dorsiflexion, the PTFL is maximally stressed, and the CFL is taut, whereas the ATFL is loose. Conversely, in plantarflexion, the ATFL is taut, and the CFL and PTFL become loose

Medial collateral ligaments (deltoid ligament)

- ***Tibionavicular***
  - resist lateral translation and external rotation of the talus.
- ***Tibiocalcaneal***
  - resist abduction of the talus
  - usually, the first ruptured with an eversion injury.
- ***Posterior tibiotalar***
  - resist ankle dorsiflexion and lateral translation and external rotation of the talus
- ***Anterior tibiotalar***
  - resist abduction of the talus when it is in plantar flexion and eversion.

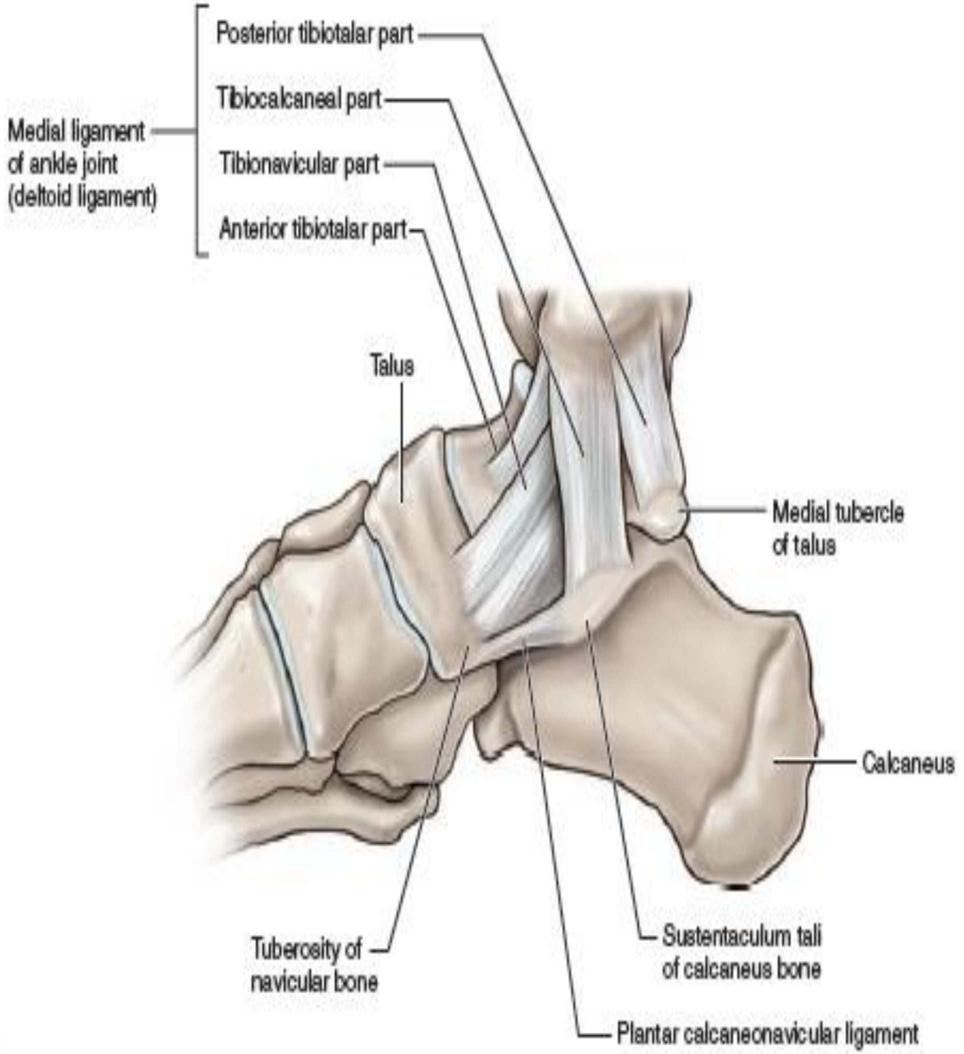


FIGURE 21-3 Medial ligaments. (Reproduced with permission from Morton DA, Foreman KB, Albertine KH. *The Big Picture: Gross Anatomy.* 2nd ed. New York, NY: McGraw-Hill Education; 2019.)

CLINICAL PEARL

The strength of the ankle ligaments from weakest to strongest is the ATFL, PTFL, CFL, and deltoid complex

Subtalar joint(talocalcaneal **joint)**

- articulation

✓ articulation between the distal talus and proximal calcaneus

✓ divided into an anterior and posterior articulation separated by the sinus tarsi

- Motion

Inversion, eversion

- **ligaments**

➢ **Medial Talocalcaneal**

➢ **Lateral Talocalcaneal**

➢ **Posterior Talocalcaneal**

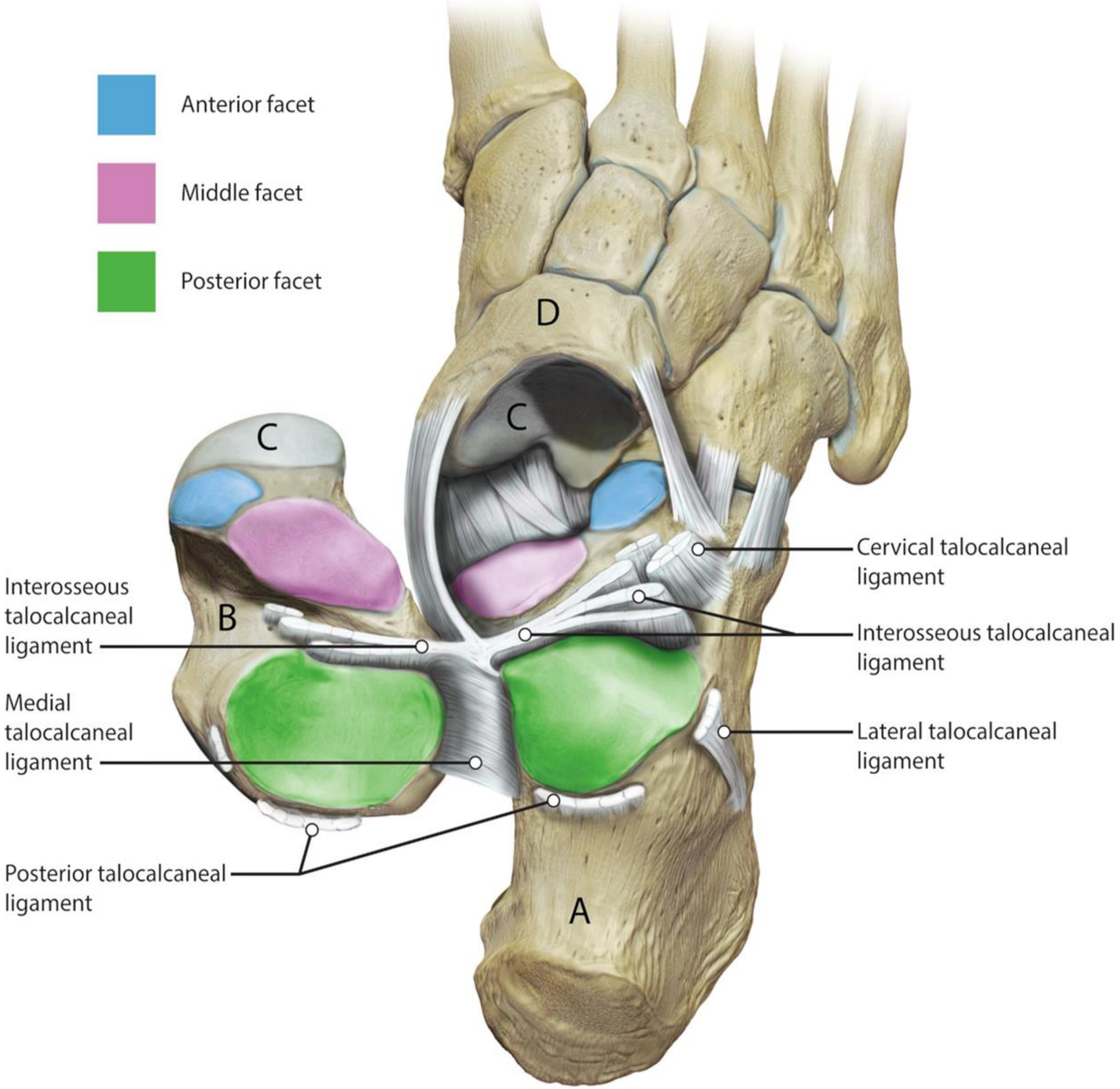
➢ **Interosseous Talocalcaneal**

- Open Packed Position

Midway between the extremes of ROM

- Closed Packed Position

Supination



Examination of Ankle and Foot

HISTORY

Determine the patient's chief complaint

PRESENTING COMPLAINT

Determine the mechanism of injuryInformation about the mechanism of injury should include when, where, how

Pain

duration, site, aggravating and relieving factors. Pain during the night, early morning or on walking after prolonged rest or sitting as in plantar fascitis, walking on uneven surface and climbing up or down stairs should be recorded.

Morning Stiffness

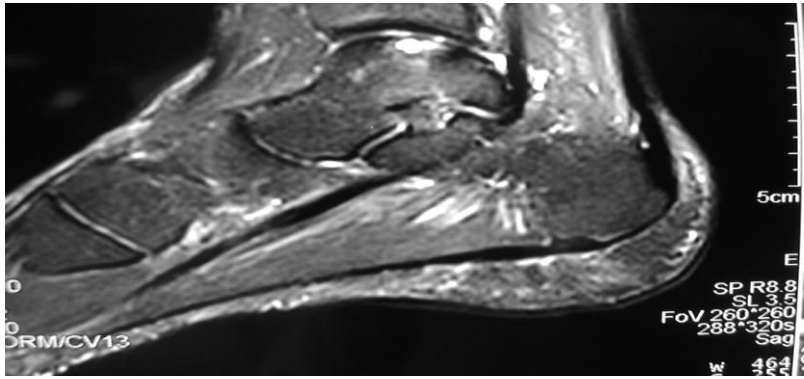
In inflammatory conditions like rheumatoid

Swelling

Site, duration, onset—sudden or insidious, localized or generalized, medical conditions, which may cause bilateral foot swelling: Renal or cardiac problems, anemia, hypoproteinemia, pregnancy, liver disease, lymphoedema,

Giving Way

Can be due to ankle instability, anterolateral impingement syndrome, neurological problems or osteochondritis of dome of talus.



Neurological Symptoms

Weakness, numbness, and pins and needles.

General Points

The exact form of the examination is very much dependent on the acuteness of the condition. For example, weight-bearing tests cannot be done if the patient cannot bear weight, and most stress tests will prove impossible if the joints cannot be taken to their full range. In these cases, the clinician must rely heavily on the history.

Avoid examining patients only from the ankle down. Many generalized diseases produce problems in the foot.

- for instance, examination of other joints in suspected arthritis, full neurological examination in a patient with suspected neuropathy, assessment of joint mobility in a child with flat feet

- *Limb alignment and length:* Look for pelvic obliquity, limb length discrepancy (and its level)

Observation

- Observing the patient while they move from sitting to standing and walk
- observe the entire kinetic chain

The following are assessed with the patient standing:

- ***Shoulder and pelvic heights.***
- ***Spinal curvature.***
- ***Pelvic rotation***
- ***The degree of hip rotation***
- ***The degree of knee flexion or hyperextension***
- ***The degree of varus and valgus of the knee and tibia***

- Posture - foot posture, arch posture
- Gait Analysis
- Deformities: bunions, hammer toes, claw toes, calluses etc.
- Effusion
- Muscle Wasting

Shoes: Examination of these is like a summary of gait over time. They show the areas under pressure in gait and from deformity, and the areas that take no pressure at all.

Skin: Look for inflammation, infection, varicose veins, discoloration, gangrene, scars or contracture, ulcers, calluses

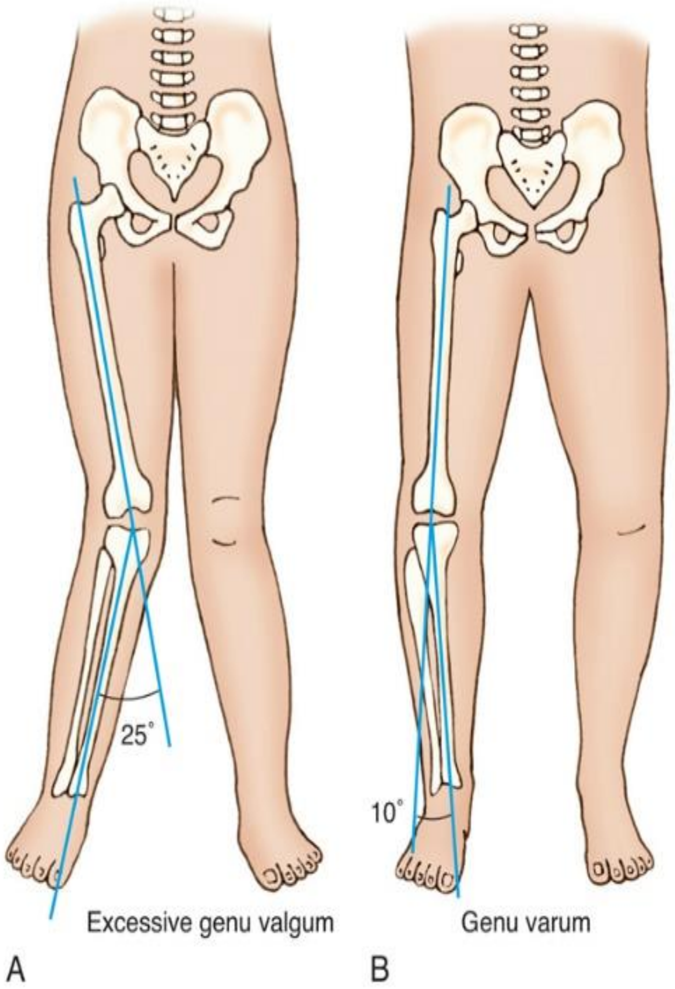
The degree of hip rotation.

- ✓Excessive internal rotation of the hip toward the opposite hip (anteversion) may result in a flattening of the medial longitudinal arch and toeing-in/internal torsion of the
- ✓Excessive external rotation of the hip away from the opposite hip (retroversion) may result in an elevation of the medial longitudinal arch.

The degree of varus and valgus of the knee and tibia.

✓Genu varus, forefoot varus promotes excessive weight-bearing on the lateral aspect of the foot

✓Genu valgum foot pronation excessive weight bearing on the medial aspect of the foot



Rotational components of the tibia

- The normal foot in relaxed standing adopts a slight toe-out position of approximately 12–18 degrees from the sagittal axis of the body

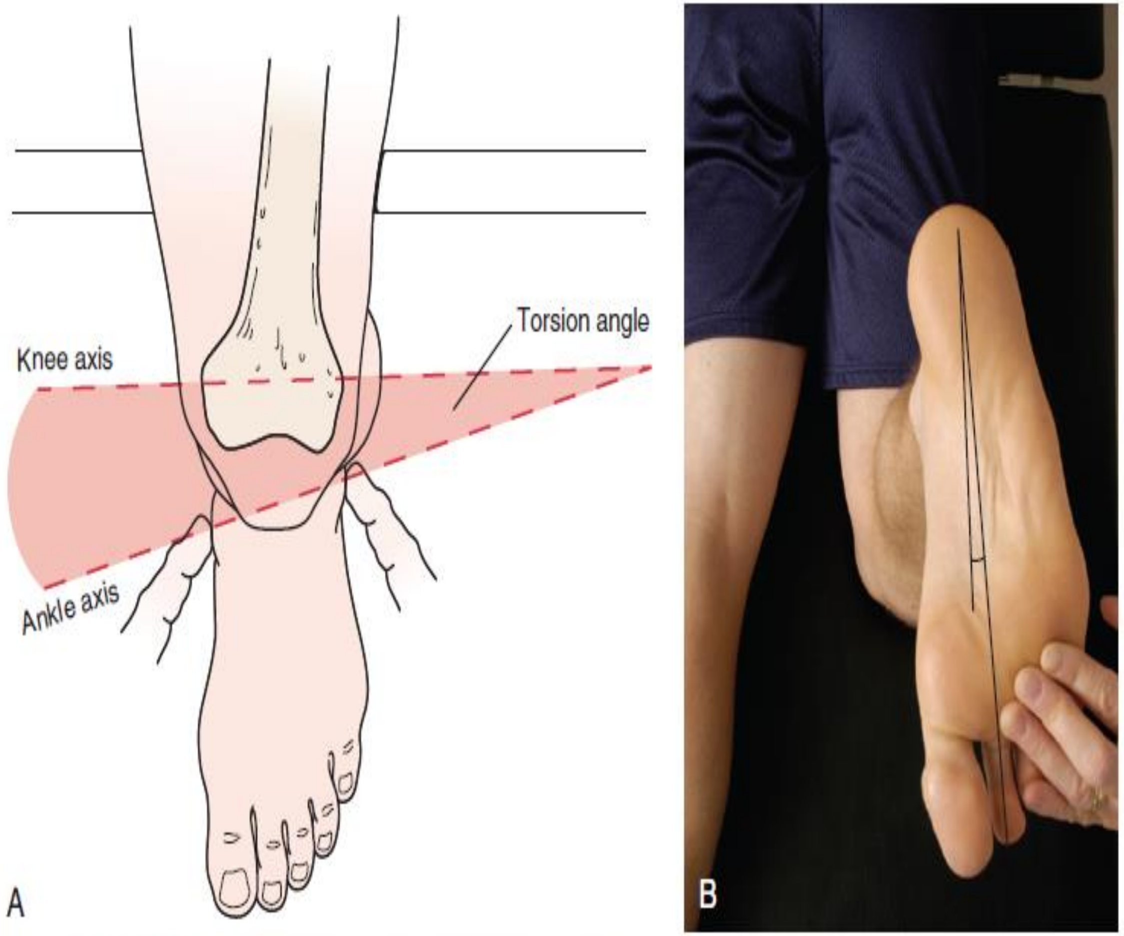
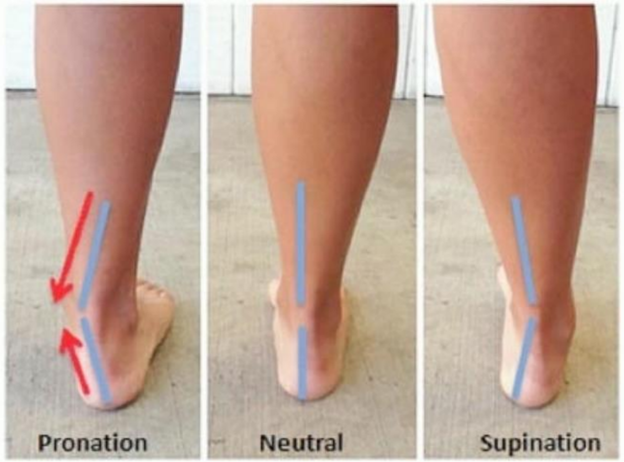


Figure 12–8

A, Determination of tibial torsion in sitting (superior view). The torsion angle determined by the intersection of the knee axis and the ankle axis. (**A** Modified from Hunt GC (ed): *Physical therapy of the foot and ankle*, p 80, New York, 1988, Churchill Livingstone.) **B,** Measurement of tibial torsion in the prone position.

Hindfoot to leg orientation

- It is assessed by measuring the acute angle formed between a line representing the posterior aspect of the distal third of the leg, and a line approximately 1-cm distal to the first mark, representing the midline of the posterior aspect of the calcaneus.
- The angle is assessed as the patient shifts weight on the lower extremity to simulate single-limb support. If the lines are parallel or in slight varus (2–8 degrees), the leg–hindfoot orientation is considered normal.



Flat-foot

- Look for too many toes sign from the back in standing posture .
- *Flexible or Rigid Flat Feet*

❑ In flexible flat feet the medial arch is present on non-weightbearing and disappears on weight bearing.

❑ On standing on tiptoes the arch reappears in flexible flatfeet.

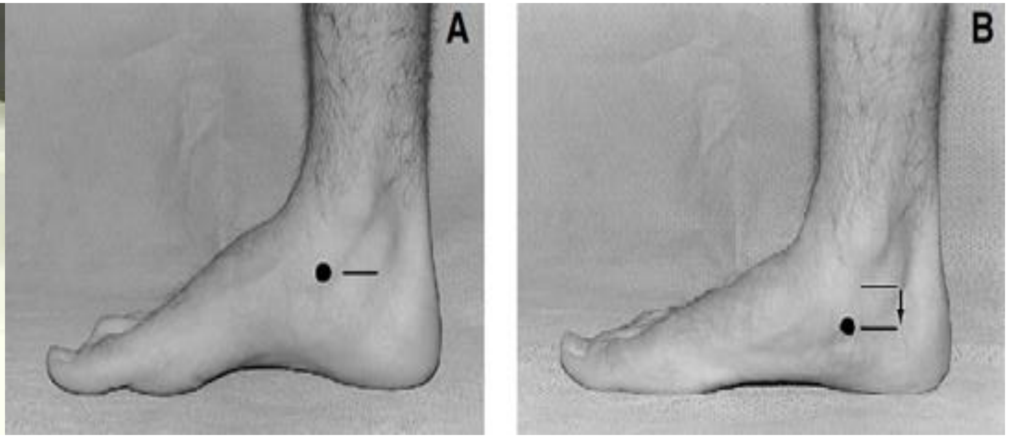
Jack's test

is performed in a weight bearing/ standing.

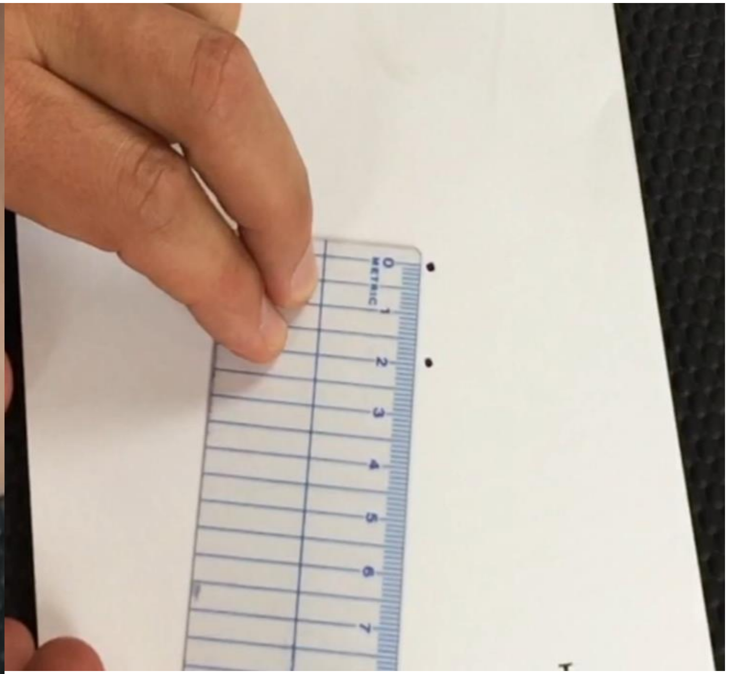
1.The patient is to stand in a normal, relaxed position,

2.The clinician then passively flexes the 1st metatarsal joint (big toe) reproduces the medial longitudinal arch.

Navicular Drop and navicular drift Test



There's some conflicting research but in general tell 6 mm is normal



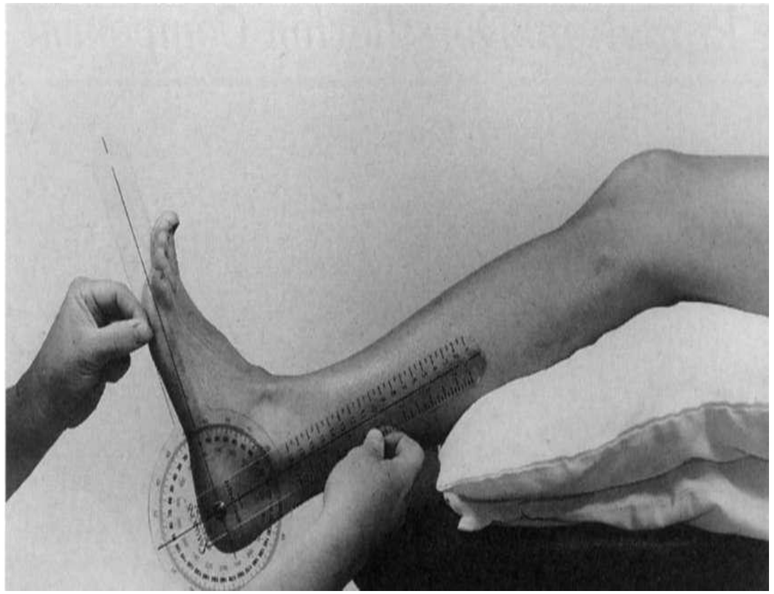
Palpation

- Joint lines
- Medial and lateral ligaments
- Achilles tendon, peronei and other extrinsic muscles
- Bony palpation

Active and Passive Range of Motion

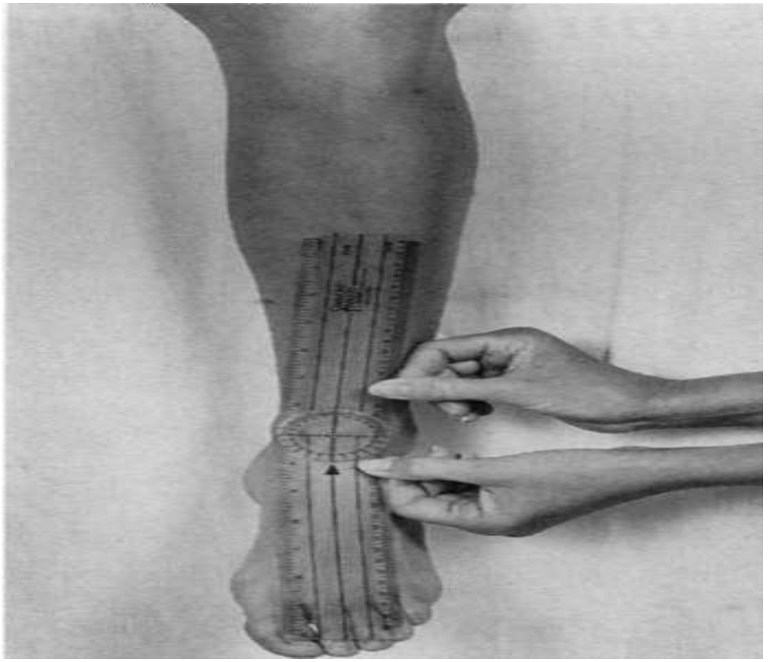
Planter flexion (50 degree) and dorsiflexion (20degree)

- Stationary arm: Lateral midline of fibula, in line with fibular head.
- Axis: Distal to, but in line with lateral malleolus, at intersection of lines through lateral midline of fibula and lateral midline of 5th metatarsal.
- Movable arm: Lateral midline of 5th metatarsal



Inversion (20 degree) and eversion (10 degree)

- Stationary arm: Anterior midline of tibia, in line with tibial crest.
- Axis: Anterior aspect of talocrural joint, midway between medial and lateral malleoli.
- Movable arm: Anterior midline of 2nd metatarsal



Passive accessory

FIGURE 5.62 Subtalar joint: lateral glide. (A) Prone; (B) Side-lying.

FIGURE 5.60 Talocrural joint: anterior glide.

FIGURE 5.59 Talocrural joint: posterior glide.

Muscle testing

Gastrocnemius and Plantaris Muscles.

- standing with the knee extended and the opposite foot off the floor
- one heel raise through full ROM, while standing with support on one leg, scores a 3/5 (fair) with manual muscle testing,
- Five single-limb heel raises scoring a 4/5 (good)
- 10 single-limb heel raises scoring a 5/5 (normal). From a functional viewpoint,
- **Soleus Muscle.**
- The soleus is tested in a similar manner
- to that of the gastrocnemius, except that the patient performs the unilateral heel raise with some degree of knee flexion

Tibialis Anterior Muscle

Tibialis Posterior Muscle

Peroneus muscle group

Assessing Ankle Girth

Figure-of-eight tape method.

The clinician places the zero endpoint of a tape measure midway between the tibialis anterior tendon and lateral malleolus. The tape is then drawn medially and is placed just distal to the navicular tuberosity. The tape is then pulled medially around the foot to then cross the plantar aspect (arch) toward the base of the fifth metatarsal. The tape is then pulled across the tibialis anterior tendon and around the ankle to a point just distal to the medial malleolus, before being finally pulled across the Achilles tendon and placed just distal to the lateral malleolus and across the start of the tape.

Neurologic Assessment

Reflexes

- patellar Ligament (L3/L4)
- Achilles Tendon (S1/S2)

Dermatomes

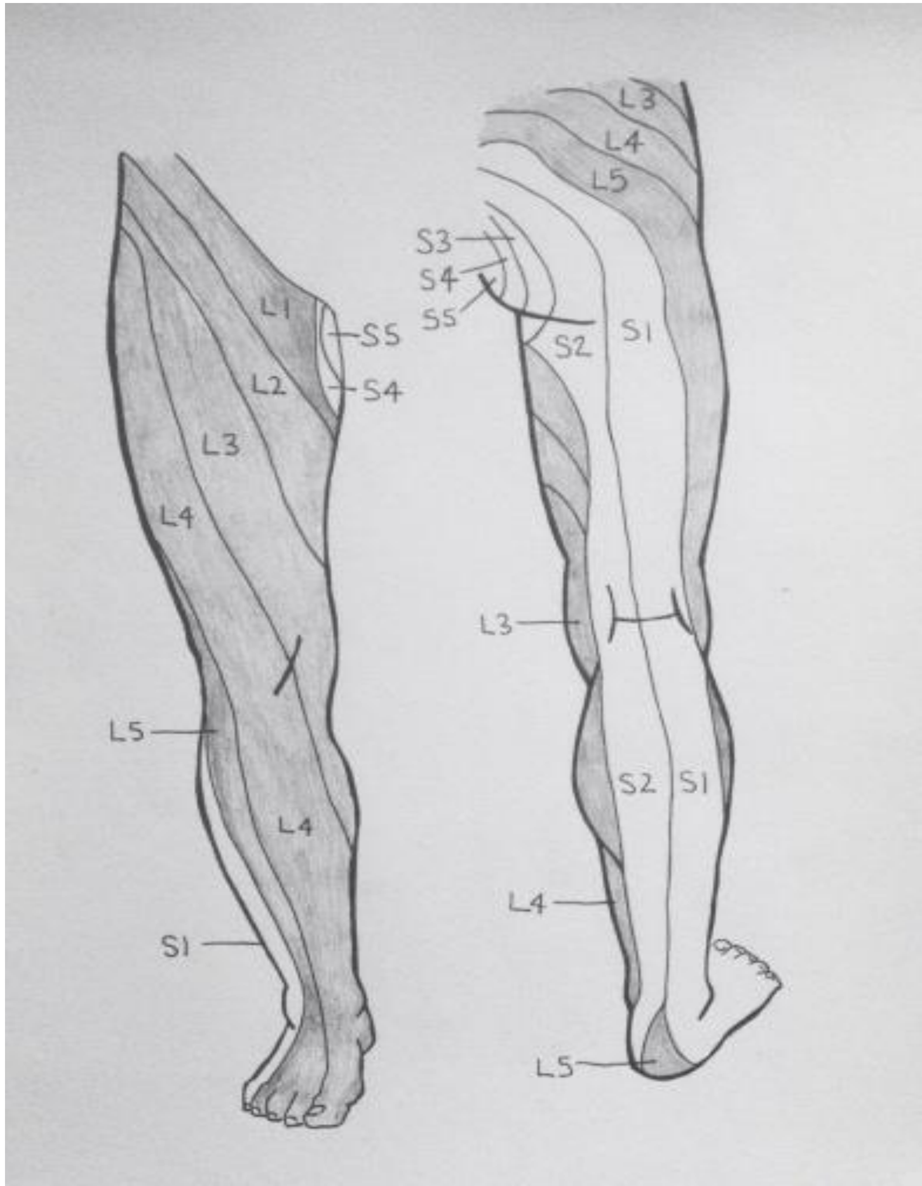
- L1 to S4

Myotomes

- L2 - Hip flexion
- L3 - Knee extension
- L4 - Dorsiflexion
- L5 - Big toe extension OR 4 lesser toes extension
- L5/S1 - Knee flexion
- S1 - Plantar flexion OR foot eversion
- S2 - Toe flexion

Other neurological testing:

- Babinski response
- Clonus

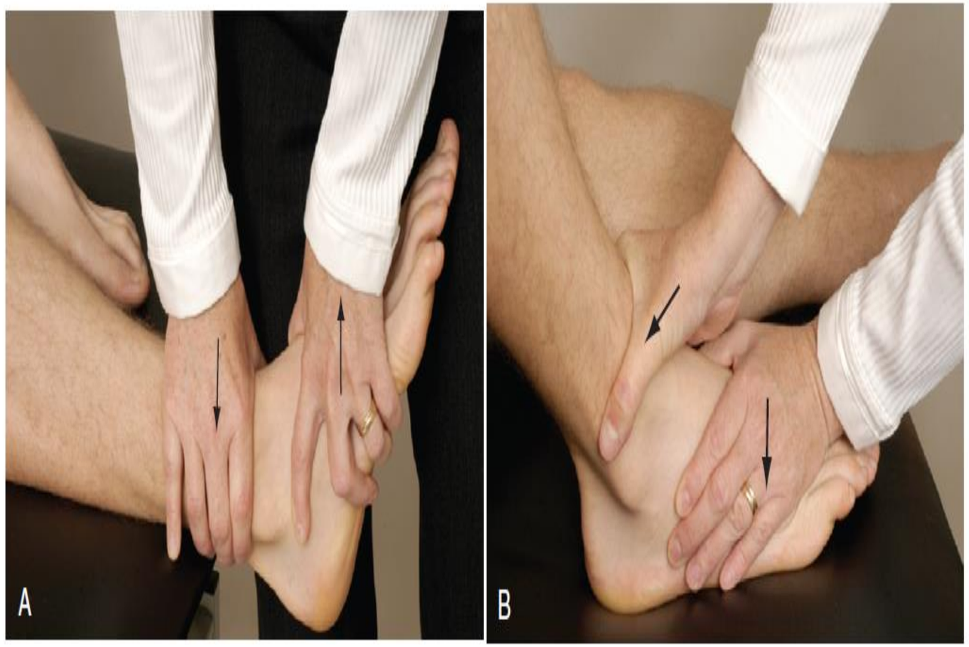


Vascular Status

Homans' Sign

Posterior (Dorsal) Pedis Pulse

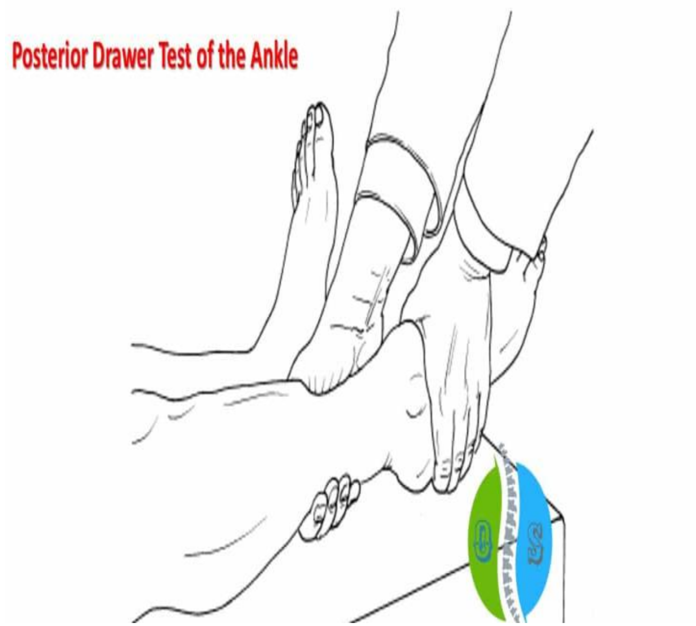
Special tests for ligamentous instability



Anterior drawer test

- **PURPOSE** To test for injuries to the anterior talo-fibular ligament
- **A POSITIVE TEST** Excessive motion or pain (or both) compared to the unaffected side

Posterior drawer test



Talar telt test

syndesmosis squeeze test

External rotation stress test (kleiger test)

Thompson's test
Simmonds test

Talar rocking

Ankle sprain

Epidemiology

Ankle ligament injuries constitute 4.7–24.4% of all injuries incurred in an individual sport, and 10–28% of all injuries that occur in running and jumping sports.

Age

• Under the age of 35 with a peak of incidence of 15 to 19 years of age.

Sex

• Slightly higher incidence of ankle sprain in males.

Sport

• Ankle sprains are the most common injury in all sports involving running and pivoting; basketball is the most common sport in the United States associated with ankle sprain but other include football, soccer, running, volleyball, baseball, and gymnastics. Ice and water sports are less likely to cause an ankle sprain.

Position

• Among soccer players, defenders and attackers have a higher risk of ankle injury as a result of contact with opponents.

<u>Low ankle sprain:</u>

Lateral ankle sprain “classic sprain” 80% to 85%

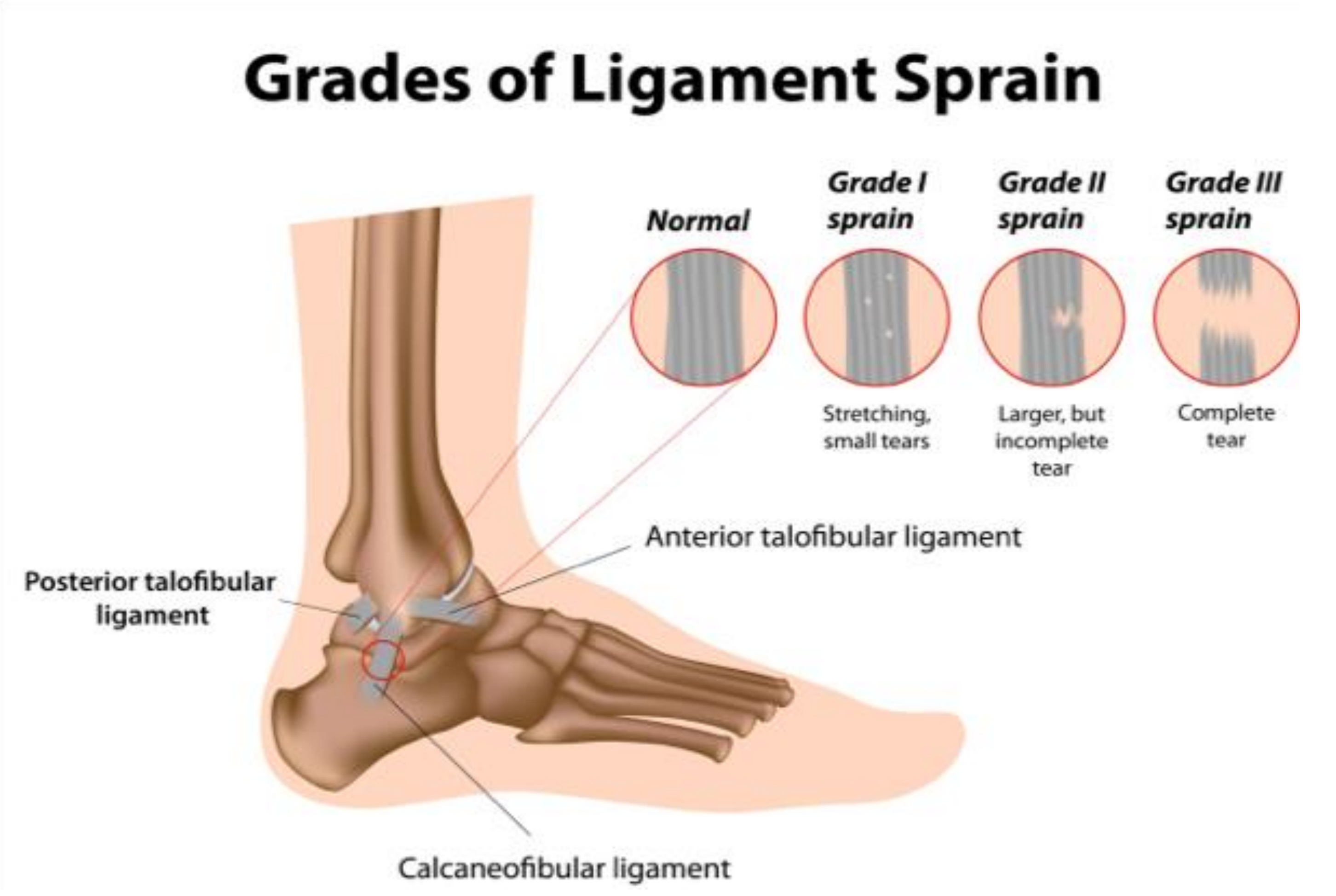
Medial ankle sprain 5% to 10%

<u>High ankle sprain</u>

(Syndesmotic sprain) 5% to 10%

Grades of ankle sprain

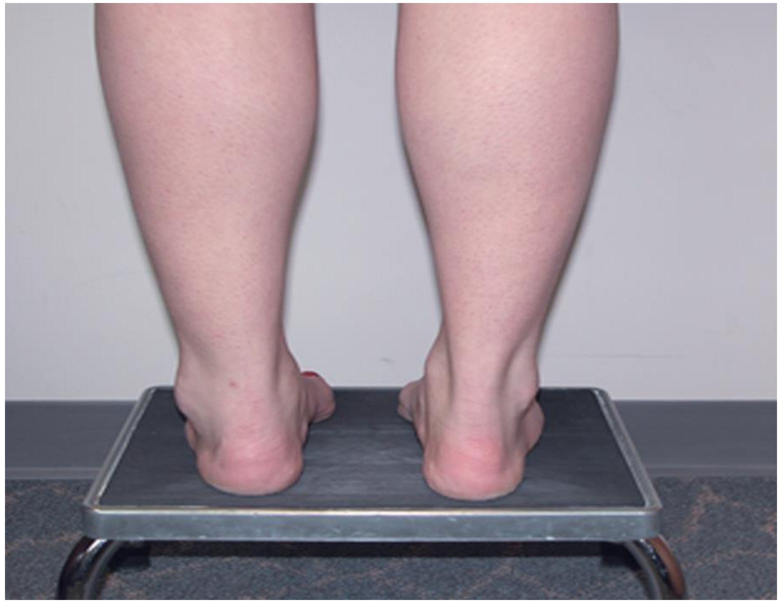
- **Grade I** ankle sprains result in a stretching of the ligamentous fibers and are considered minor sprains.
- **Grade II** ankle sprains result in a partial tearing of the ligamentous fibers and are considered to be moderate sprains.
- **Grade III** ankle sprains result in substantial tearing of the ligamentous fibers and are considered severe sprains.



Predisposing factors

Intrinsic Factors

- Muscle strength imbalance: eversion-to inversion
- Increased BMI
- Higher risk for dominant ankle in soccer
- History of previous ankle sprains
- Pes cavus or calcaneovarus alignment



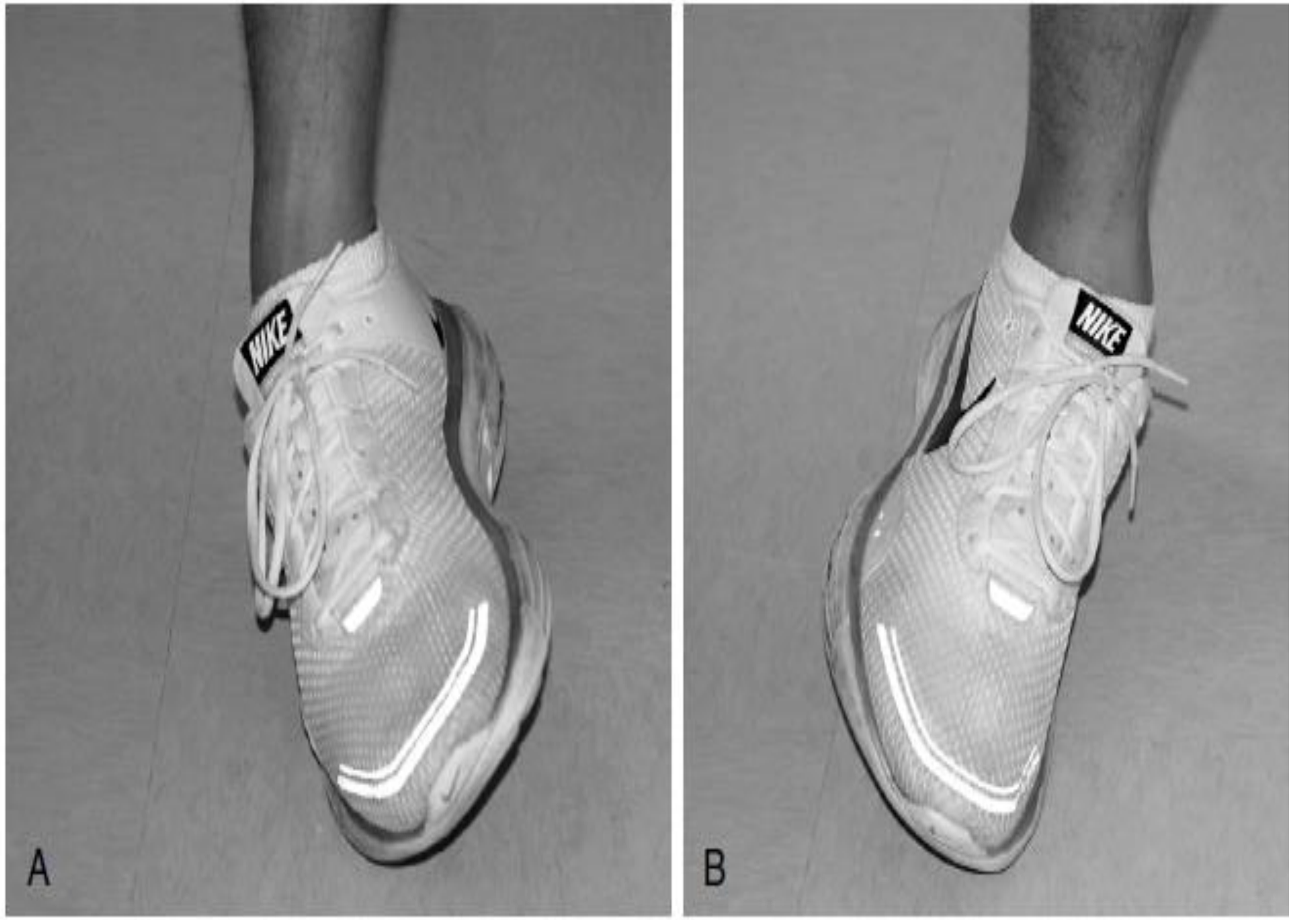
Extrinsic Factors

- shoe wear: high heels, poor fit
- Inadequate warmup with poor flexibility
- Artificial turf increases the risk of ankle injury

Mechanism of injury

A- Inversion with plantarflexion (most common)
Injury to the anterior talofibular ligament (ATFL) and possibly the calcaneofibular ligament (CFL) and (PTFL).
B- eversion (not common)
Injury for sprains of the deltoid ligament complex (DLC).
C- Syndesmosis sprains usually occur with external rotation

due to forced ankle dorsiflexion and external rotation of the foot. Miss-diagnosis may result in long term pain and dysfunction

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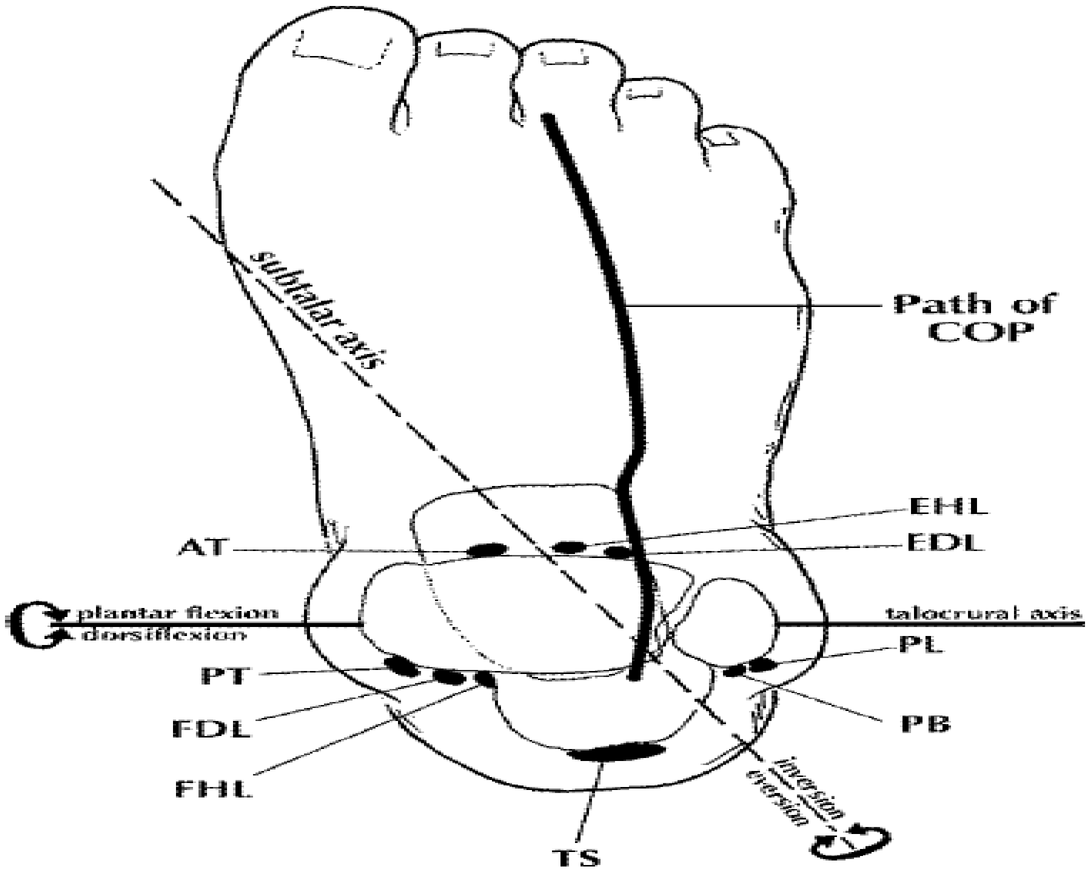
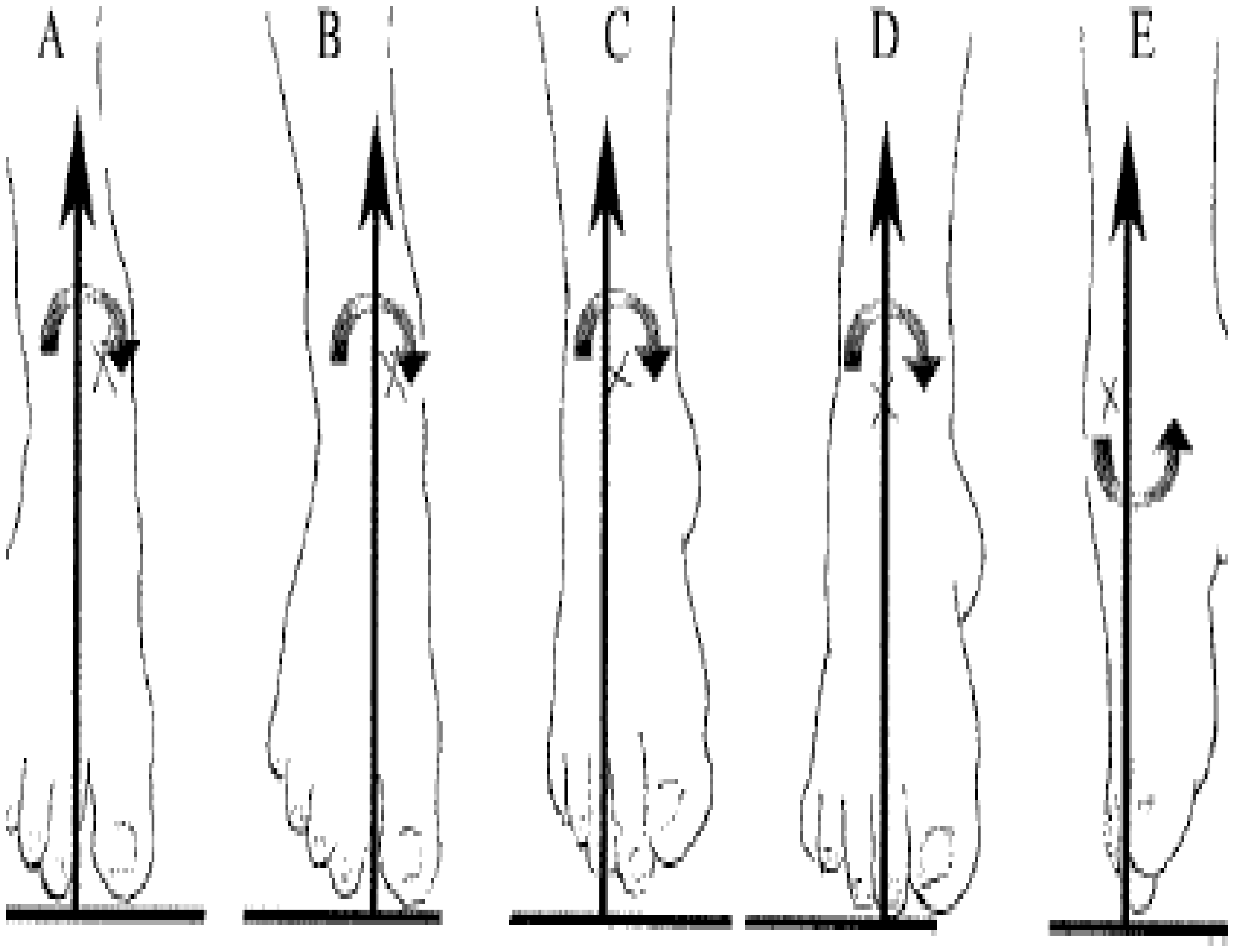
- The ground-reaction force typically acts lateral to the **subtalar-joint axis** and anterior to the **talocrural-joint axis**. The external load usually everts and dorsiflexes the ankle. This torque is counteracted by the strong plantar-flexor and invertor muscles (Mann 1980)



- A neutral, B everted and C-E, inverted positions.
- The subtalar-joint axis is marked just medial to the anterior tibial tendon. The inverted foot moves the axis laterally to the line of action of the reaction force, leading to a potentially dangerous situation: giving way.



Clinical Presentation

The mechanism of the ankle sprain is an important clue to diagnosis.

- An inversion injury suggests lateral ligament and medial compression damage.
- Eversion injury suggests medial ligament damage. If the injury involved ankle compression, the clinician should consider osteochondral injury.

lateral and syndesmotic sprain. Note: ecchymosis more proximal and anterior.

Swelling, ecchymosis, and tenderness laterally for lateral sprains and lateral malleolar fractures

The location of pain and swelling generally indicates which ligaments were injured. The most common site is over the anterolateral aspect of the ankle involving the ATEL

Weight bearing →

With sprains and osteochondral lesions (OCLs) it may be difficult to weight bear on the injured limb because of pain, but it is usually still possible to walk on the foot. Inability to weight bear on the injured foot usually indicates the presence of a fracture (Ottawa Ankle Rules).

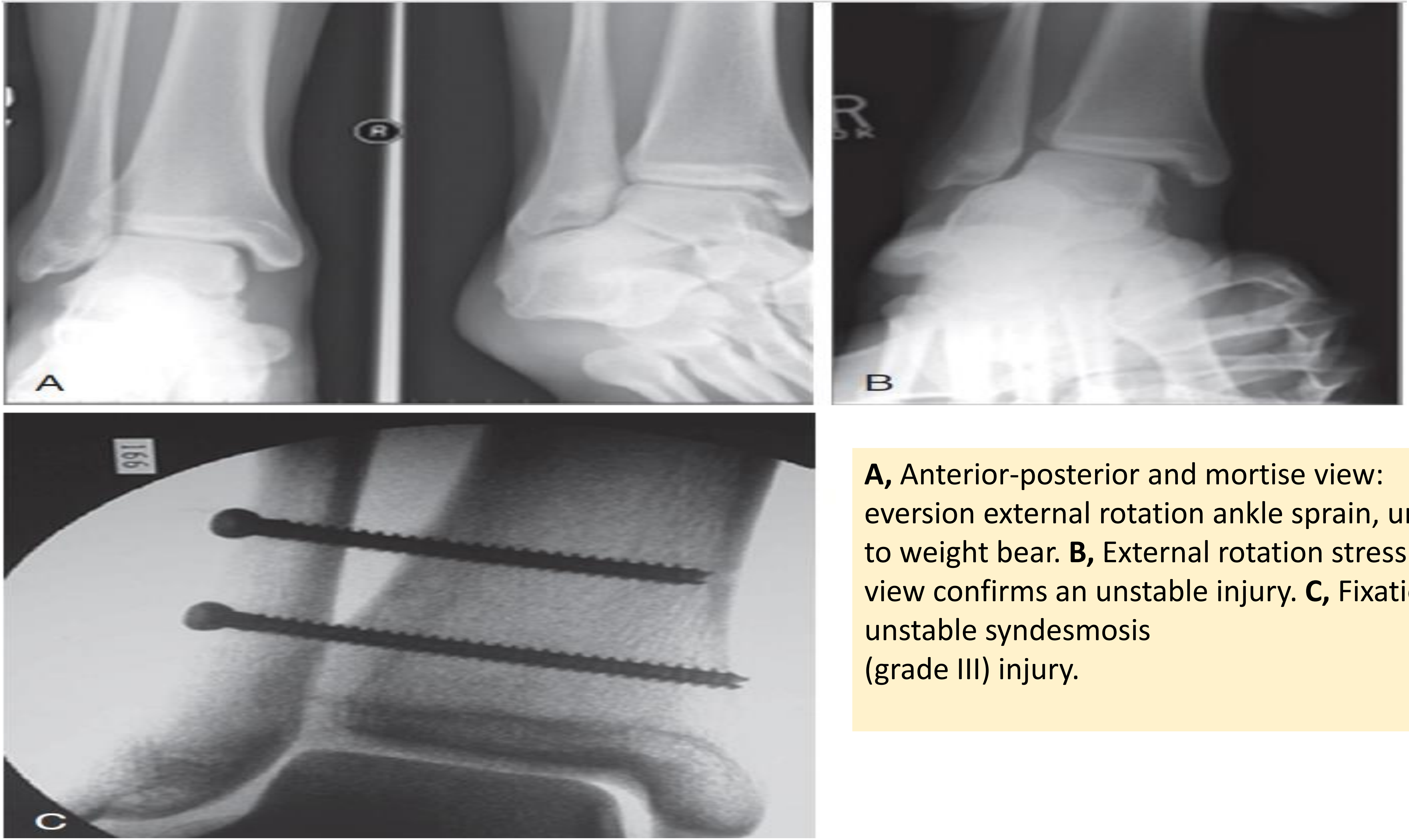
TABLE 39.2 Clinical Signs and Symptoms Associated With Ankle Sprains

Grade I	Grade II	Grade III
Stretching of ligaments, usually the ATFL Point tenderness Limited dysfunction No laxity Able to bear full weight Little to no edema	Partial tearing of ligaments, usually the ATFL and CFL Point and diffuse tenderness Moderate dysfunction Slight to moderate laxity Antalgic gait and pain with FWB, may need supportive device to ambulate Mild to moderate edema	Substantial tearing of ligaments, may involve the PTFL in addition to the ATFL and CFL Point and diffuse tenderness Moderate to severe dysfunction Moderate to severe laxity Limited to no ability for FWB without supportive device Severe edema

ATFL, anterior talofibular ligament; CFL, calcaneofibular ligament; FWB, full weight bearing; PTFL, posterior talofibular ligament.

An osteochondral lesion should be considered when persistent pain centered over ankle joint line is present together with intermittent locking, stiffness, and limping

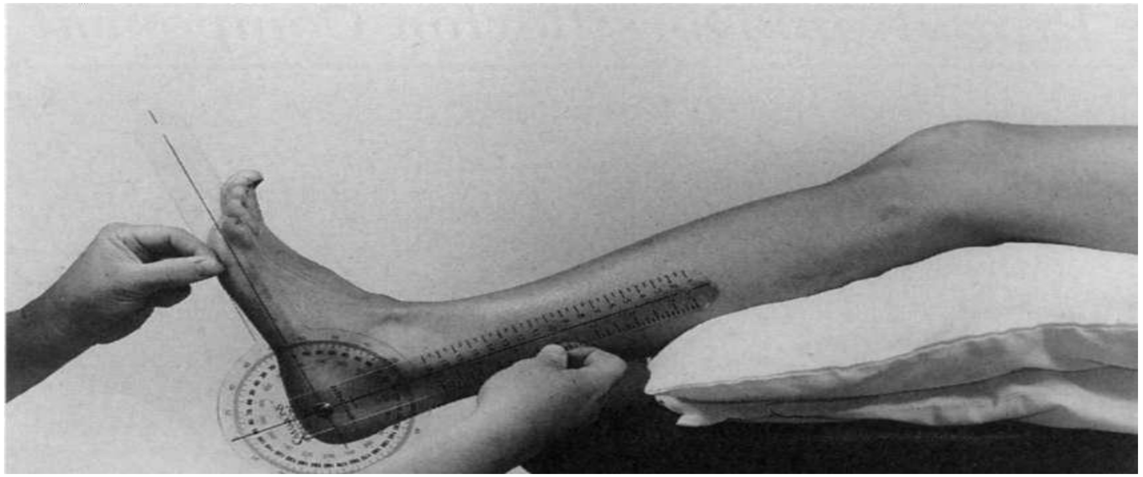
Radiograph showing widening of the tibiofibular “clear space” (arrows) as a result of disruption of the syndesmosis. The clear space is normally less than 5 mm wide.

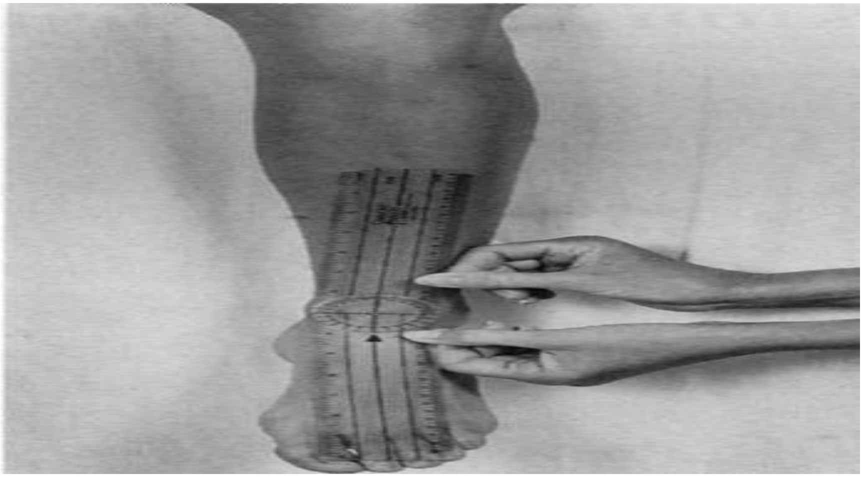


A, Anterior-posterior and mortise view: eversion external rotation ankle sprain, unable to weight bear. **B,** External rotation stress test; view confirms an unstable injury. **C,** Fixation of unstable syndesmosis
(grade III) injury.

Ankle girth

Range of motion assessment





Talar Tilt - **tests** the CFL.

External rotation stress **test** (Kleiger's **test**) - syndesmotic **sprain**

Anterior Draw - **tests** the ATFL.

Posterior Draw - **tests** the PTFL.

Talar rocking

Squeeze **test** - for syndesmotic **sprain**

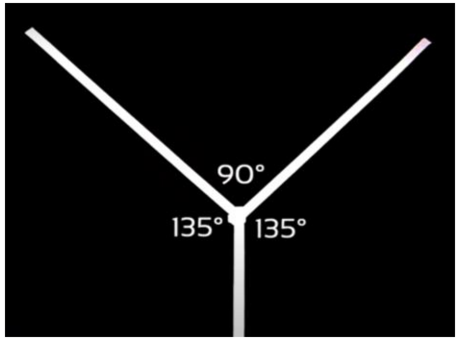
Functional tests

lunge test
Assess ankle dorsiflexion compared with the uninjured side.

proprioception. Single-leg standing with eyes closed may demonstrate impaired proprioception compared with the uninjured side

assessment for return to sports post-injury

y balance test



	RIGHT LEG	LEFT LEG
Direction 1	$\frac{Reach1 + Reach2 + Reach3}{3}$	$\frac{Reach1 + Reach2 + Reach3}{3}$
Direction 2	$\frac{Reach1 + Reach2 + Reach3}{3}$	$\frac{Reach1 + Reach2 + Reach3}{3}$
Direction 3	$\frac{Reach1 + Reach2 + Reach3}{3}$	$\frac{Reach1 + Reach2 + Reach3}{3}$

Average distance in each direction / leg length * 100

measuring the distance from the Anterior Superior Iliac Spine (ASIS) to the most distal aspect of the medial malleolus.

A college football player who scored below 89.6% was 3.5 times more likely to get injured.

Butler RJ, Lehr ME, Fink ML, Kiesel KB, Plisky PJ. Dynamic balance performance and noncontact lower extremity injury in college football players: an initial study. Sports Health. 2013 Sep;5(5):417-22. doi: 10.1177/1941738113498703. PMID: 24427412; PMCID: PMC3752196.

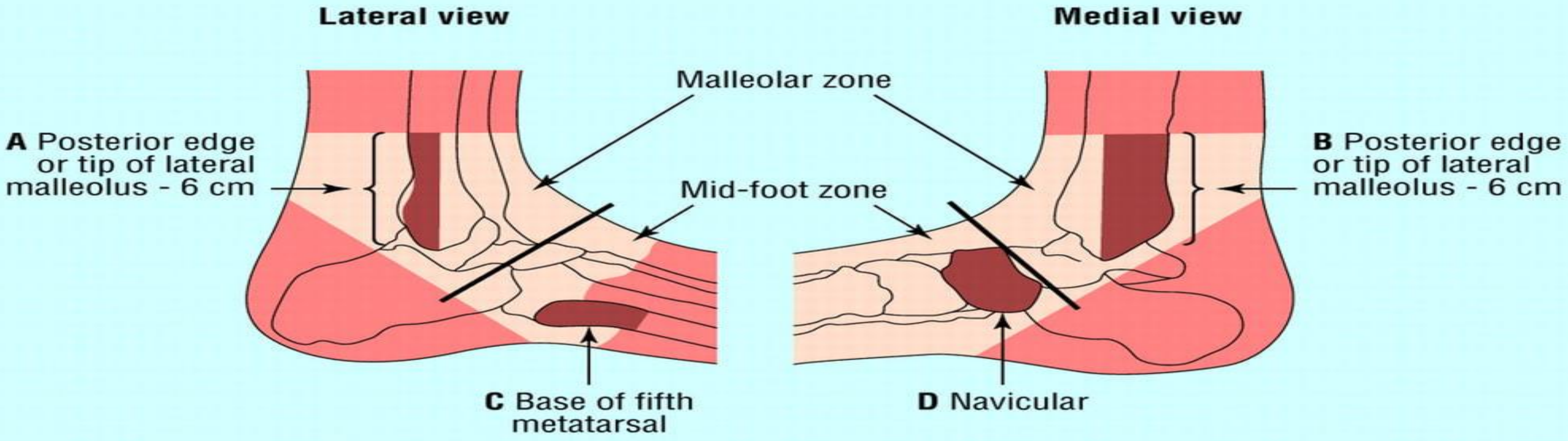
Single hop test

The goal is to have a less than 10% difference in hop distance between the injured limb and uninjured limb.

Investigations

[Ottawa Ankle Rules]

Should the clinician order a radiograph? Clinicians can use Ottawa ankle rules to assist them in making this decision



A series of ankle *x* ray films is required only if there is any pain in malleolar zone and any of these findings:

- Bone tenderness at **A**
- Bone tenderness at **B**
- Inability to bear weight both immediately and in emergency department

A series of ankle *x* ray films is required only if there is any pain in mid-foot zone and any of these findings:

- Bone tenderness at **C**
- Bone tenderness at **D**
- Inability to bear weight both immediately and in emergency department

TREATMENT AND REHABILITATION PROTOCOL

- Patients with grade I sprains can be progressed quicker than patients with grade II sprains. The same can be said when comparing grade II and grade III sprains.
- patients with

➢ grade I sprains can often return to their normal physical activity levels within 1 to 2 weeks,

➢ grade II sprains can expect to return in 4 to 8 weeks.

➢ grade III injuries, which can take as long as 12 to 16 weeks to recover.

TABLE 39.3

Clinical Signs and Symptoms Associated With the Stages of Tissue Healing

Acute Stage	Subacute Stage	Maturation Stage
Pain at rest, ↑ w/ activity TTP ↑ swelling Heat Protective guarding and muscle spasm Loss of function* Restricted and painful ROM Laxity w/stress tests*	↓ pain, TTP, swelling, heat ↓ spasm and guarding ↑ function ↑ ROM w/↓ pain ↓ laxity w/stress tests*	No s/s of inflammation ↑ function ↑ ROM

↑, increased; TTP, tenderness to palpation; ROM, range of motion; ↓, decreased; s/s, signs and symptoms.
*Presence and amount depend on severity of sprain.

The steps in treating and rehabilitating ankle sprains typically follow this progression

- Step 1: Protect the area from further injury.
- Step 2: Decrease pain, swelling, and spasm.
- Step 3: Re-establish range of motion (ROM), flexibility, and tissue mobility.
- Step 4: Re-establish neuromuscular control, muscular strength, endurance, and power.
- Step 5: Re-establish proprioception, coordination, and agility.
- Step 6: Re-establish functional skills.

Immobilization versus functional treatment

- Although there has long been debate as to whether or not to immobilize sprained ankles or omit immobilization and immediately begin a “functional treatment” plan, current practices are to use a functional treatment plan, especially when managing grades I and II sprains. A functional treatment plan limits immobilization and encourages pain-free activities that do not overstress the injured ligaments. Functional rehabilitation has been shown to be associated with more frequent return to sports and higher rates of patient satisfaction than immobilization (Kerkhoffs et al. 2001).
- long periods of immobilization may lead to prolonged joint stiffness and contractures, weakening of non-injured ligaments, and muscle atrophy.

Acute phase

Goals

1. Protect from further injury.
2. Encourage tissue healing Methods
3. Limit pain, swelling,

Methods:

- Rest.
- Tape, brace, splint, or walking boot (boot primarily for grades II–III).
- Crutches or cane as needed (primarily for grades II–III).
- Pulsed ultrasound (after 3 days).
- Ice/cryotherapy
- intermittent compression device).
- Electrical stimulation.
- Ankle pumps with ankle elevated.
- Soft Tissue Techniques. Distal to proximal soft tissue mobilization/edema massage
- Grade I joint mobilizations (after 3 days)
- Isolated submaximal isometric contractions have been demonstrated to reduce pain. Isometric contractions can be performed during the acute phase, initially avoided the affected planes. For example, avoid inversion initially in the case of a lateral ankle sprain.

Fig. 39.10 Posterior mobilization to the talus. Grade I and II joint mobilization techniques are effective in reducing pain.

Subacute Phase

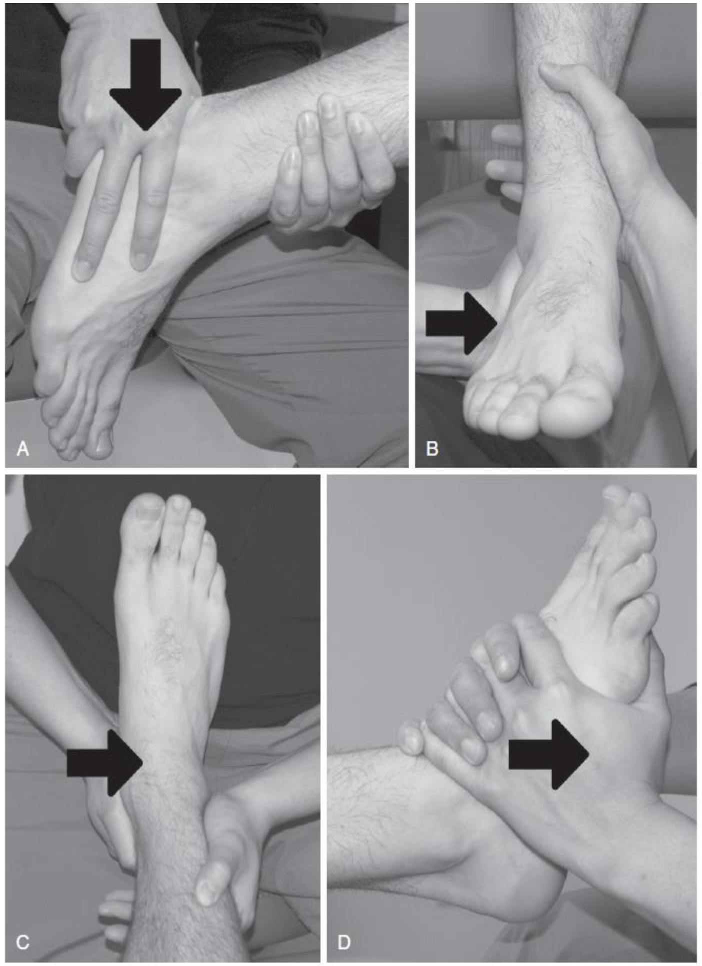
Goals

- Restore range of motion and flexibility
- Re-establish neuromuscular control and restore muscular strength and endurance
- Re-establish proprioception and coordination
- improve proximal stability

Methods:

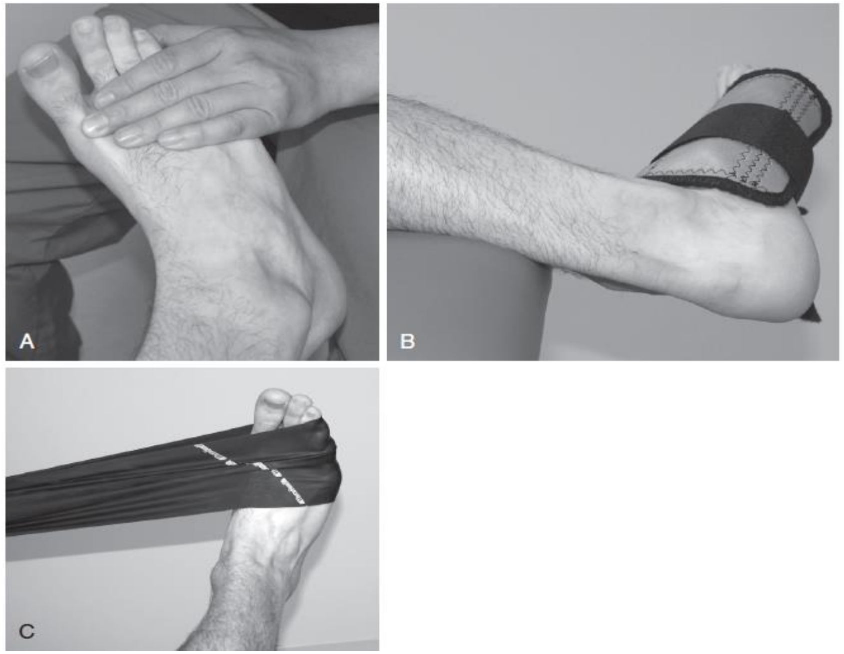
- Progress with pain-free PROM, AAROM, AROM. Plantarflexion, dorsiflexion, eversion, inversion (as tolerated)
- Ankle pumps.
- Heel cord stretches. Standing gastroc-soleus (G-s) stretching, Manual G-s stretching while maintaining traction on the ankle joint to prevent impingement pain with syndesmotic sprains.
- Joint mobilizations (progressing to grade II–III as needed
- posterior talocrural mobilization to improve dorsiflexion
- <u>Strengthening the glutes</u> is also very important to improve proximal stability reducing weakness caused by gait adaptation, use of crutches and/or proper training sessions.

Fig. 39.6 Active range of motion (AROM). A, Dorsiflexion. B, Plantarflexion. C, Inversion. D, Eversion.

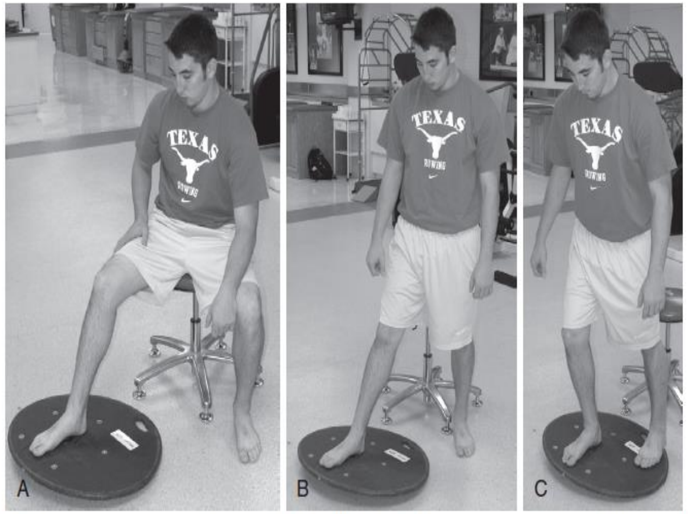


mobilization techniques to restore range of motion and arthrokinematics. A, Anterior mobilization to increa
to increase eversion. C, Lateral mobilization to increase inversion. D, Distraction of the talocrural joint for pain

- Isometric strengthening exercises.
- Progressing to isotonic strengthening exercises.
- Manual resistance, cuff weights and elastic bands
- Progression to touch down, partial, then full weight-bearing should be encouraged early, with the exception of syndesmotic ankle sprains, which may require a longer period of non-weight bearing.
- Progressing to PWB the FWB strengthening exercises (heel raises, toe raises, squats, lunges).



- Seated balance boards or ankle disc circles (progress to PWB and FWB as tolerated).
- Star Excursion Balance
- Weight shifts (forward, backward, and laterally).
- Sensory reweighting exercises(**Gaze stabilization exercises)**
- CKC squats, lunges, lateral lunges, step-ups
- Progress from static stances to dynamic activities
- airplanes, single leg Romanian deadlifts
- Progress from eyes open to eyes closed.



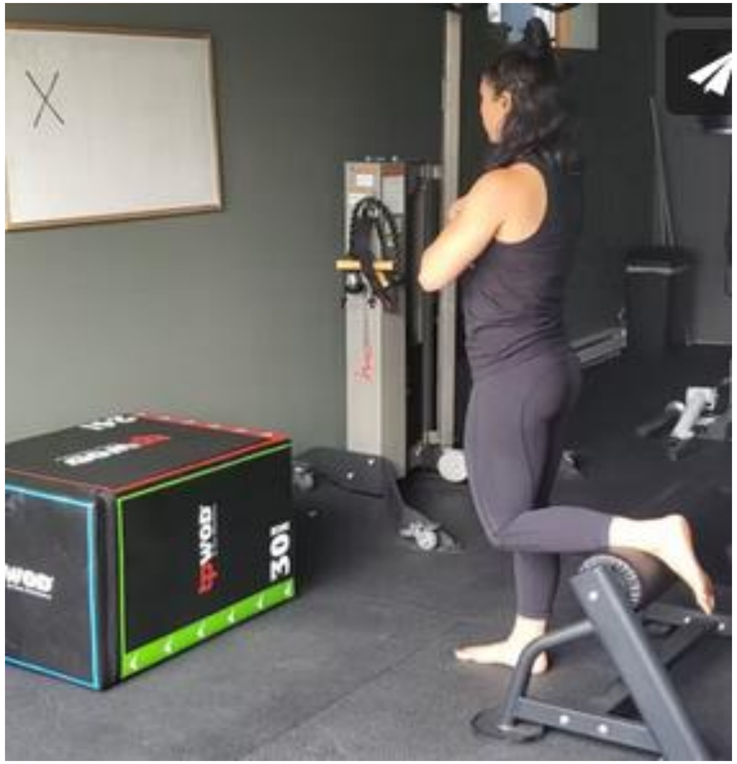


Fig. 39.15 Proprioception exercises without perturbations. **A,** Stepping up and down on the injured leg develops proprioception. **B,** Lateral step-ups increase the difficulty of the exercise.

Mobilization with motion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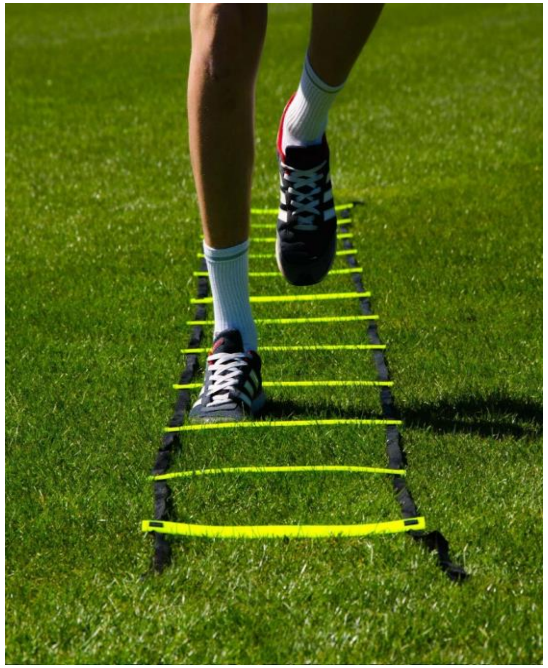
Maturation Phase return to sport

Goal:

- Restore functional/sports-specific skills

Method

- Plyometrics.
- Functional exercises (jumping, running, changes of direction).
- Agility training
- Lunges/squats on an unstable surface
- Jumping rope.
- Four-square hops/side-to-side hops
- Shuttle runs.
- “Shadow boxing”.
- Four-square hops.
- Full speed planned movement drills (Ladder drills, Cone drills)
- carioca,



ing from side to side emphasize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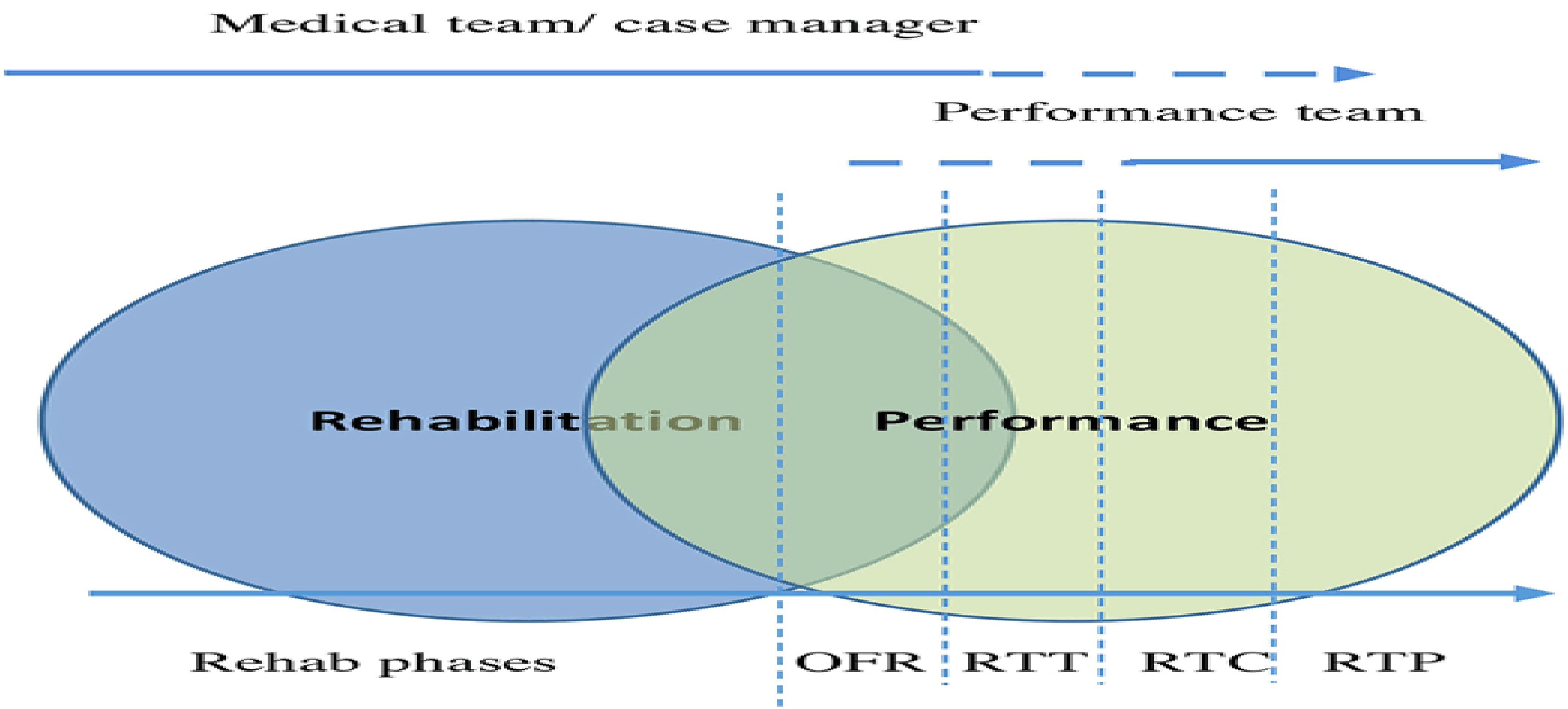
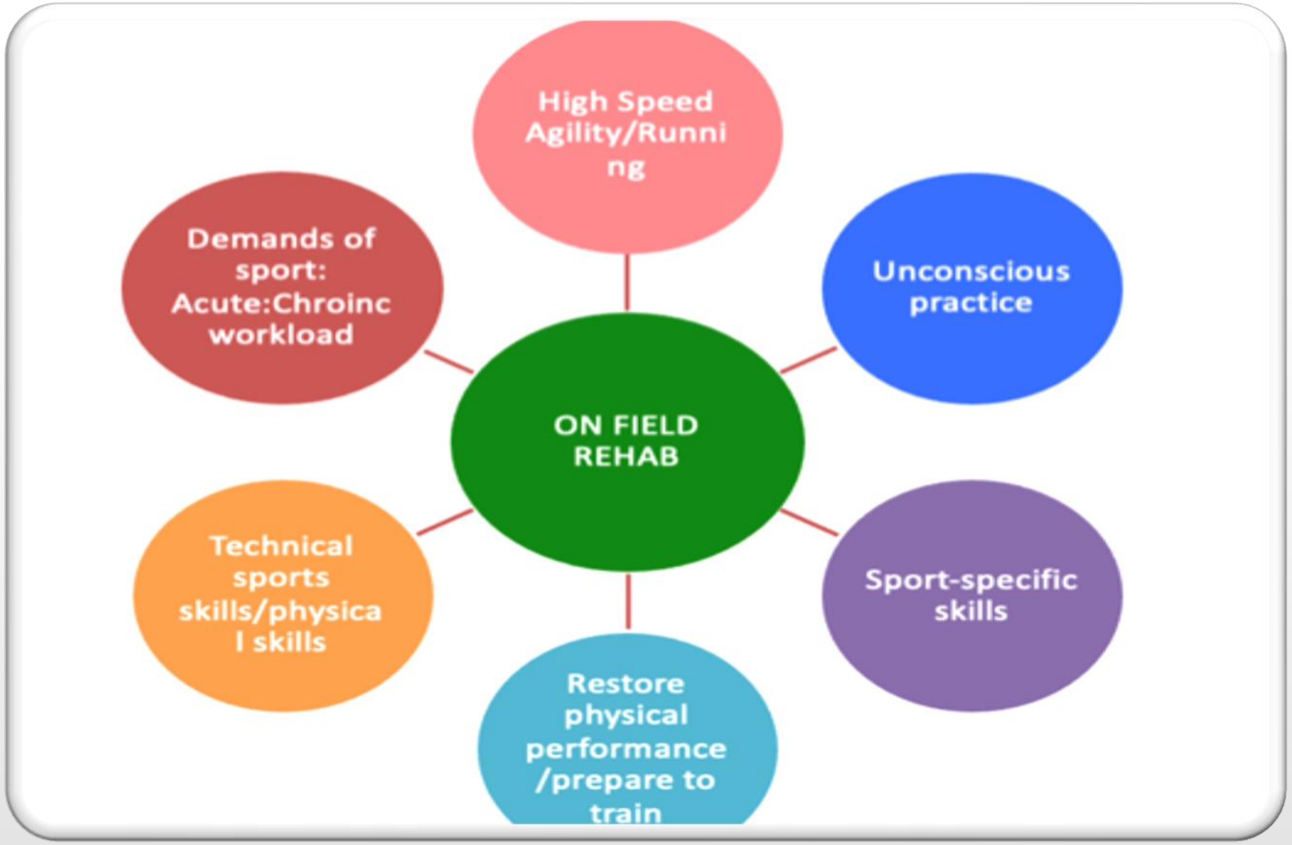


Figure 1 represents the functional recovery model (return to sport and performance). The transition from the rehabilitation phases of functional recovery (rehabilitation) to the actual performance is highlighted. Four stages are indicated, starting from on-field rehabilitation (OFR), to return to training (RTT), then return to competition (RTC) and finally return to performance (RTP).

On field rehabilitation

- On field rehabilitation is a key step for a safe Return to Play. At this stage that move from a gym, where you can perform any exercises in a more controlled environment, to the field where you start to practice sport-specific skills and modified training with the team. This figure represents the six main aspects that must be re-trained before a return to play.



injury prevention

- Fundamentally, range of motion, motor control and strength play a role in injury prevention because they provide athletes with the capacity to absorb, distribute and transfer forces along the kinetic chain.

Achilles tendinopathy

by

Waleed saber

Orthopedic physical therapy lecturer

s.v.u.

- The Achilles tendon is the largest and strongest tendon in the body.
- The tendon has no true synovial sheath but is encased in a **paratenon,** a single cell layer of fatty areolar tissue.

Vascular supply

- The vascular supply to the tendon comes distally from intraosseous vessels from the calcaneus and proximally from intramuscular branches.
- Vascular density is greatest proximally and least in the midportion of the tendon.

Epidemiology

- Rising incidence of Achilles tendinopathy and rupture caused by increasing participation in recreational and competitive sports
- Age: typically middle age (mean 40 years old)

Middle-aged recreational athlete or “weekend warrior”

- Sex: Men greater than women (although incidence in women increasing as participation in sports increases)
- Sport: mid- to long-distance running and jumping sports; basketball very common for acute rupture in recreational athletes

Predisposing factors

Intrinsic Factors
- Advancing age
- Gender
- Abnormal dorsiflexion range of motion
- Abnormal subtalar range of motion
- Decreased plantar flexion strength
- foot deformity e.g., over pronation
- Improper conditioning/training
- History of intratendinous or peritendinous corticosteroid injection
- Co-morbidity: obesity, hypertension, diabetes, high cholesterol

Extrinsic Factors
- Repetitive forceful loading or sudden extreme loading of the Achilles tendon (e.g., strong eccentric loading as when landing from a jump shot)
- Training errors as Increase in training intensity or Uneven training surfaces (i.e., hills, excessively crowned roads)
- Improper footwear (nonathletic shoes, unevenly worn/warped shoes)
- Previous injury

Traumatic Factors
- Direct trauma or penetrating injury to the Achilles tendon
- Repetitive microtrauma within the tendon from excessive or frequent activity with inadequate rest periods

Over-pronation pathomechanics

Clement and colleagues introduced the idea of functional overpronation producing a whipping action contributing to the development of Achilles Tendinopathy

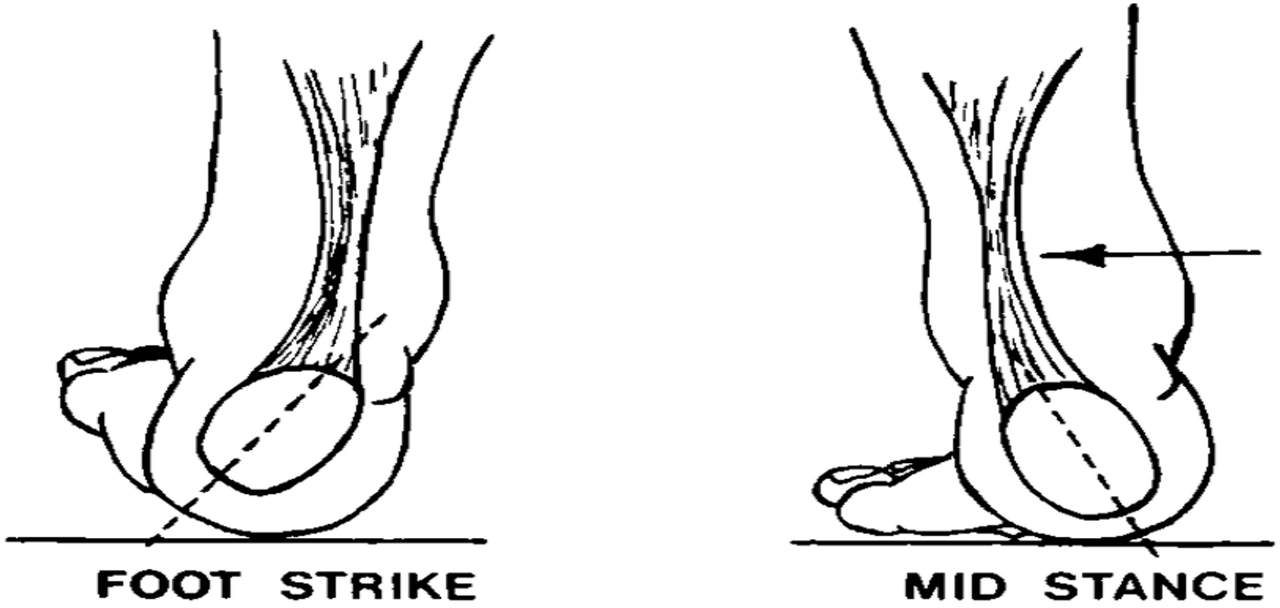


Figure 1. Whipping action of the Achilles tendon produced by overpronation.

Immediately after foot strike the foot rolls into pronation and the knee begins to flex. Both knee flexion and pronation of the foot impart obligatory internal rotatory forces to the tibia .

As the body passes over the foot during midstance, the foot rolls into supination and the knee begins to extend in preparation for takeoff. Supination of the foot and knee extension both impart external rotatory forces to the tibia. In the ideal situation, supination and knee extension begin simultaneously.

In individuals who overpronate the foot is still pronating after knee extension has begun. As a result, the external tibial rotation generated by knee extension conflicts with the exaggerated internal rotation produced by prolonged pronation. In turn, this produces a whipping effect drawing the Achilles tendon medially and resulting in microtears particularly in its medial aspect

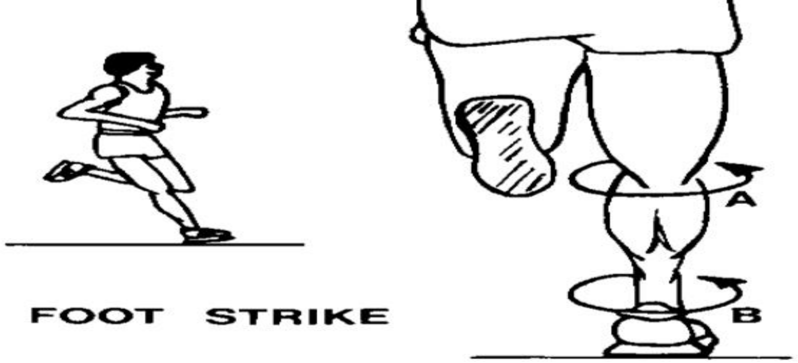


Figure 2. Internal rotation imparted to tibia by knee fl (A) and pronation (B) following foot strike.

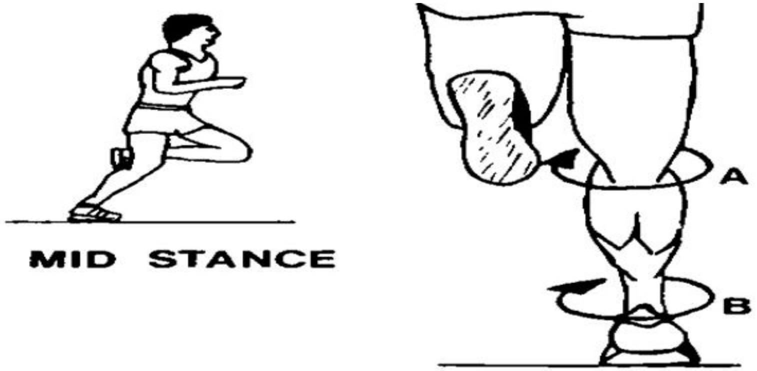


Figure 3. External rotation imparted to tibia by simultaneous initiation of knee extension (A) and supination (B) in prepara-n for takeoff in the ideal situation.

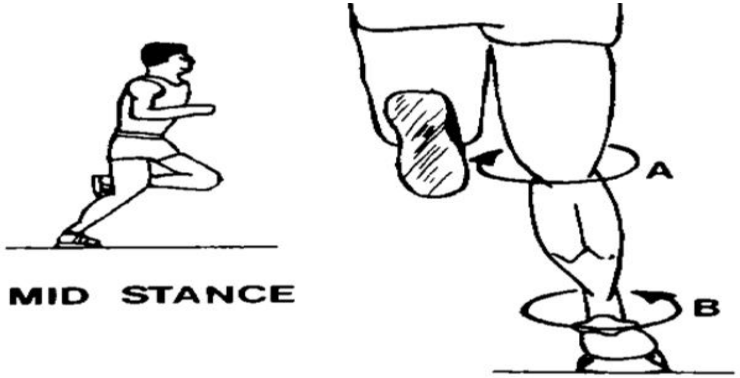


Figure 4. External rotation imparted to tibia by knee extension (A) in preparation for takeoff conflicting with internal rotation imparted to tibia by prolonged pronation (B).

Pathological Findings

- **Paratenonitis**: thickened paratenon, adherent to underlying tendon. Inflammatory infiltration of the paratenon seen microscopically.
- **Tendinosis:** Noninflammatory degeneration of tendon fibers. Tendon may appear discolored and thickened or nodular. Microscopically: lack of inflammatory cells, scattered neovascularization, possible necrosis and/or calcification. Typically appears 2 to 6 cm proximal to the calcaneal insertion.
- **Paratenonitis with tendinosis**: combination of paratenonitis and tendinosis
- **Rupture (partial or complete):** frank disruption and separation of tendon fibers.

TABLE 44.4 **Continuum of Disease in Achilles Tendon Lesions**

Disorder	Pathology
Paratenonitis	Inflammation of the peritendinous structures, including the paratenon and septum
Tendinosis	Asymptomatic degeneration of tendon without inflammation, with regional focal loss of tendon structure
Paratenonitis with tendinosis	Inflammation of the peritendinous structures along with intratendinous degeneration
Retrocalcaneal bursitis	Mechanical irritation of the retrocalcaneal bursa
Insertional tendinosis	Inflammatory process within the tendinous insertion of the Achilles tendon

Clinical Presentation

For paratenonitis

- pain after activity; progresses to symptoms at beginning of activity or with less intense/routine activities
- Warmth, thickening, swelling
- Tenderness to palpation, typically 2 to 6 cm above the calcaneal insertion
- Calf atrophy
- **Painful arc sign** is negative in paratenonitis

Painful arc sign (Royal London Hospital) Test

In paratenonitis, the area of tenderness and fullness stays fixed with active ROM of ankle. The inflammation involves only the paratenon, which is a fixed structure, unlike pathology of the Achilles tendon itself, which migrates superiorly and inferiorly with ROM of the ankle.

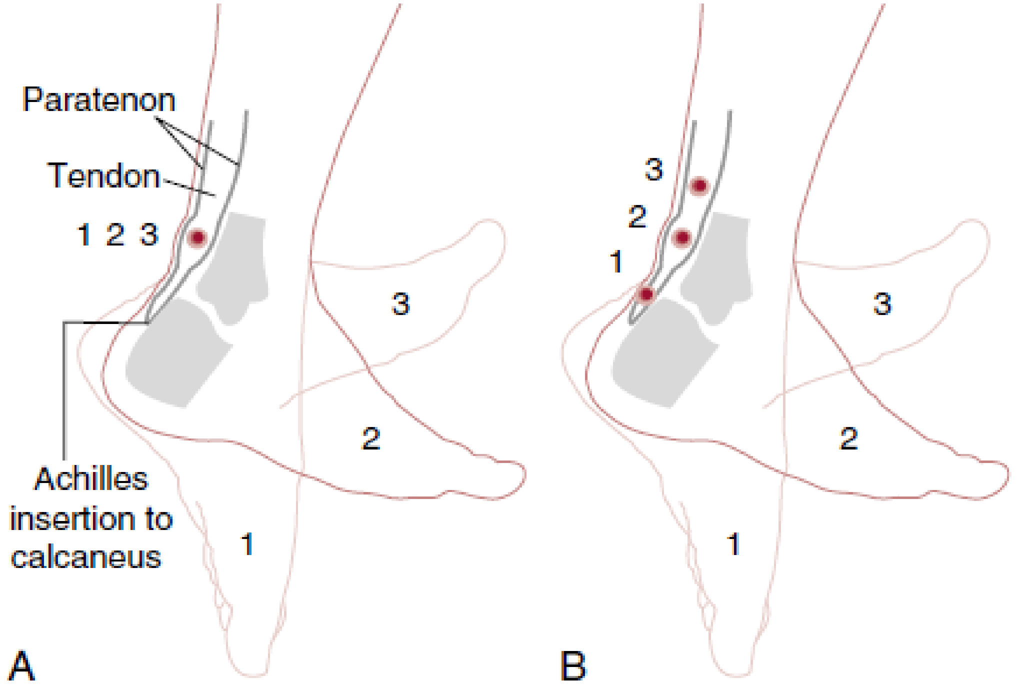


Fig. 44.3 Painful arc sign. **A,** In peritenonitis, the tenderness remains in one position despite moving the foot from dorsiflexion to plantarflexion. **B,** In the case of partial tendon rupture or tendinitis, the point of tenderness *moves* as the foot goes from dorsiflexion to plantarflexion. (*A* and *B* redrawn from Williams JG: Achilles tendon lesions in sports. Sports Med 3:114, 1986.)

For tenoninosis

- often asymptomatic and remains subclinical until it presents as a rupture.
- It may elicit low-grade discomfort related to activities
- a palpable painless mass or nodule may be present 2 to 6 cm proximal to the insertion of the tendon.
- This can progress to gradual thickening of the entire tendon substance.
- The painful arc sign is positive in patients with Achilles tendinosis. The thickened portion of tendon moves with active plantarflexion and dorsiflexion of the ankle

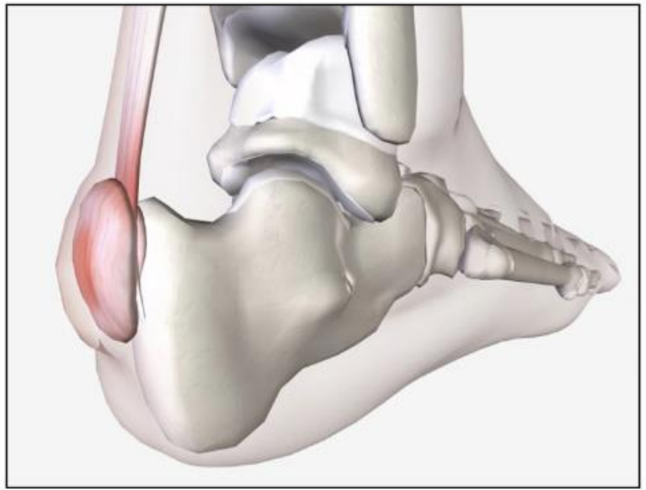
For PARATENONITIS WITH TENDINOSIS

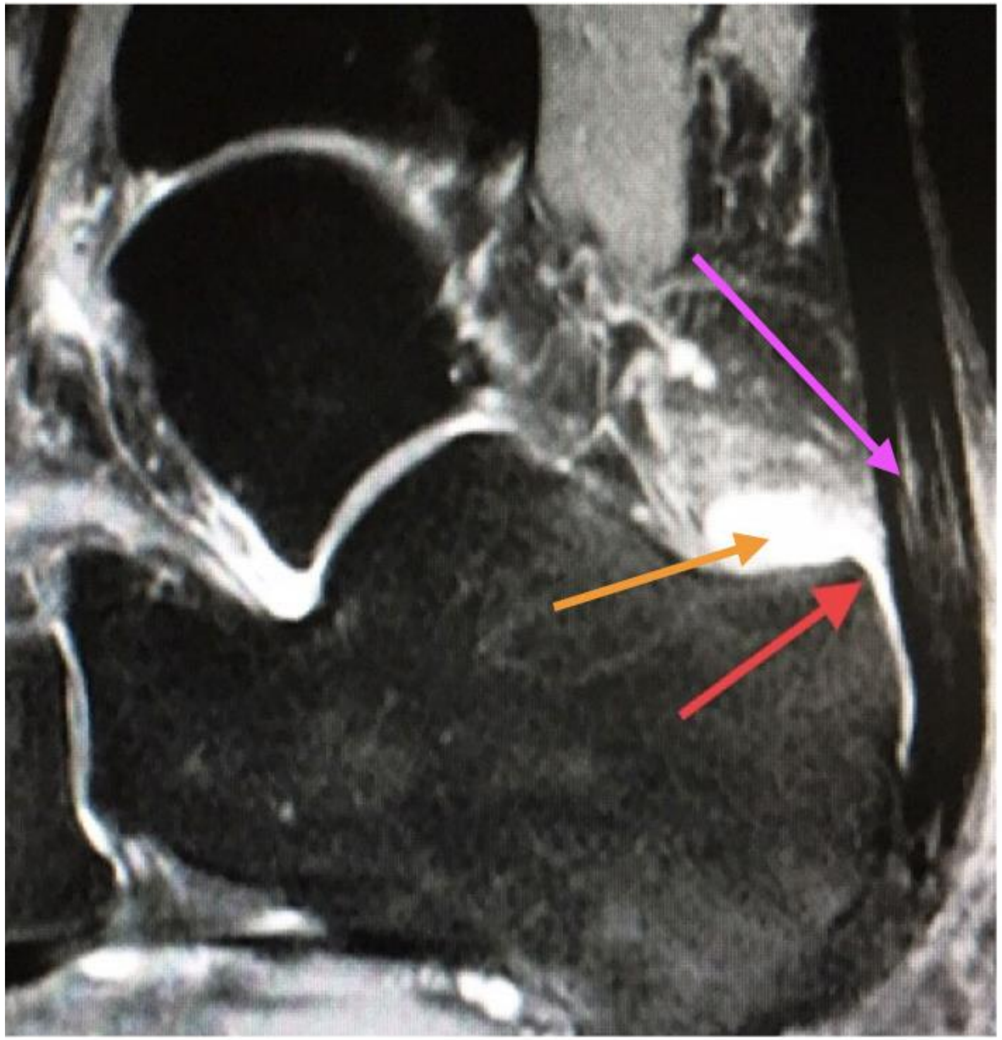
- Inflammation involves both the paratenon and intratendinous focal degeneration.
- Gives the clinical appearance of paratenonitis because the symptoms associated with tendinosis are absent or very subtle.
- The tendinosis is unrecognized until both processes are noted on MRI or at surgery (most commonly after a rupture).
- Often focal, tender nodules are the first sign of the development of tendinosis in a patient with paratenonitis.

INSERTIONAL ACHILLES TENDINITIS

- Often begins as a painful inflammatory process within the tendinous insertion of the Achilles on the calcaneus.
- prominent posterior calcaneal tuberosity
- Pain may be increased by hill running, interval programs, and training errors.
- Patients with insertional tendinitis report morning ankle stiffness, posterior heel pain, and swelling that worsens with activity.
- Examination reveals tenderness at the bone–tendon junction and limited ankle dorsiflexion (Heckman et al. 2009).

Typical appearance of Haglund's Deformity





Fissuration of the Achilles tendon
(thin white lines inside the black tendon)

Area of impingement between the bone and tendon

Bony oedema of the calcaneus bone
(the tip of the bone turns white)

RETROCALCANEAL BURSITIS

- Inflammation of the bursa between the calcaneus and the Achilles tendon
- The bursa can become inflamed, hypertrophied, and adherent to the Achilles tendon, which can lead to degenerative changes within the tendon (Schepsis et al. 2002).

Clinical presentation

- pain anterior to the Achilles tendon and is frequent in athletes training with uphill running.
- It is diagnosed by the two-finger squeeze test, in which pain is elicited by applying pressure medially and laterally just anterior to the Achilles tendon (Heckman et al. 2009).

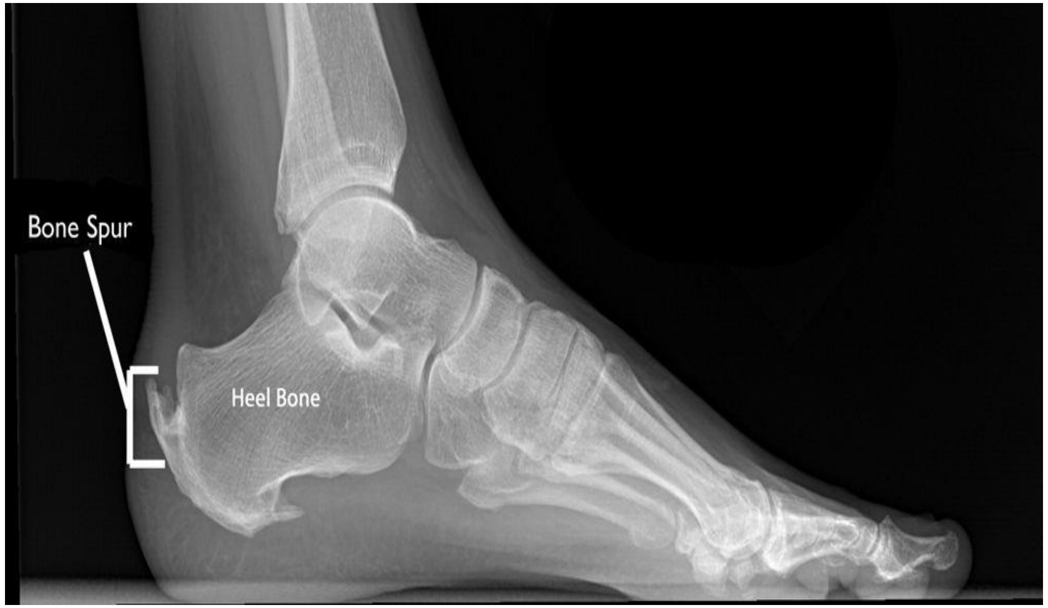
Imaging

Plain radiography:

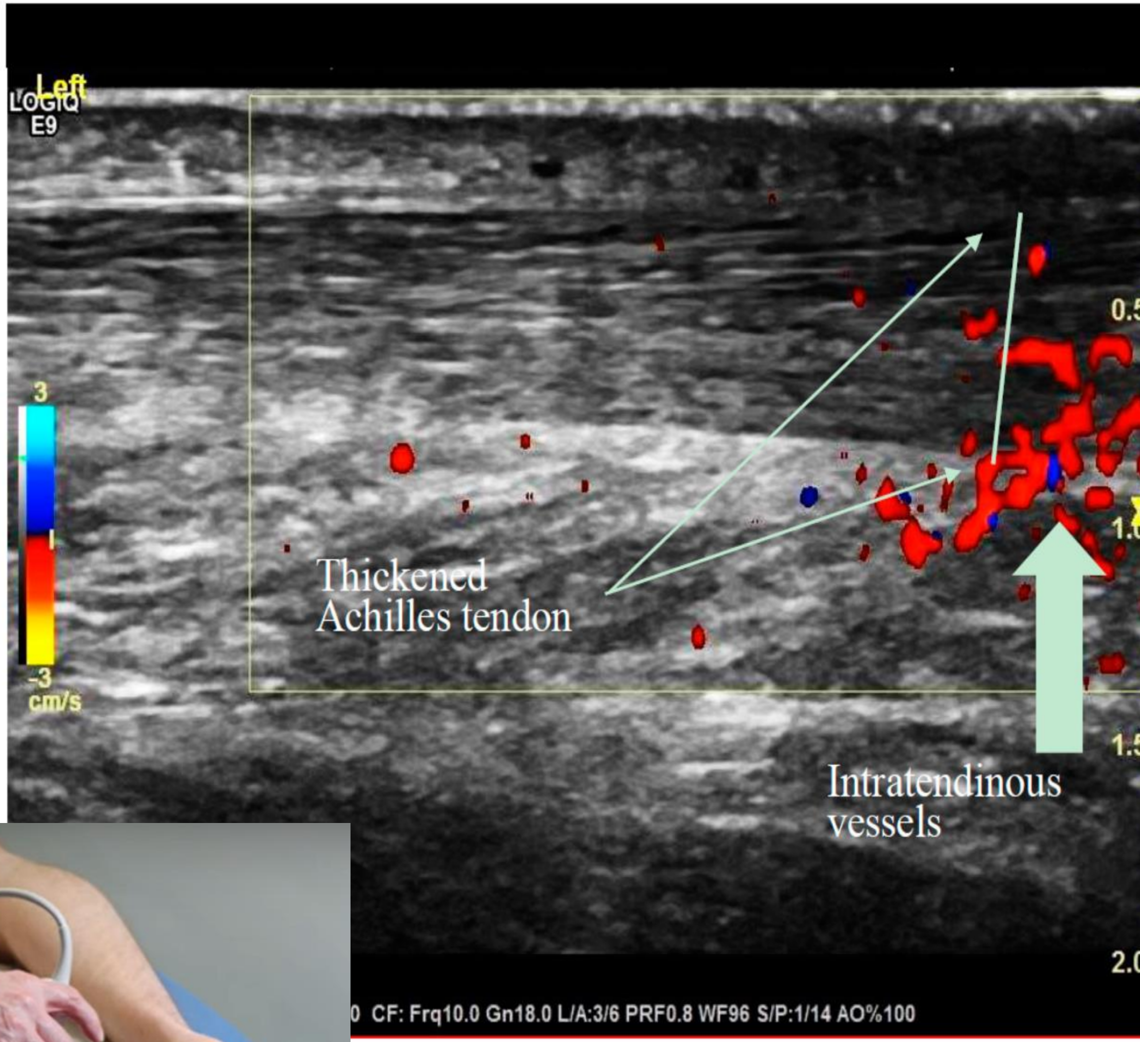
- not particularly helpful for Achilles tendinopathy, but may help rule out other diagnoses (i.e., symptomatic Os trigonum, Haglund deformity).
- Identify any prominence of the posterior calcaneal tuberosity, intratendinous calcification, or a calcaneal spur.

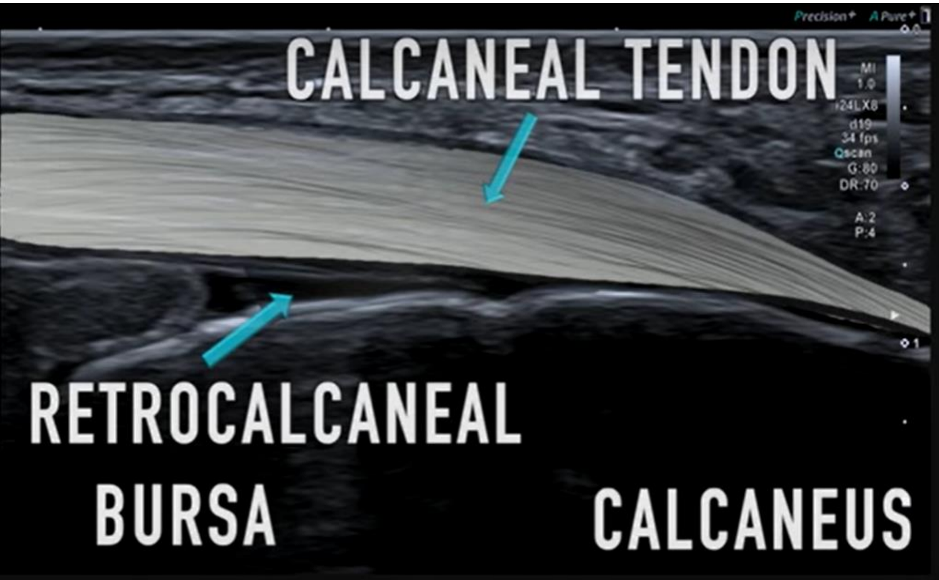
Calcification of the Achilles tendon

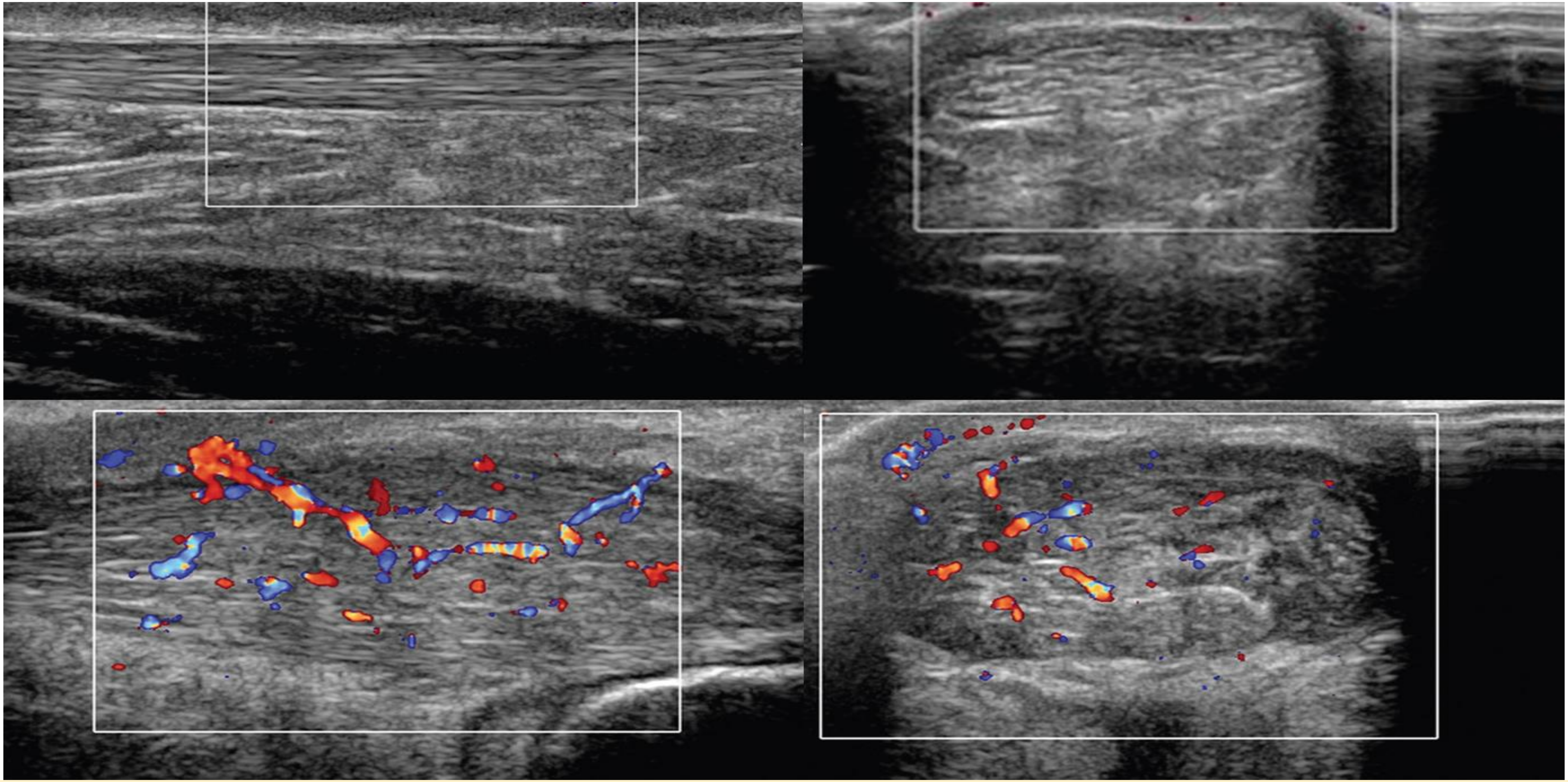
Large posterior bump



Ultrasound:
fast and inexpensive. May reveal peritendinous fluid or adhesions (as with tendinopathy), or partial/complete rupture on dynamic exam. Color Doppler may show abnormally increased blood flow.







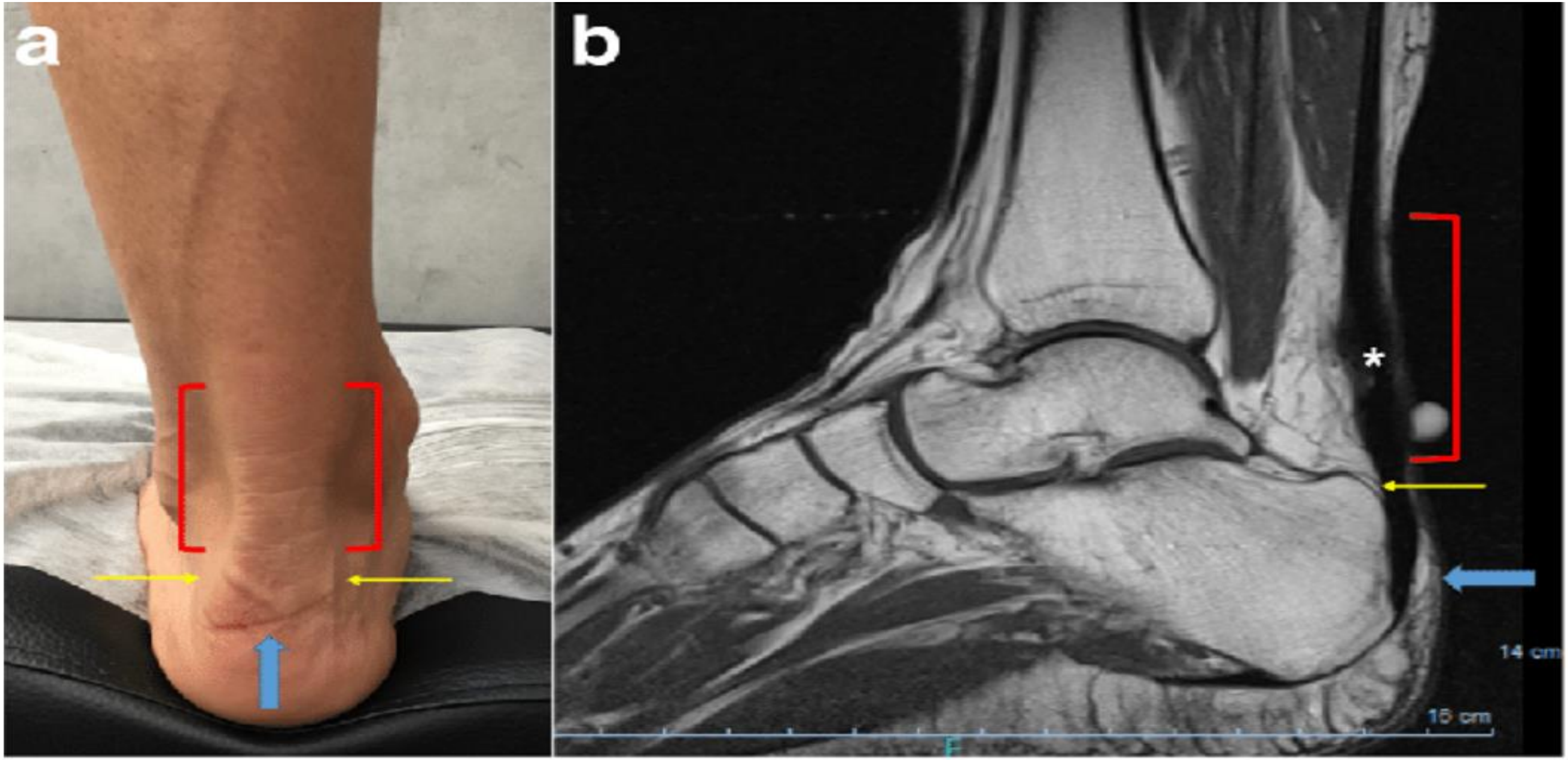
Ultrasound image of an Achilles tendon with color Doppler. (A) Longitudinal and (B) transverse images of a normal, asymptomatic Achilles tendon showing normal tendon echo texture with no Doppler signal. (C) Longitudinal and (D) transverse images of a symptomatic Achilles tendon showing significant thickening of the tendon and the presence of hypoechoic changes. Significant Doppler signal is also apparent within the tendon.

Magnetic resonance imaging (MRI): usually secondline after ultrasound because of cost. Extremely helpful in classifying tendinopathy and for diagnosing partial and complete tendon tears

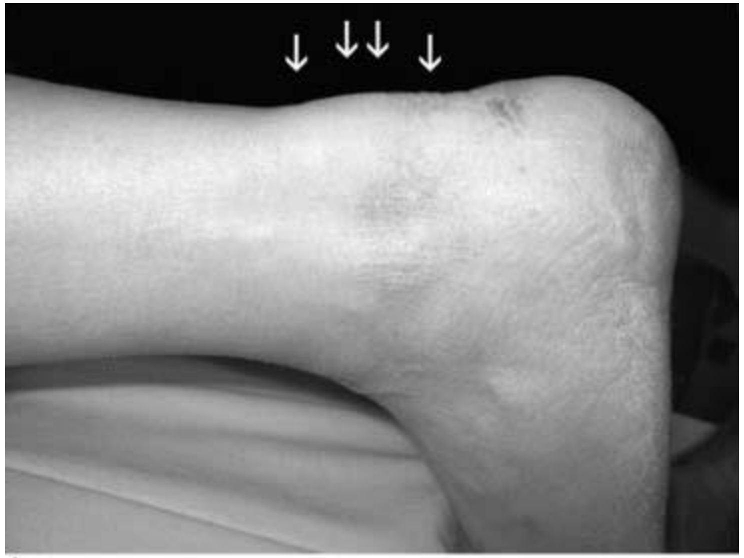
Normal MR Appearance

- The normal average thickness of the Achilles tendon is 6 mm.
- the anterior and posterior margins of the Achilles tendon should be parallel below the soleus insertion

FIGURE 2. Magnetic resonance (MR) imaging of the normal Achilles tendon. (a) Sagittal and (b) axial proton-density weighted sequence MR image showing a normal Achilles tendon (arrow) with uniform thickness and predominantly low signal intensity.



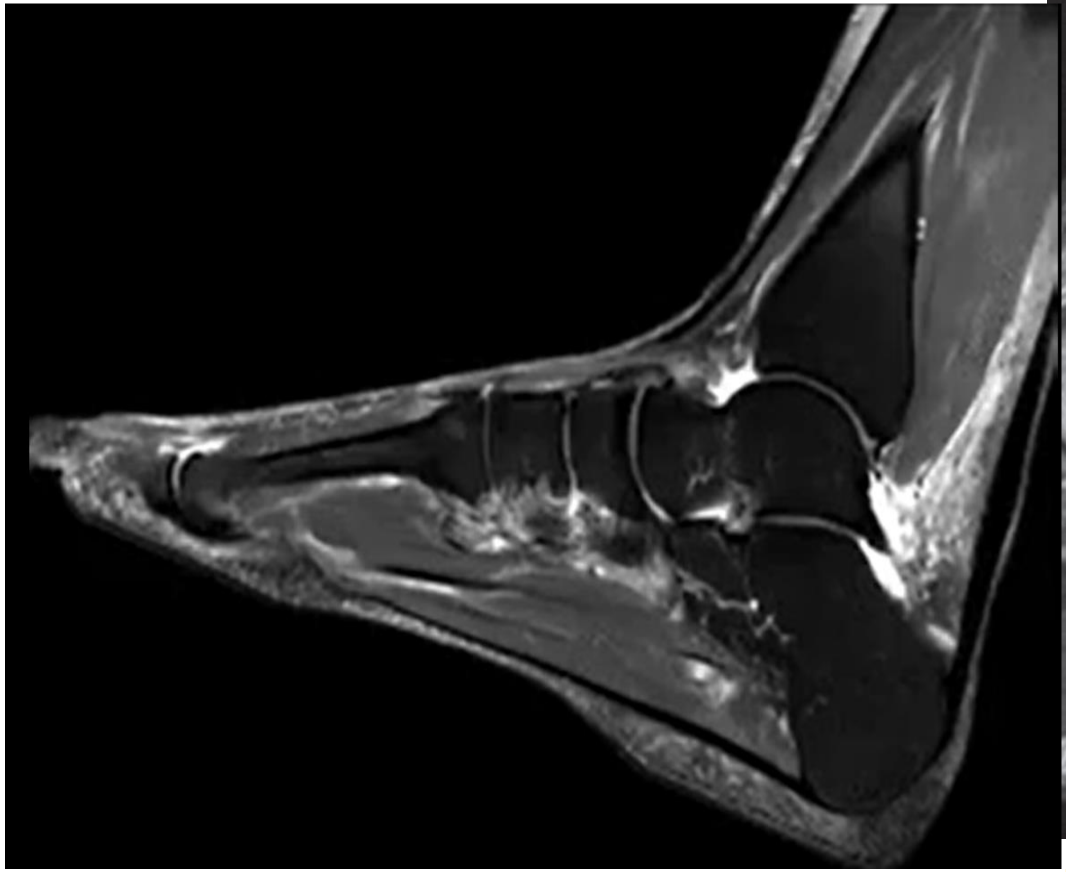
Site of clinical complaints (a) and MRI (b) correlation of most relevant Achilles pathology sites. Mid-portion Achilles tendinopathy (red brackets); retrocalcaneal bursitis (yellow arrow); insertional achilles tendinopathy and superficial bursitis (blue arrow). MRI sagittal view (b) demonstrating Achilles tendon enlargement and signal changings (*)



A

B

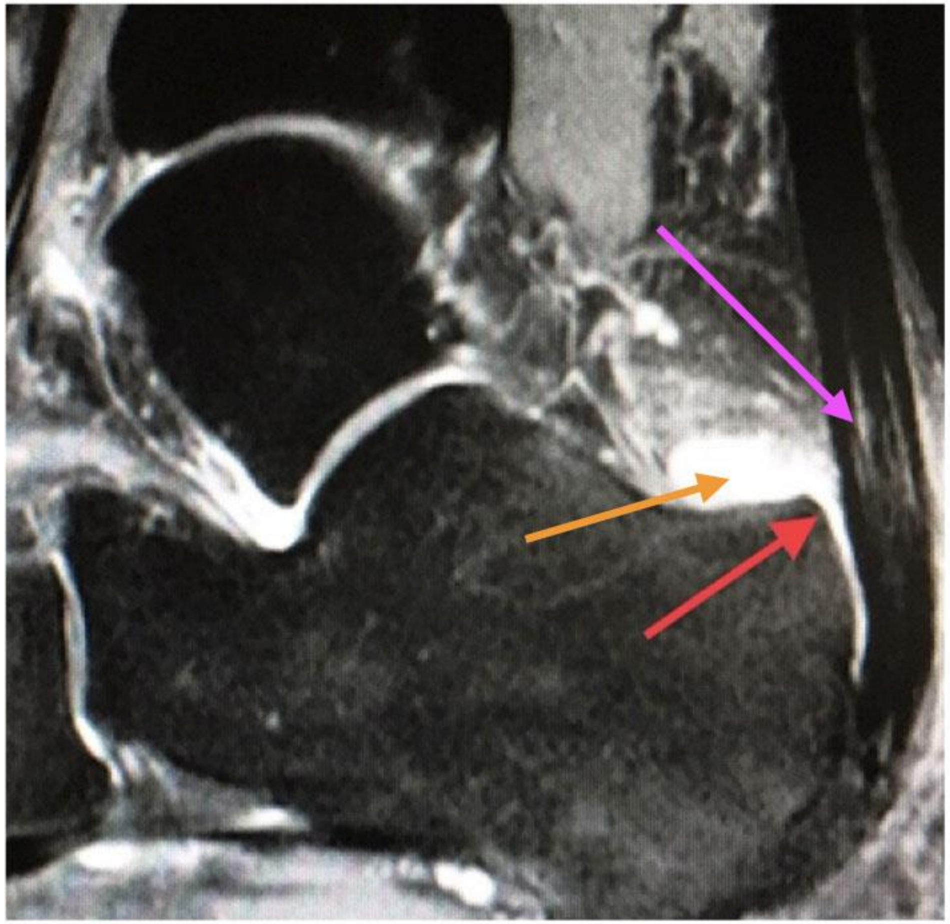
Magnetic resonance imaging shows thickened Achilles tendon. A Haglund’s deformity also is noted.



Achilles paratenonitis

MRI of a patient with an Achilles tendon rupture. T1-weighted (**A**) and T2-weighted (**B**) images show frank disruption of the tendon fibers.

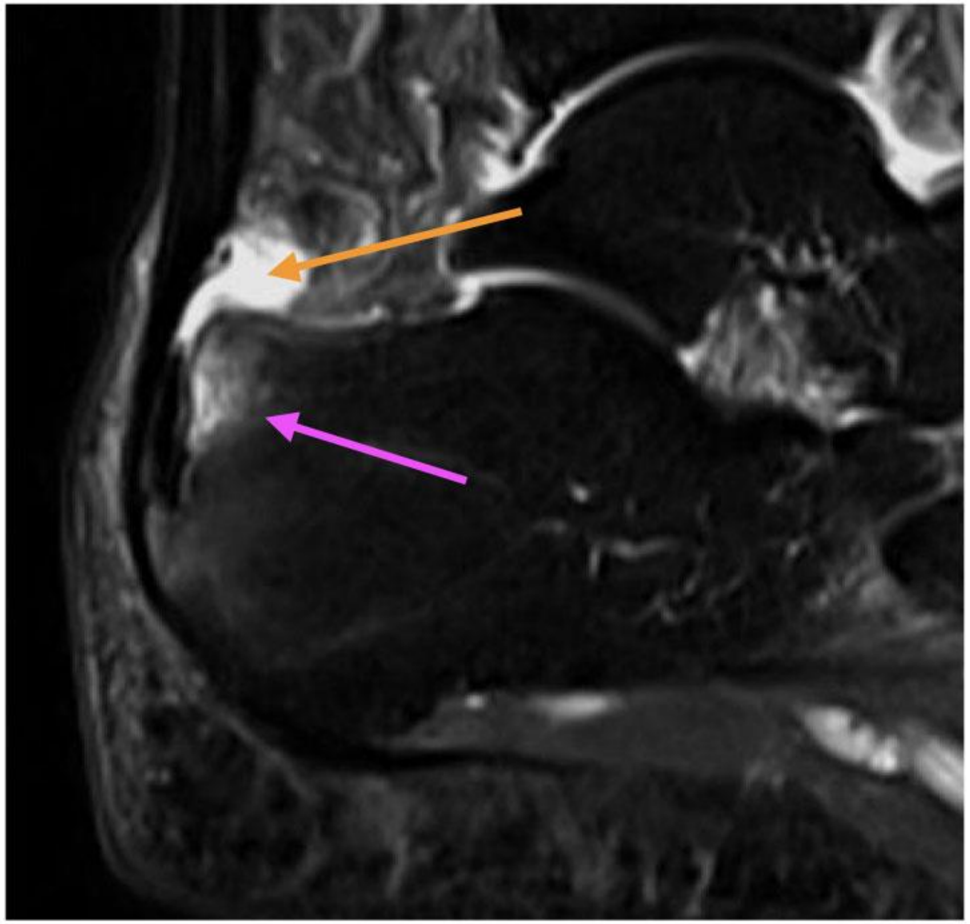
Typical MRI of Haglund's Deformity



Fissuration of the Achilles tendon
(thin white lines inside the black tendon)

Area of impingement between the bone and tendon

Bony oedema of the calcaneus bone
(the tip of the bone turns white)



Bony oedema of the calcaneus bone
(the tip of the bone turns white)

Bursitis (inflammation between
the bone and tendon)

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

EXAMINATION – OUTCOME MEASURES: ACTIVITY LIMITATIONS/ SELF-REPORTED MEASURES

A Clinicians should use the Victorian Institute of Sport Assessment-Achilles (VISA-A) to assess pain and stiffness, and either the Foot and Ankle Ability Measure (FAAM) or the Lower Extremity Functional Scale (LEFS) to assess activity and participation in patients with a diagnosis of midportion Achilles tendinopathy.

Foot and Ankle Ability Measure (FAAM)
Activities of Daily Living Subscale

Please Answer **every question** with **one response** that most closely describes your condition within the past week.
If the activity in question is limited by something other than your foot or ankle mark "Not Applicable" (N/A).

	No Difficulty	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Standing	4	3	2	1	0	
Walking on even Ground	4	3	2	1	0	
Walking on even ground without shoes	4	3	2	1	0	
Walking up hills	4	3	2	1	0	
Walking down hills	4	3	2	1	0	
Going up stairs	4	3	2	1	0	
Going down stairs	4	3	2	1	0	
Walking on uneven ground	4	3	2	1	0	
Stepping up and down curbs	4	3	2	1	0	
Squatting	4	3	2	1	0	
Coming up on your toes	4	3	2	1	0	
Walking initially	4	3	2	1	0	
Walking 5 minutes or less	4	3	2	1	0	
Walking approximately 10 minutes	4	3	2	1	0	
Walking 15 minutes or greater	4	3	2	1	0	

Because of your foot and ankle how much difficulty do you have with:

Home responsibilities	4	3	2	1	0	
Activities of daily living	4	3	2	1	0	
Personal care	4	3	2	1	0	
Light to moderate work (standing, walking)	4	3	2	1	0	
Heavy work (push/pulling, climbing, carrying)	4	3	2	1	0	
Recreational activities	4	3	2	1	0	

How would you rate your current level of function during you usual activities of daily living from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities.

__________ . 0 %

Foot and Ankle Ability Measure (FAAM)
Sports Subscale

Because of your foot and ankle how much difficulty do you have with:

	No Difficulty	Slight Difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Running	4	3	2	1	0	
Jumping	4	3	2	1	0	
Landing	4	3	2	1	0	
Starting and stopping quickly	4	3	2	1	0	
Cutting/lateral movements	4	3	2	1	0	
Ability to perform activity with your normal technique	4	3	2	1	0	
Ability to participate in your desired sport as long as you like	4	3	2	1	0	

How would you rate your current level of function during your sports related activities from 0 to 100 with 100 being your level of function prior to your foot or ankle problem and 0 being the inability to perform any of your usual daily activities?

________ . 0%

Overall, how would you rate your current level of function?

☐ Normal ☐ Nearly Normal ☐ Abnormal ☐ Severely Abnormal

TREATMENT OF ACHILLES TENDINOPATHY

Acute

1. **Protection:**

- Unloading of the tendon with a heel lift 12-15mm
- taping into plantar flexion
- using assistive devices for non-weight bearing to weight bearing as tolerated gait

2. **Modalities to control inflammation**:

- Ice
- ultrasound (pulsed or phonophoresis)
- Iontophoresis
- low level laser

3. **Soft tissue mobilization**

transverse friction massage, instrumented soft tissue mobilization) may be used to reduce pain and improve mobility. Utilization of these techniques in acute tendinopathy and paratendinitis is not recommended.

4. **Joint mobilization to improve movement restrictions.**
5. **Four-way ankle isometrics**

4. Stretching/Flexibility Techniques for the Musculotendinous Unit

Strap assisted static stretch

Active stretch performed with knee straight and knee slightly bent. The uninvolved side is “reaching” into the sagittal plane in a rhythmic manner.

Sub-Acute

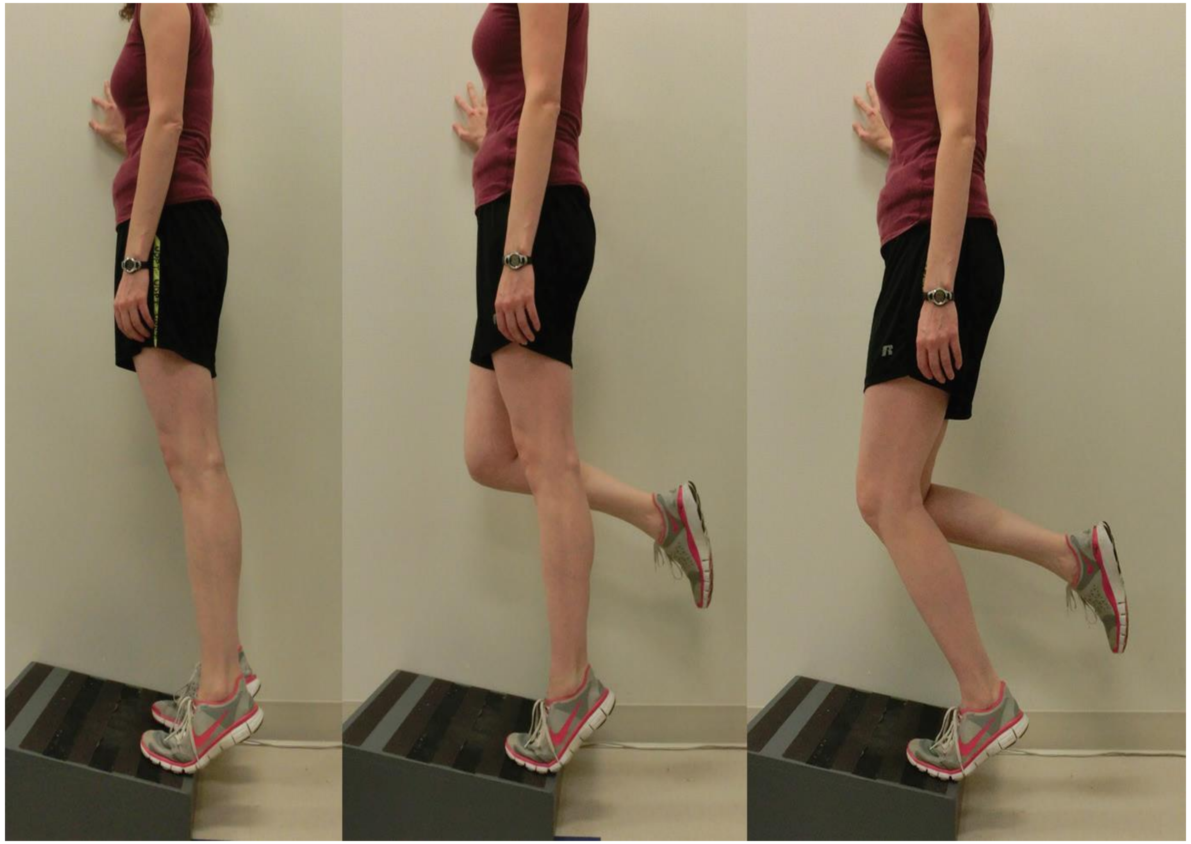
Eccentric loading protocol

- Multiple studies have reported good results with eccentric training in up to 90% of patients with noninsertional Achilles tendinopathy (Rompe et al. 2007 and 2008, Fahlstrom et al. 2003, Roos et al. 2004, Alfredson et al. 1998).

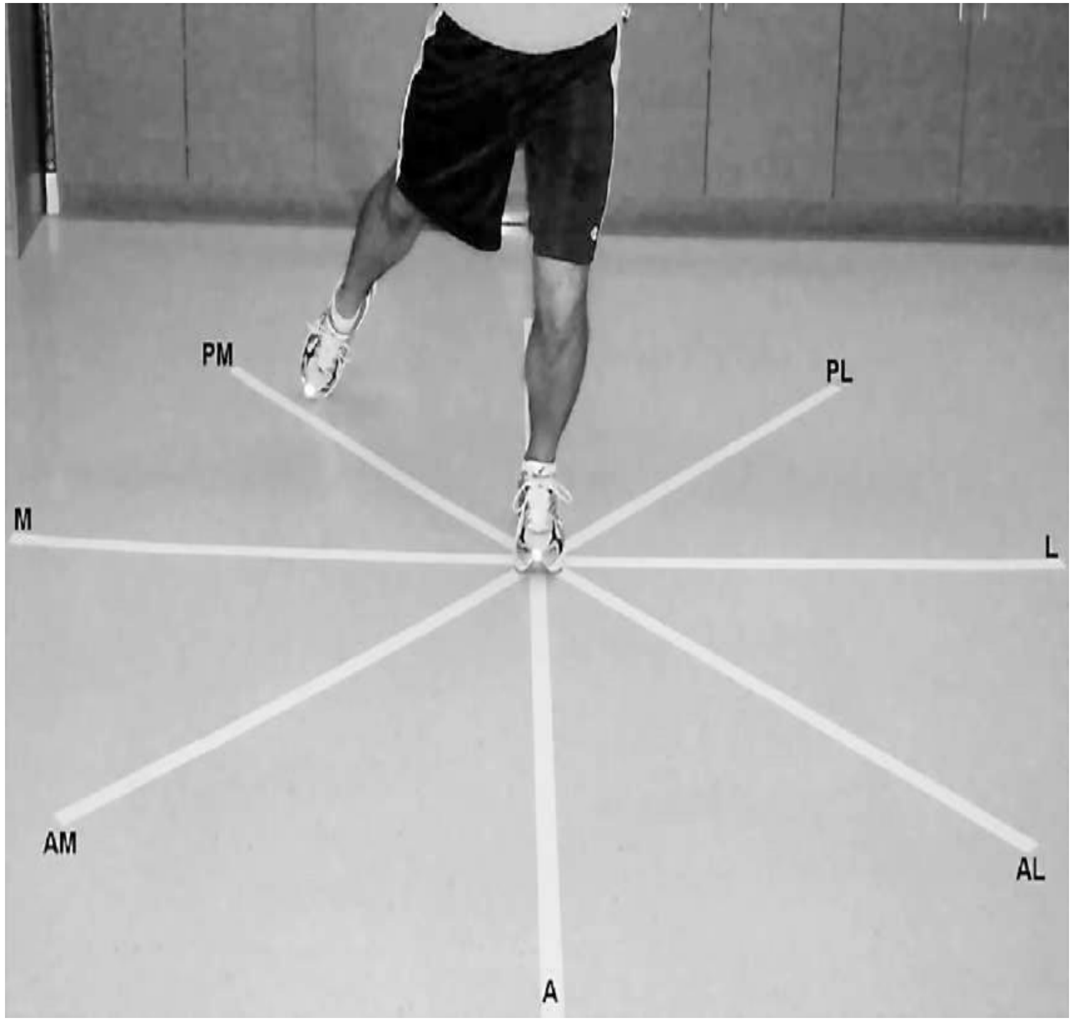
Effects of eccentric training

- A programme of eccentric exercise affects type I collagen production
- increase tensile strength in the tendon over time.
- The effect of repetitive stretching, with a “lengthening” of the muscle–tendon unit, may also have an impact on capacity of the musculotendinous unit to effectively absorb load.
- alteration of the neovascularisation and accompanying nerves.

Resistance band eccentric loading



Sensorimotor Exercises



star excursion exercise

Wall reach. Reaching may be performed in the sagittal, frontal or transverse planes.

Closed Kinetic Chain Exercises

Squatting with differing bases of support imparts varying stress on the Achilles tendon and can help in transition to higher level, functional, and sport-specific activities.

Core strengthening exercises

Bridge

Crunch

Supine toe tap

Bird Dog

Functional recovery phase (return to sport)

lunges

side lunges

Reverse lunge knee-ups

Plyometrics

Box jumps

Stairway hops

Tuck jumps

Criterion-Based Rehabilitation Guidelines to Progress to Advance Sport-Specific Training and Conditioning

- **Greater than 75% symmetry in hop testing**

May include SL hop for distance, SL vertical jump, SL triple hop

- **Symmetry with single leg heel raise endurance test**

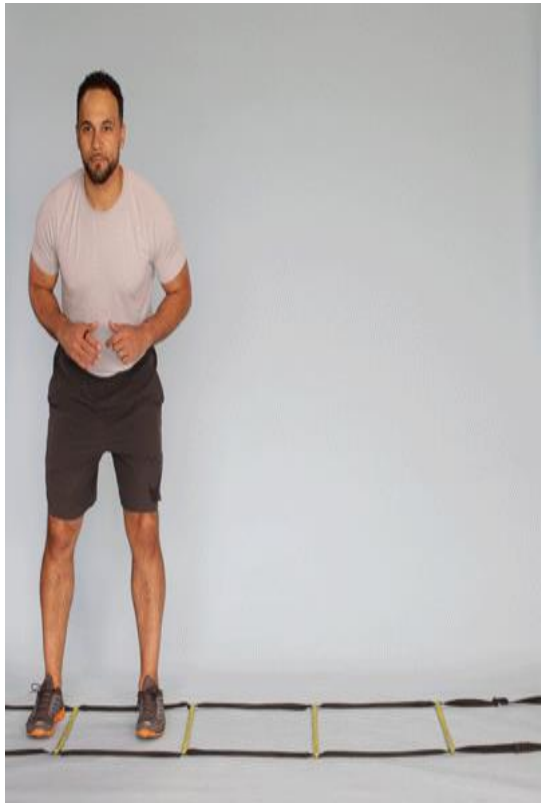
(maximum repetitions)

Sport-Specific Exercises

i.e., high knees with heel raise, Agility drills

Carioca drill

Side shuffle



Agility ladder drills Lateral sidestep

Agility ladder drills
Two-in-one linear run

T-drills

Stand up to figure 8

Criteria for Abandoning Nonoperative Treatment and Proceeding to Surgery

- Inability to regain strength
- Inability to regain function
- Debilitating pain
- Patient preference

Specific Criteria for Return to Sports Participation

- Greater than 85% symmetry in hop testing

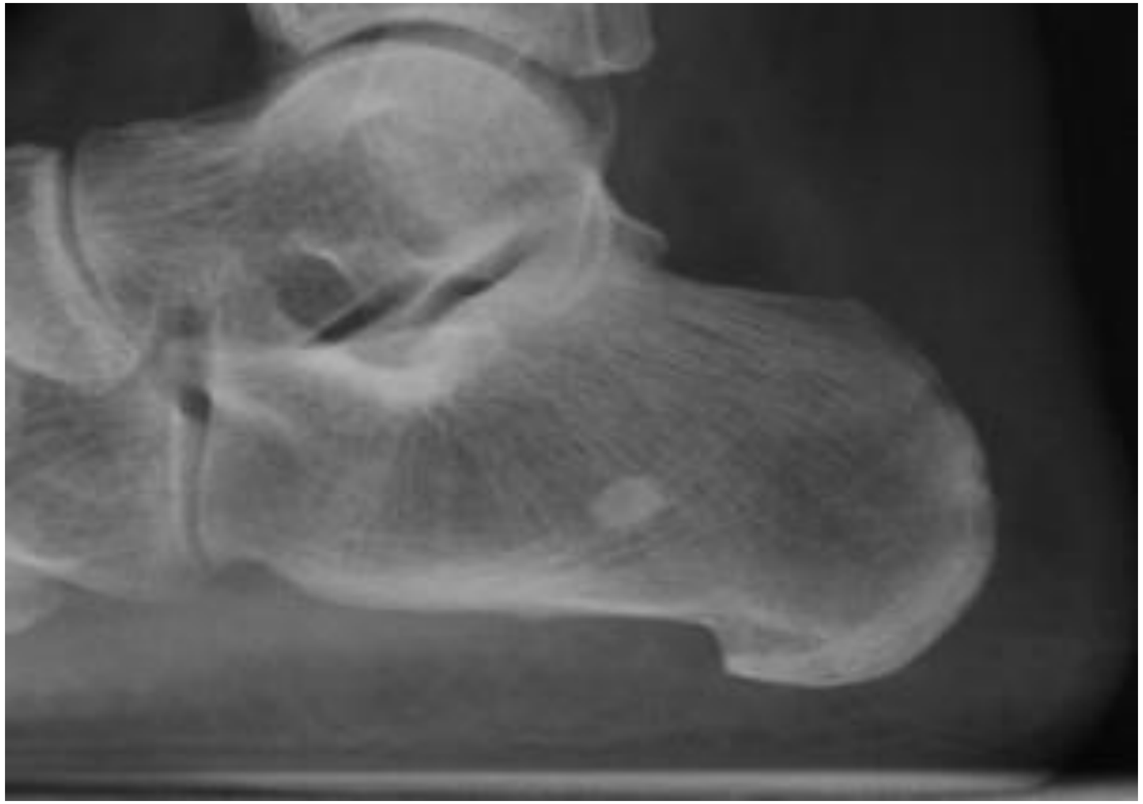
OPERATIVE TREATMENT

operative treatment consists of

- débridement, lysis of adhesions, and excision of thickened portions of the paratenon.
- percutaneous tenotomies
- Endoscopic debridement

the *Achilles SpeedBridge* technique for Insertional Achilles Tendinopathy

Pre-op Haglund deformity and bone spur at the insertion of the Achilles tendon



Post op – removal of pain generating deformity confirmed.

Achilles Pain, Stiffness, and Muscle Power Deficits: Midportion Achilles Tendinopathy Revision 2018

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

J Orthop Sports Phys Ther. 2018;48(5):A1-A38. doi:10.2519/jospt.2018.0302

A, strong evidence; B, moderate evidence; C, weak evidence; D, conflicting evidence; E, theoretical/foundational evidence; F, expert opinion.

INTERVENTIONS – EXERCISE

A Clinicians should use mechanical loading, which can be either in the form of eccentric exercise, or a heavy-load, slow-speed (concentric/eccentric) exercise program, to decrease pain and improve function for patients with midportion Achilles tendinopathy without presumed frailty of the tendon structure.

F Patients should exercise at least twice weekly within their pain tolerance.

INTERVENTIONS – STRETCHING

C Clinicians may use stretching of the ankle plantar flexors with the knee flexed and extended to reduce pain and improve satisfaction with outcome in patients with midportion Achilles tendinopathy who exhibit limited ankle dorsiflexion range of motion.

INTERVENTIONS – MANUAL THERAPY

F Clinicians may consider using joint mobilization to improve mobility and function and soft tissue mobilization to increase range of motion for patients with midportion Achilles tendinopathy.

INTERVENTIONS – HEEL LIFTS

D Because contradictory evidence exists, no recommendation can be made for the use of heel lifts in patients with midportion Achilles tendinopathy.

INTERVENTIONS – TAPING

F Clinicians should not use therapeutic elastic tape to reduce pain or improve functional performance in patients with midportion Achilles tendinopathy.

F Clinicians may use rigid taping to decrease strain on the Achilles tendon and/or alter foot posture in patients with midportion Achilles tendinopathy.

INTERVENTIONS – LOW-LEVEL LASER THERAPY

D Because contradictory evidence exists, no recommendation can be made for the use of low-level laser therapy in patients with midportion Achilles tendinopathy.

INTERVENTIONS – IONTOPHORESIS

B Clinicians should use iontophoresis with dexamethasone to decrease pain and improve function in patients with acute midportion Achilles tendinopathy.

EXTRACORPOREAL SHOCKWAVE THERAPY

there is evidence that ESWT benefits patients with chronic midportion Achilles tendinopathy

PLATELET-RICH PLASMA INJECTION

2018 Summary

Many systematic reviews determined that high-level evidence does not support the use of PRP injections for a variety of outcomes, including VISA-A, return to sport, ultrasound measures, and function (eg, FAAM), for individuals with midportion Achilles tendinopathy.[7,52,65,112,159,169,198]

Achilles tendon rupture

by

Waleed saber

Orthopedic physical therapy lecturer

s.v.u.

Epidemiology

- The incidence has increased dramatically in the past 50 years.
- 75% of ruptures are sports related.
- The peak incidence occurs between 30 and 45 years of age, with a male-to-female ratio of 6:1 (Hansen et al. 2016).

Mechanism of injury

- pushing off with the weight bearing foot while extending the knee
- A sudden or violent dorsiflexion of a plantarflexed foot (eccentric contracture).


Sensitive Content
This video contains sensitive content which
some people may find disturbing

Pathophysiology

- Most Achilles tendon ruptures occur approximately 2 to 6 cm proximal to its insertion on the calcaneus, called “watershed” region of reduced vascularity.

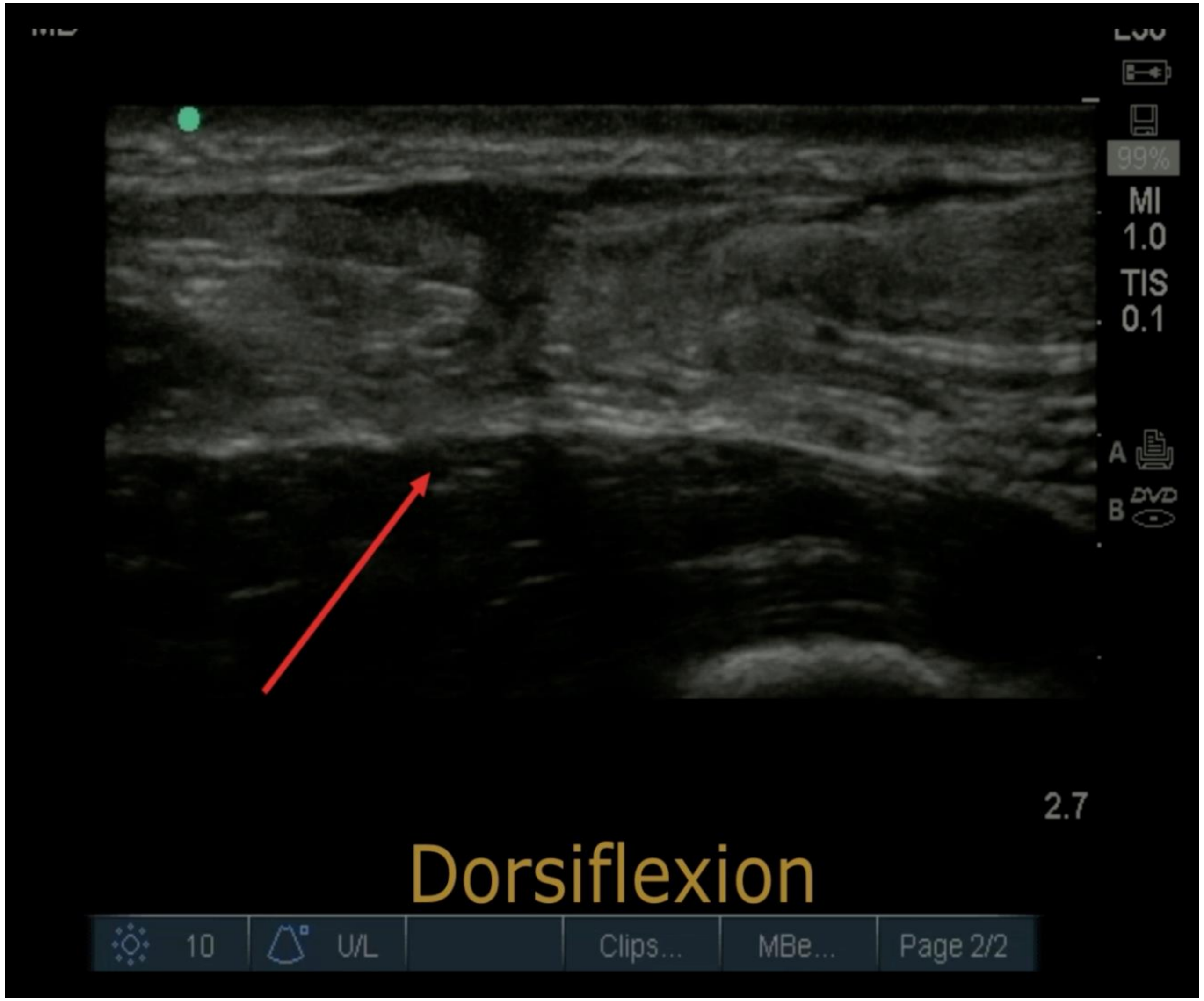
CLINICAL SIGNS AND SYMPTOMS

- Sharp pain
- A pop heard at the time of complete rupture.
- Patients often describe a sensation of being kicked in the Achilles tendon.
- Immediate inability to bear weight or return to activity.
- A palpable defect may be present in the tendon initially

Special test

- Thompson test will be positive.

Achilles Tendon Rupture



TREATMENT OF ACUTE RUPTURE OF THE ACHILLES TENDON

- Both nonoperative and operative treatment can be used to restore length and tension to the tendon
- Treatment should be individualized based on operative candidacy. The patient's overall health, vascular status, and activity level are considered.
- Traditionally, younger patients and athletes have been treated with operative repair. A main reason for this is that studies have shown that operative repair has been associated with lower rerupture rates, more frequent return to athletic activities, quicker return to full activity, and greater plantarflexion strength (Heckman et al. 2009, Khan et al. 2005).
- Khan et al., in a meta-analysis of randomized trials comparing surgical and conservative management, found rerupture rates of 3.5% in the operative group and 12.6% in the nonoperative group as well as significant weakness in the nonoperative group (Khan et al. 2005).
- Ultrasound serial examinations can be helpful to confirm that Achilles tendon end apposition occurs with 20 degrees or less of plantarflexion of the foot. If a significant gap remains with the leg placed in 20 degrees of plantarflexion, we still favor operative treatment in young, healthy patients

Comparing Surgical and Conservative Treatment on Achilles Tendon Rupture: A Comprehensive Meta-Analysis of RCTs

Guorong et al, 2021.

A total of 13 RCTs were included in this meta-analysis. A significant difference was observed in re-rupture, complication rate, adhesion to the underlying tendon, sural nerve injury, and superficial infection. A substantial reduction in re-rupture rate could be observed for surgical treatment while the complication rate was higher compared with conservative treatment.

NONOPERATIVE TREATMENT OF ACUTE ACHILLES TENDON RUPTURE

Phase I (weeks 0 to 4)		PHASE II (weeks 4 to 6)	PHASE III (weeks 6 to 8)
Day 0–10	**Day 10-Week 4**		
• Cast in 20° PF • NWB using crutches	• D/C PF cast Apply removable orthosis set to 20° PF • Every hour-AROM DF not to exceed neutral and PROM PF	• Removable orthosis brought to neutral • Gentle soft tissue mobilization • Gentle gastroc/soleus isometrics • SLRs, OKC knee extensions and flexion • Well leg exercises	• WBAT in orthosis with 2- to 3-cm heel lift • Gait training on level surface in orthosis • Joint mobilizations • Balance and proprioceptive training in orthosis • DF AROM not to exceed 10° • Begin pool therapy: Walk → run in full emersion • Stationary bike in orthosis • CKC exercises in orthosis: squats, leg press with DF to neutral

PHASE IV (weeks 8 to 12)	PHASE V (weeks 12 to 16)	PHASE VI (weeks 16 to 24)
• Remove Orthosis, 1 cm heel lift as needed • Seated heel/toe raises • OKC PF with resistance bands • CKC exercises: step ups → step downs • Proprioceptive training: double leg → single leg balance drills • Gait training on treadmill level surface → gentle incline • Stationary bike • Pool therapy: Double leg toe raise → single leg	• Squats, lunges, leg press, lunges, leg press • Pool therapy: gentle jogging and hopping-start in chest deep water → waist deep	• Olympic/power lifting • Plyometrics • Walk-jog progression • Screening for return to sports and implementation/progression of sport-specific exercises

Specific Criteria for Return to Sports Participation

- Single leg heel rise, symmetry of greater than 90% (number of repetitions to failure)
- Single leg hop for distance symmetry of greater than 90%
- Single leg vertical jump symmetry of greater than 90%

OPERATIVE TREATMENT FOR ACUTE ACHILLES TENDON RUPTURE

SURGICAL PROCEDURE

Repair

- End-to-end suture technique for ruptured tendons

Repair with Augmentation

- use of gastrocnemius fascia flaps or the plantaris tendon if available.

Reconstruction

- Neglected, chronic ruptures, however, require reconstruction with endogenous or exogenous materials.
- Endogenous materials include fascia lata, peroneus brevis transfer, flexor digitorum longus, and flexor hallucis longus.
- Exogenous materials such like carbon fiber.

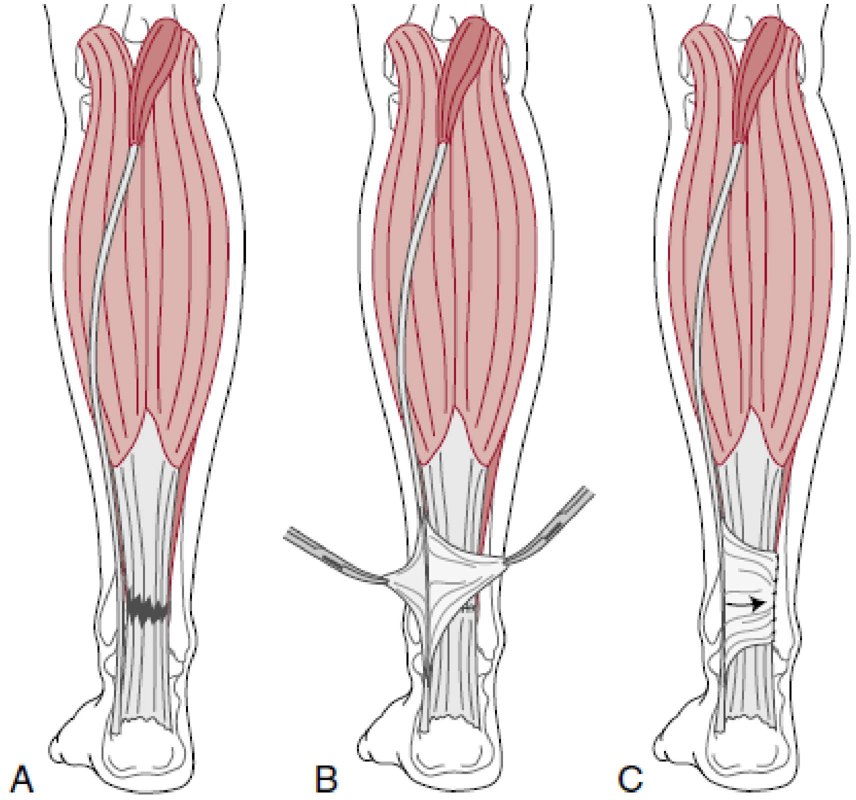
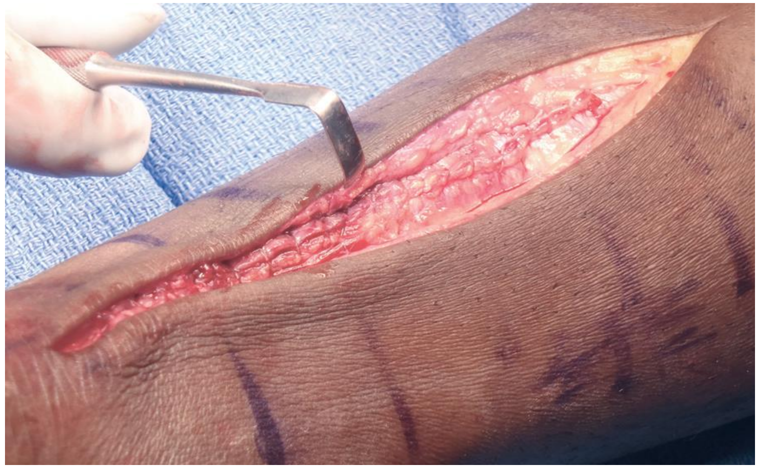


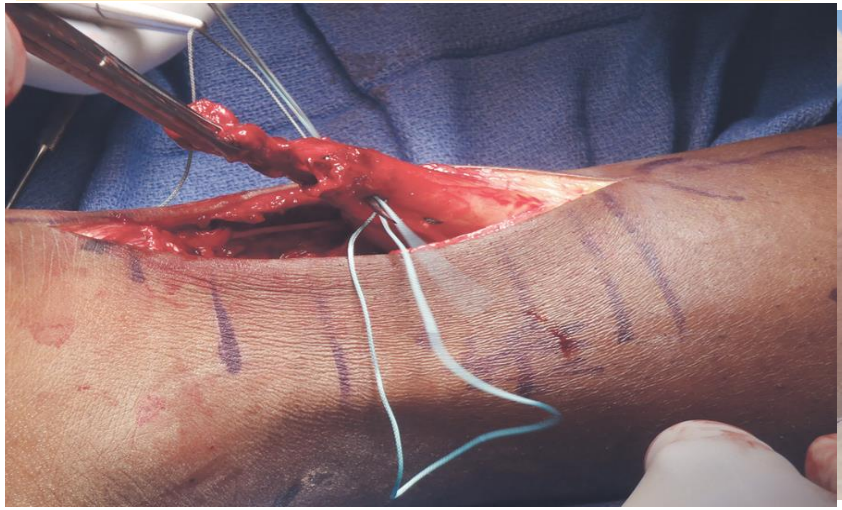
Fig. 45.1 Reinforcement with plantaris tendon. **A**, Rupture. **B**, Achilles tendon is repaired, and plantaris tendon is divided and fanned. **C**, Plantaris tendon is used to reinforce repair.

posteromedial incision is made to avoid the sural nerve and small saphenous vein. The length of incision will vary to allow optimal exposure and access to the tendon.



The paratenon is carefully preserved and reclosed with absorbable suture.

Exposed “mop-ends



Various suture techniques are described. The Bunnell stitch was used in this case

plaster splint, with the ankle is resting plantar-flexion to protect the repair.

POSTOPERATIVE REHABILITATION OF ACHILLES TENDON RUPTURE

Phase I (days 0 to 14): Immediate Postoperative Period

Goals
- Protect repaired Achilles tendon.
- Decrease pain and inflammation.
- Prevent effects of immobilization.

Protection
- splint is applied for first 24 to 96 hours
- Rigid walking boot with three heel wedges resulting in approximately 20° of equinus is applied after splint is discontinued.
- Weight bearing as tolerated on crutches with rigid walking boot.

Management of Pain and Swelling
- Cryotherapy
- TENS and IFC e-stim.
- Elevation of surgical limb

Manual Therapy Techniques
- Grades I and II talocrural, subtalar, distal tibiofibular, and mid-foot joint mobilizations
- Ankle circles (ABCs) with DF limited to neutral
- Three-way ankle isometrics: DF, inversion (INV), and eversion (EV)

Phase II (weeks 2 to 6)

Goals
- Protection of repaired structures
- Decrease pain and inflammation
- Neutral DF ROM
- Discontinue use of crutches and walking boot
- Full weight-bearing status

Protection
- Use a walking boot for ambulation without crutches as tolerated

Soft Tissue Techniques
- Achilles tendon soft tissue mobilizations
- Scar mobilizations to surgical incision

Therapeutic Exercises
- Gentle towel calf stretch not to exceed neutral DF
- Resistance band exercises—DF, INV, and EV
- Four-way ankle isometrics
- Sitting calf (heel) raises beginning at week 5
- Seated BAPS (Biomechanical Ankle Platform System)

Phase III (weeks 6 to 10)

Goals
- Restore normal gait mechanics without heel lifts in shoes
- Full active ankle ROM

Protection
- Discontinue walking boot for ambulation

- CKC Achilles stretch
- Resistance band exercises
- Bodyweight squat, lunges
- Aquatic therapy: swimming, gait training, deep water aqua jogging
- In-line tandem walking
- Single limb stance balance progression
- Standing BAPS
- Step-up, lateral step up, and forward step down
- Gait training
- Stair climbing

TIMELINE 38-4 **Postoperative Rehabilitation for Acute Achilles Tendon Rupture** (Continued)

PHASE IV (weeks 10 to 14)	PHASE V (weeks 14 to 24)	PHASE VI (weeks 24 to 52)
• Elliptical trainer • Walk-jog progression • PREs for all motions • OKC eccentric Achilles loading • Bilateral standing heel raises • SL balance and reach • Patient reported outcome measures	• SL heel raises • SL squats • Jog progression to running/sprint drills • Form running drills • Plyometrics @ 20 wks • Olympic style lifts @ 20–24 wks • Agility and sport-specific drills • Hop testing • Patient-reported outcome measures	• Individual strength and flexibility program based off impairments • Running/sprint drills • Plyometrics • Agility and sport-specific drills (skipping → hopping → jumping) • Return to sport

Gravity reduced plyometric exercise

Criteria for Return to Sport

Single hop for distance, crossover triple hop for distance, triple hop for distance, and vertical jump should be at least 90% of the distance or height performed on the unaffected limb.

Posterior Tibial Tendon Insufficiency (PTTI)

by

Waleed saber

Orthopedic physical therapy lecturer

s.v.u.

Posterior Tibial Tendon Insufficiency is the most common cause of adult-acquired flatfoot deformity, caused by attenuation and tenosynovitis of the posterior tibial tendon leading to medial arch collapse.

EPIDEMIOLOGY

- ❑ Demographics
  - more common in women
  - often presents in the sixth decade
- ❑ Risk factors
  - obesity
  - hypertension
  - diabetes
  - increased age
  - corticosteroid use
  - Overuse

Origin	Posterior surface of tibia, posterior surface of fibula and interosseous membrane
Insertion	Tuberosity of navicular bone, all cuneiform bones, cuboid bone, bases of metatarsal bones 2-4
Actions	Talocrural joint: Foot plantarflexion Subtalar joint: Foot inversion Supports medial longitudinal arch of foot
Innervation	Tibial nerve (L4, L5)

Etiology

Researchers have proposed numerous mechanisms for the degeneration of the posterior tibial tendon (PTT).

- The most commonly the cause for PTT degeneration is credited to a repetitive loading causing microtrauma and progressive failure.
- A retromalleolar(Critical zone of hypovascularity), hypovascular region does exist and may also contribute to the disease.
- The anatomic course of the posterior tibial tendon also likely contributes as the tendon does make an acute turn around the medial malleolus, putting a significant amount of tension on the tendon in the region distal and posterior to the medial malleolus
- Other proposed causes are - constriction beneath the flexor retinaculum, abnormal anatomy of the talus, degenerative changes associated with osteoarthritis, and preexisting pes planus.

CLINICAL PRESENTATION

Symptoms

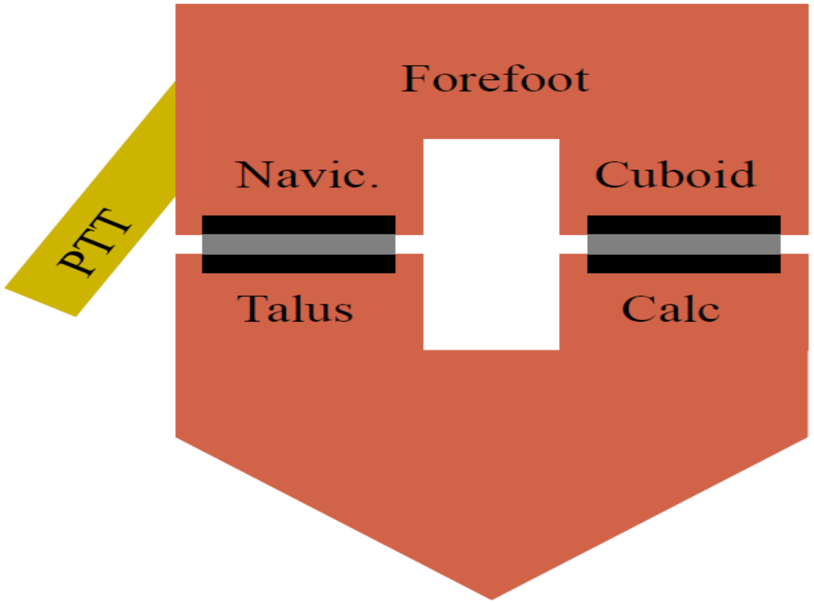
- medial ankle/foot pain and weakness is seen early
- progressive loss of arch
- lateral ankle pain due to subfibular impingement is a late symptom

Physical exam

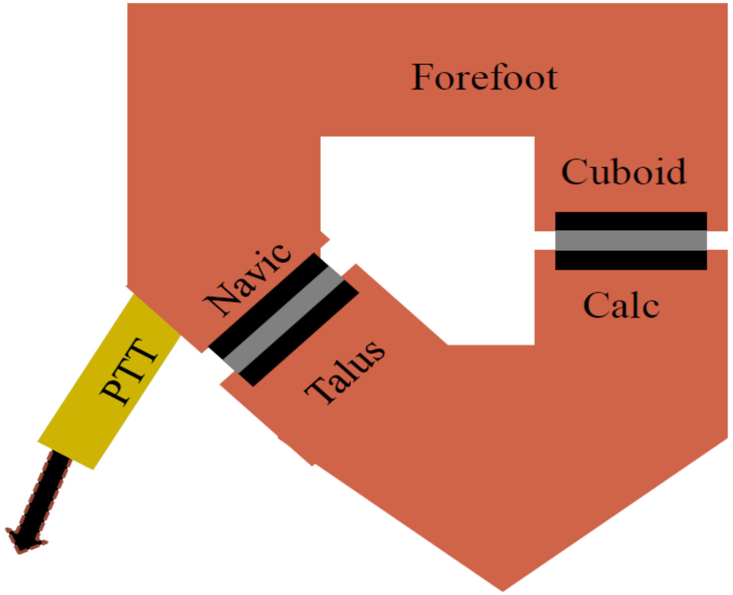
inspection & palpation

- pes planus
- collapse of the medial longitudinal arch
- hindfoot valgus deformity
- forefoot abduction (Stage IIB disease)
- "too many toes" sign
- tenderness just posterior to tip of medial malleolus
- determine whether deformity is flexible or fixed

Transverse Tarsal Locking Mechanism



- two hinge system which is parallel when the PTT is relaxed, allowing transverse tarsal motion



- When the PTT fires, the hinges become divergent and cannot open and close as a unit.
- This locks the transverse tarsal joint, creating a stable hindfoot for foot lift-off

PTT Initiates heel rise by inverting subtalar joint & locking transverse tarsal joints

So Patients of PTT dysfunction

- Unable to initiate heel raise
- Able to maintain heel raise one occurred by action of calf muscles

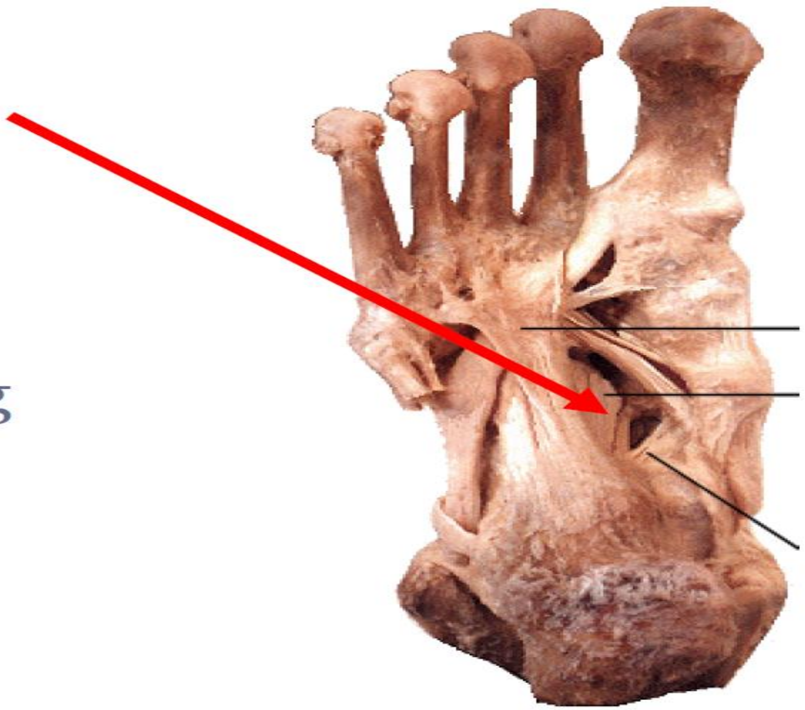
PTT Dysfunction-Pathophysiology

- Unopposed pull of peroneus brevis
  - PB pulls on the lateral column (base of 5MT) to ***evert***, ***pronate*** and ***abduct***, so it is the ***antagonist*** of the PTT

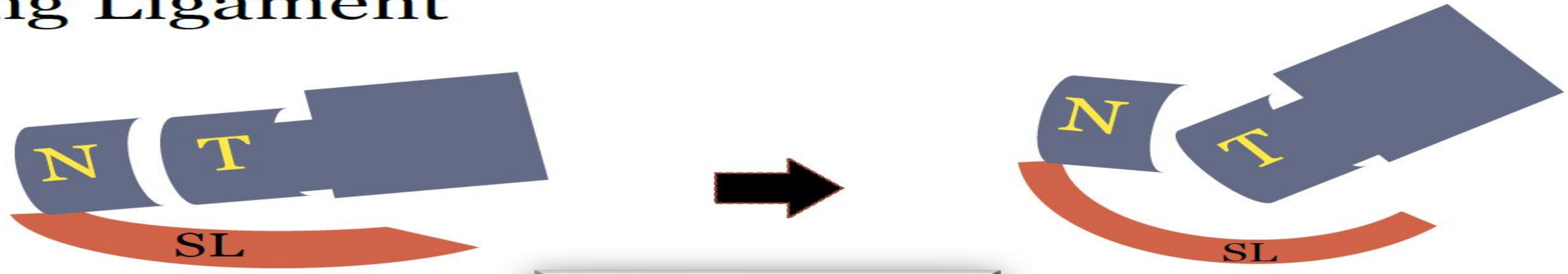
    Chronic, unopposed eversion force → Heel valgus → Eventual attenuation of medial ligamentous structures
- Progressive collapse of arch
  - Calcaneus drifts into relative eversion, causing the talus to fall into plantar flexion as the spring ligament attenuates
- End stage
  - Marked calcaneal valgus
  - Talus PF
  - Forefoot abduction

Superior Medial Calcaneonavicular

- ~~Spring~~ Ligament
  - The hammock that supports the talonavicular joint
  - Loss of PTT function -> forefoot abduction -> attenuation of spring ligament
  - As the hammock collapses, the talonavicular joint falls



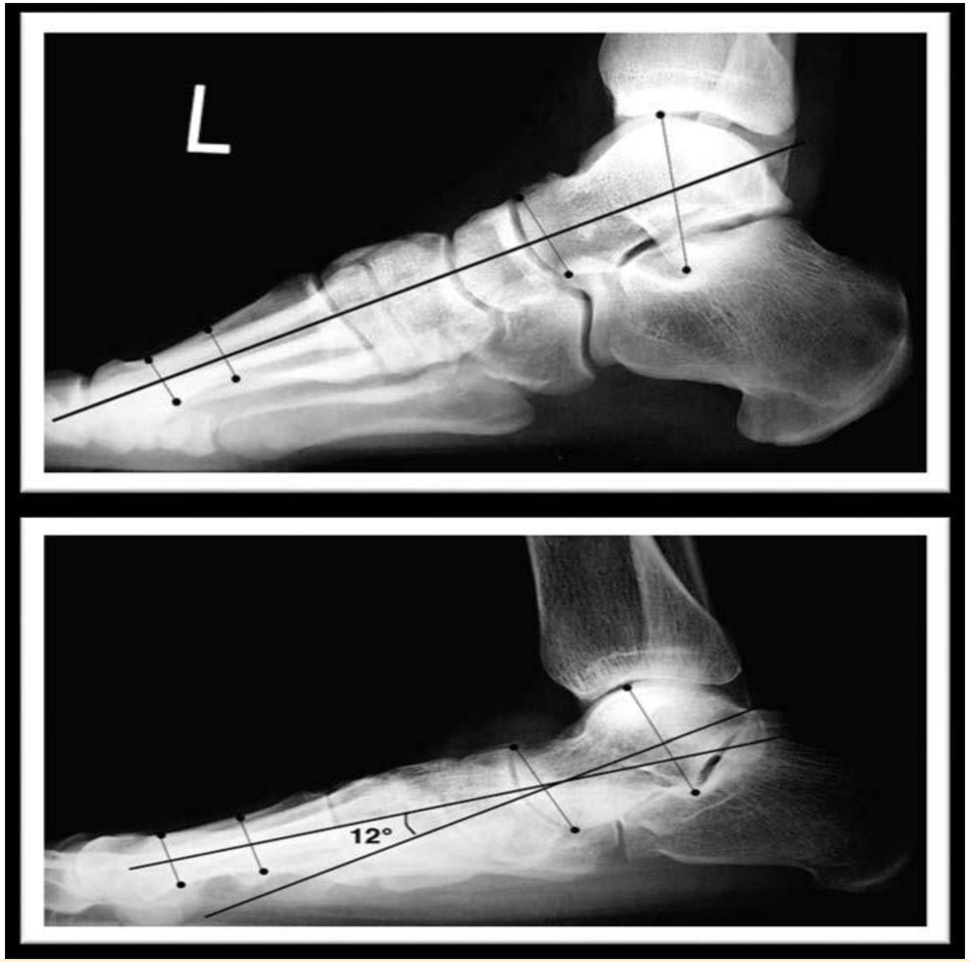
Spring Ligament



Posterior Tibial Tendon Insufficiency Classification		
	Deformity	*Physical exam*
Stage I	Tenosynovitis No deformity	(+) single-heel raise
Stage IIA	Flatfoot deformity Flexible hindfoot Normal forefoot	(-) single-leg heel raise Mild sinus tarsi pain
Stage IIB	Flatfoot deformity Flexible hindfoot Forefoot abduction ("too many toes", > 40% talonavicular uncoverage)	(-) single-leg heel raise Mild sinus tarsi pain
Stage III	Flatfoot deformity Rigid forefoot abduction Rigid hindfoot valgus	(-) single-leg heel raise Severe sinus tarsi pain
Stage IV	Flatfoot deformity Rigid forefoot abduction Rigid hindfoot valgus Deltoid ligament compromise	(-) single-leg heel raise Severe sinus tarsi pain Ankle pain

PPT Dysfunction-X-rays

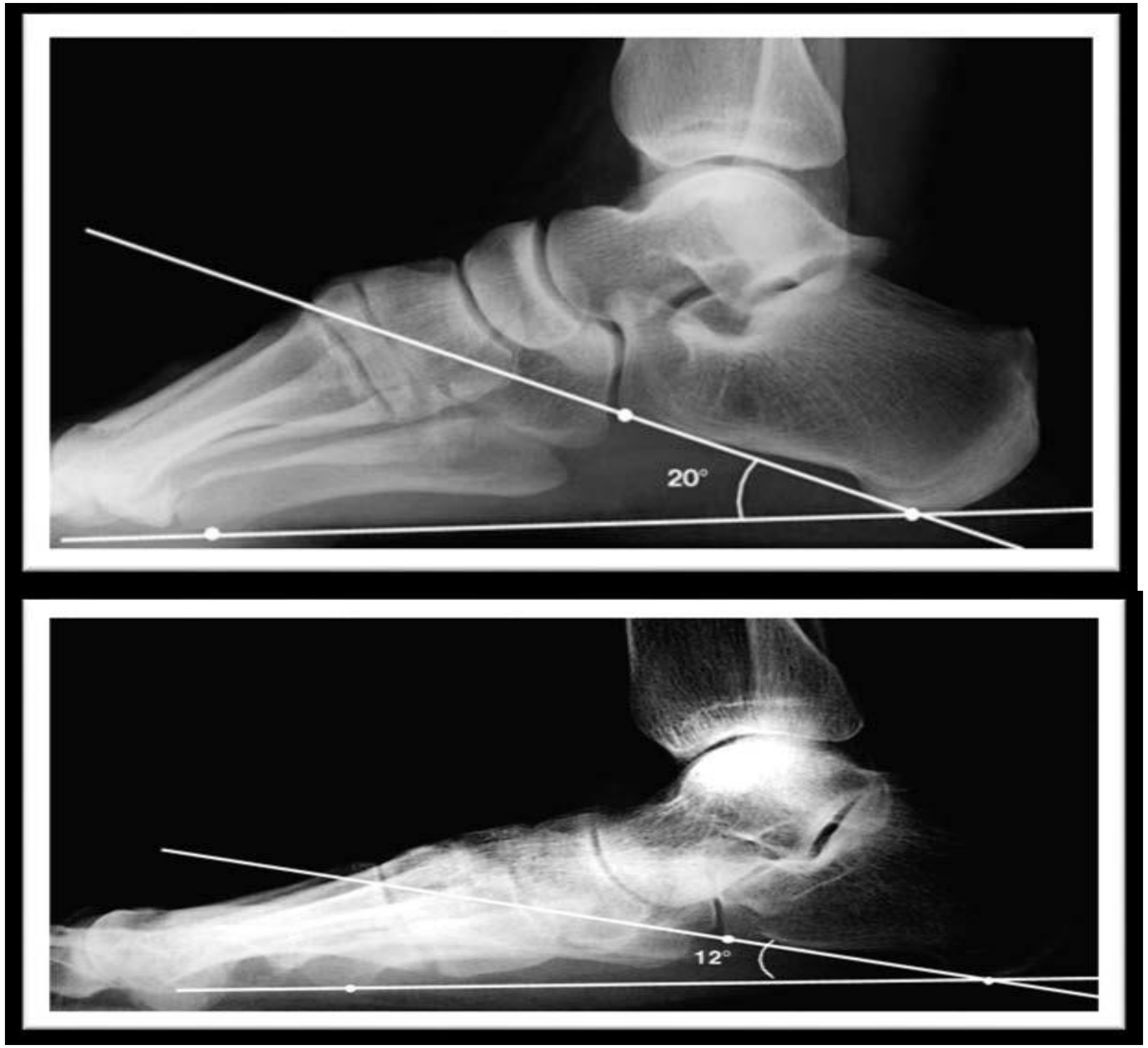
Talonavicular uncoverage percentage (percentage of the talus that is not in contact with the navicular medially). (a) Normal foot <30%; (b) pathological flatfoot, >30%.



Meary's angle: It is the angle between a line drawn along the longitudinal axes of the talus (mid-talar axis) and the first metatarsal (first metatarsal axis).

It can be used to classify the severity of deformity :

- mild: <15º
- moderate: 15-30º
- severe: >30º



Calcaneal pitch angle is formed on a weight-bearing lateral foot radiograph between the calcaneal inclination axis (i.e. most inferior part of the calcaneus) and the supporting horizontal surface

the normal range of calcaneal pitch 18–32°

Talonavicular uncoverage percentage (percentage of the talus that is not in contact with the navicular medially). (a) Normal foot, <30%; (b) pathological flatfoot, >30%.

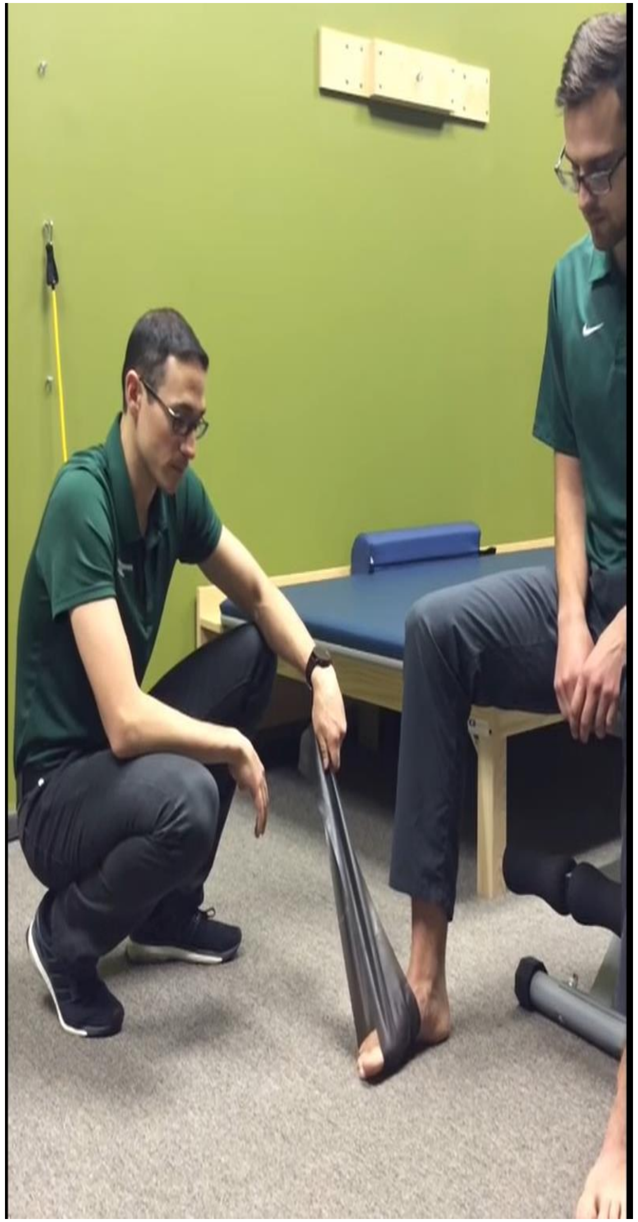
PTT Dysfunction-Conservative Treatment

- Stage I – Tendinitis / Tenosynovitis
  - Concept: Rest the tendon!
    - Lace-up brace (inversion)
    - CAM boot
    - SLWC
  - Concept: Reduce Inflammation
    - NSAIDS (not steroids)

- Iontophoresis
- Cryotherapy
- Pulsed ultrasound
- Calf stretching
- Gradual progression to strengthening of tibialis posterior when pain is gone

Sole-to-sole isometrics

Heel raise with PTT bias

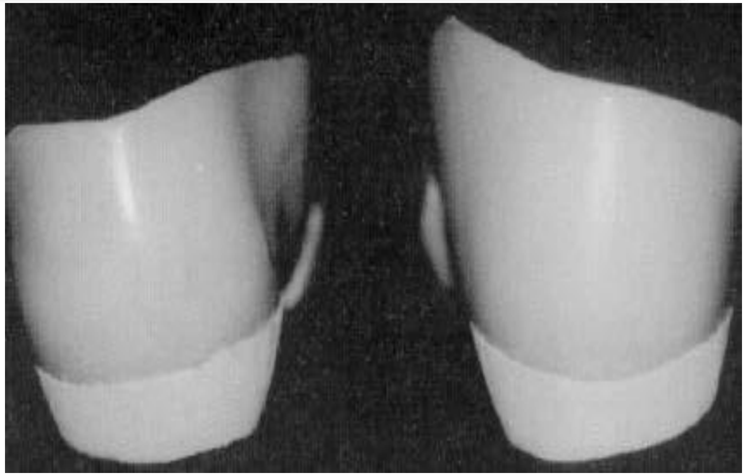



Treadmill

Leaning Single Leg heel Raise

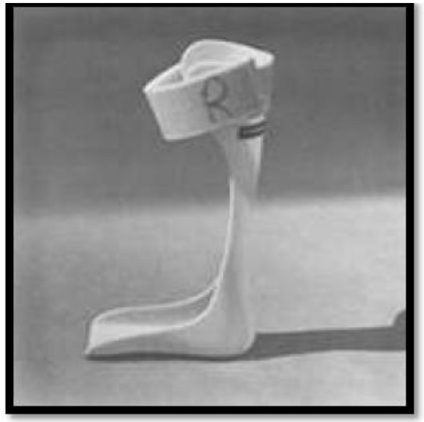
- Stage II
  - Concept: If the foot is still flexible, hold it in the correct orientation
    - Medial Posted Heel Wedge: Restores subtalar neutral and eliminates heel valgus
    - Medial Arch Support: Shores up the sagging arch
    - Lateral Forefoot Restraint: Blocks abduction of the forefoot

UCBL orthosis



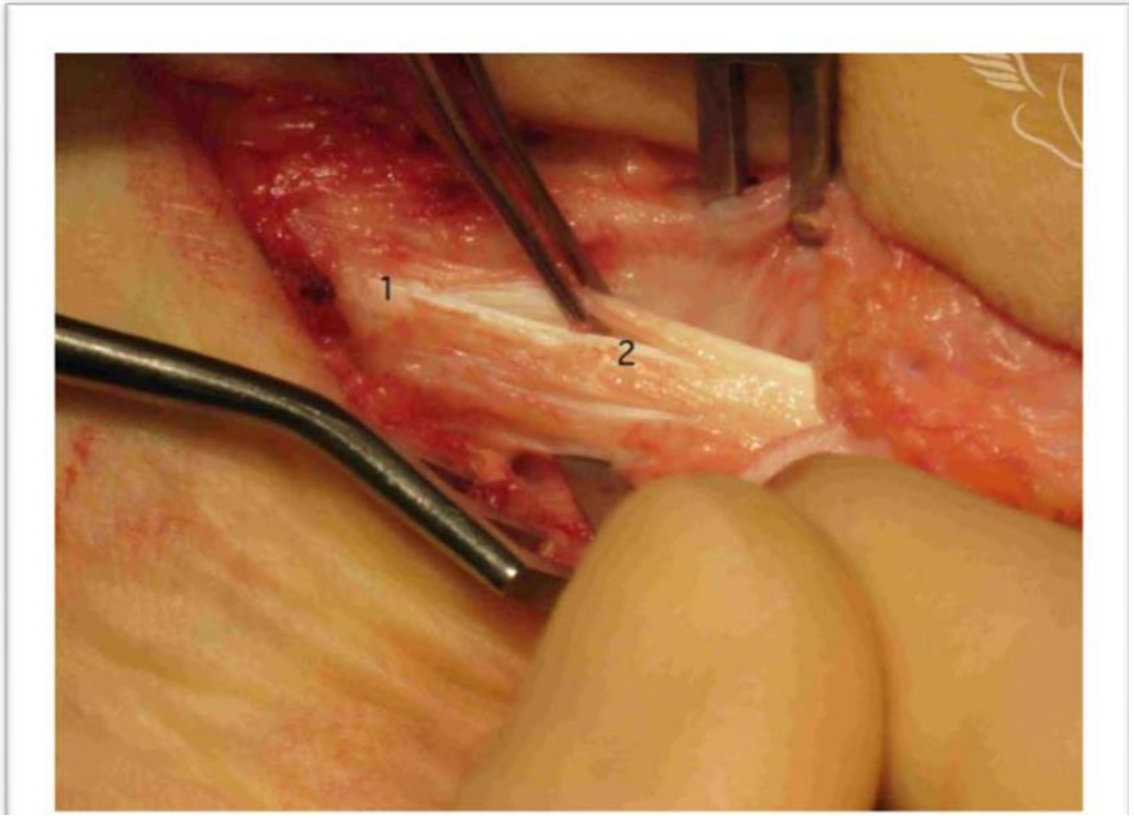
- Stage III-IV
  - Concept: Accommodate the deformity rather than trying to correct it (it's **rigid**!)
    - MAFO Brace
    - Articulating AFO
    - Arizona brace

  - In situ molding



PTT Dysfunction-Surgical Treatment

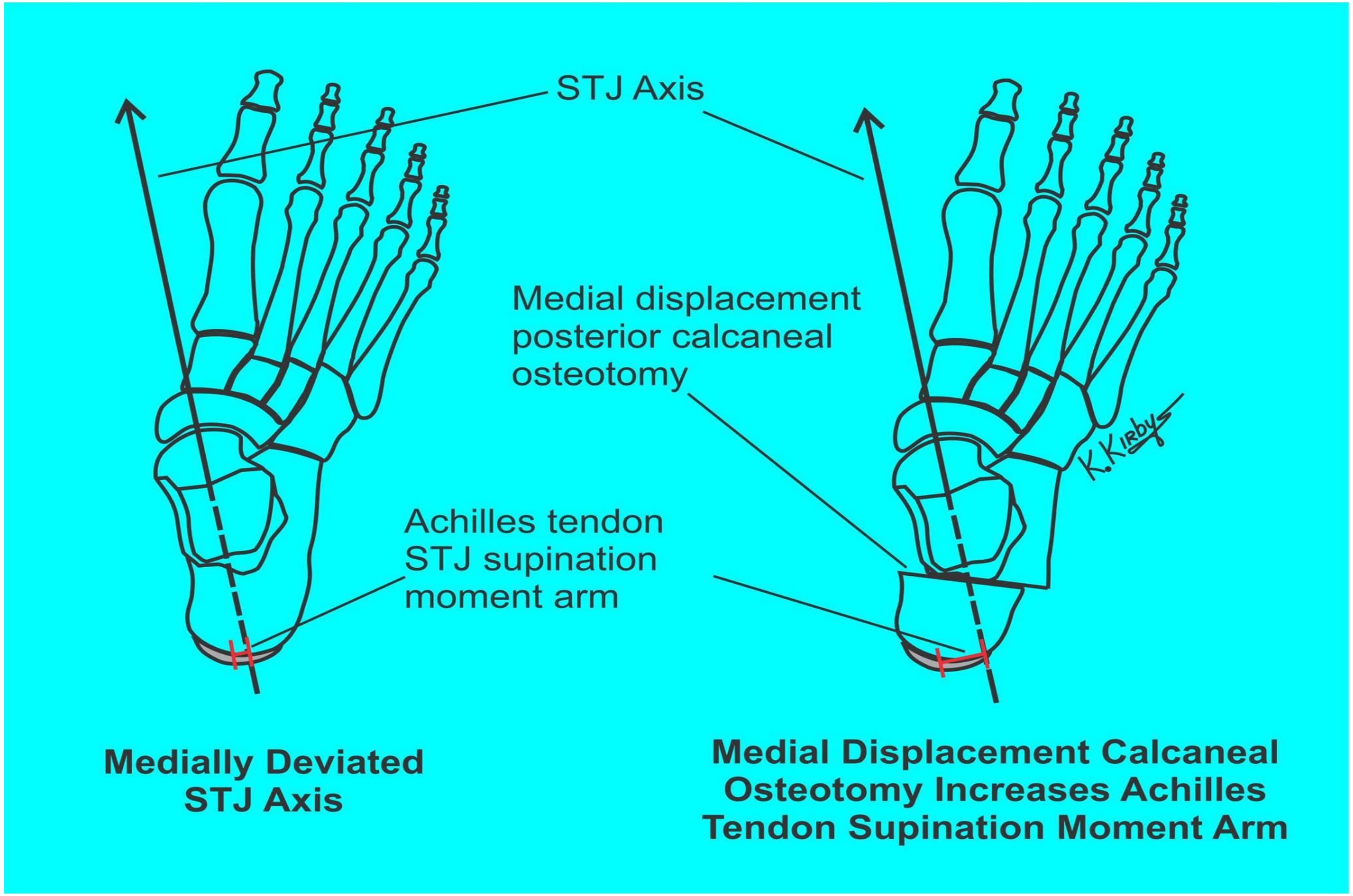
- Stage I
  - If patients fail 6 months of conservative treatment
  - Synovectomy
  - Repair any fissuring of tendon, if present



Stage II

Flexor digitorum longus transfer
For flexible deformity not rigid deformity

Displacement Calcaneal Osteotomy



- Stage III – **Rigid** Deformities
  - Subtalar Arthrodesis
    - Allows TTJ motion
      - Must have TTJ flexibility
      - Must have < 10° forefoot varus
    - Fuse in 5° heel valgus