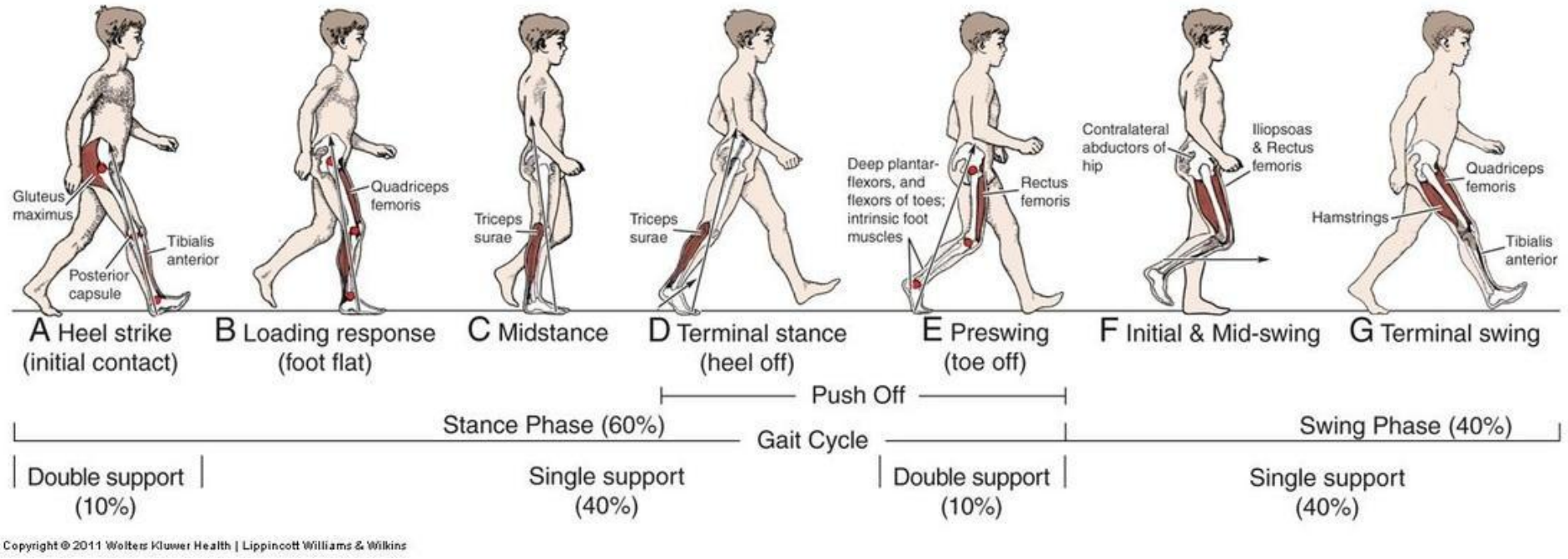
ANKLE AND FOOT

Chapter 22
Page 849

Why are the ankle and foot so important?

- form the base of stability for the entire body
- all its structures - joints, ligaments, bones, fascia, skin and muscles specialize in accepting great levels of force from body weight and ground forces
- Has the ability to maintain contact with and adapting to variable surfaces.
- What is the first step of understanding the ankle and foot?

GAIT!

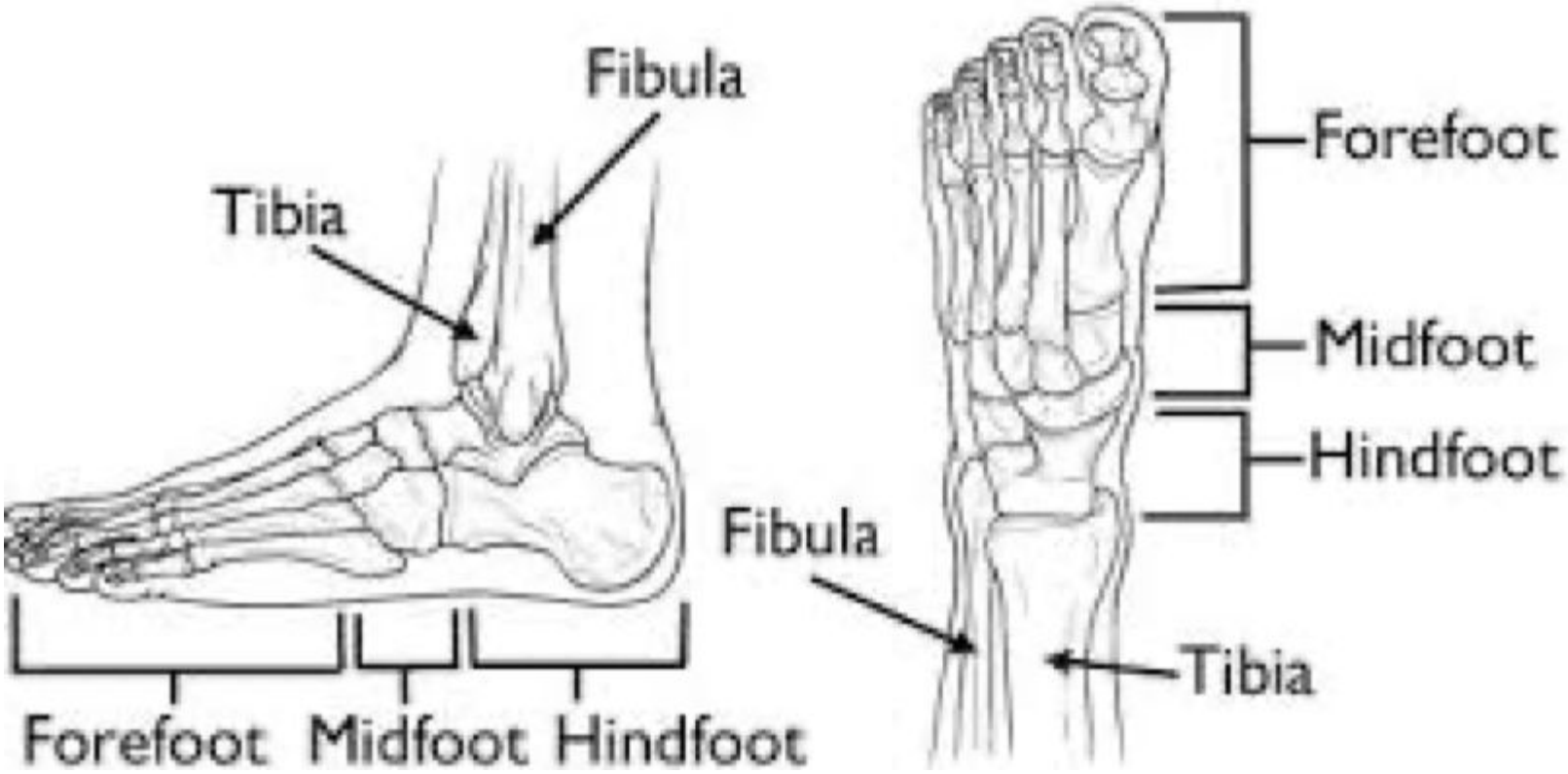


Overview

- 26 Irregular shaped bones (28 with sesamoids) (Def: a small nodular mass of bone or cartilage in a tendon, especially at a joint or bony prominence.-www.merriam-webster.com)
- More than 100 ligaments
- 30 muscles
- Provides propulsion and restraint for each step
- Arches provide a complex spring-like structure which transmits forces upon heel strike and then propels the body forward. The arches essentially store up energy on the heel strike and release it on the forward propulsion.

3 Functional Areas

- **Hindfoot** – Talocrural joint and Subtalar joint
- **Midfoot** – Talonavicular, Calcaneocuboid, Cuneonavicular, Intercuneiform, Cuneocuboid and Cubonavicular joints
- **Forefoot** – Tarsometatarsal, Metatarsophalangeal, Interphalangeal joints


Fibula
Tibia
Forefoot
Midfoot
Hindfoot
Forefoot
Midfoot
Hindfoot
Fibula
Tibia

Hindfoot

- Talocrural joint – *plantar and dorsiflexion* occur through the joint, either by the tibia moving on a fixed foot or the foot moving on a fixed tibia
- Subtalar joint – *Pronation and supination* occur at this joint
- Talocrural and Subtalar joints are a unit which act as torque converters and shock absorbers during the stance phase of gait

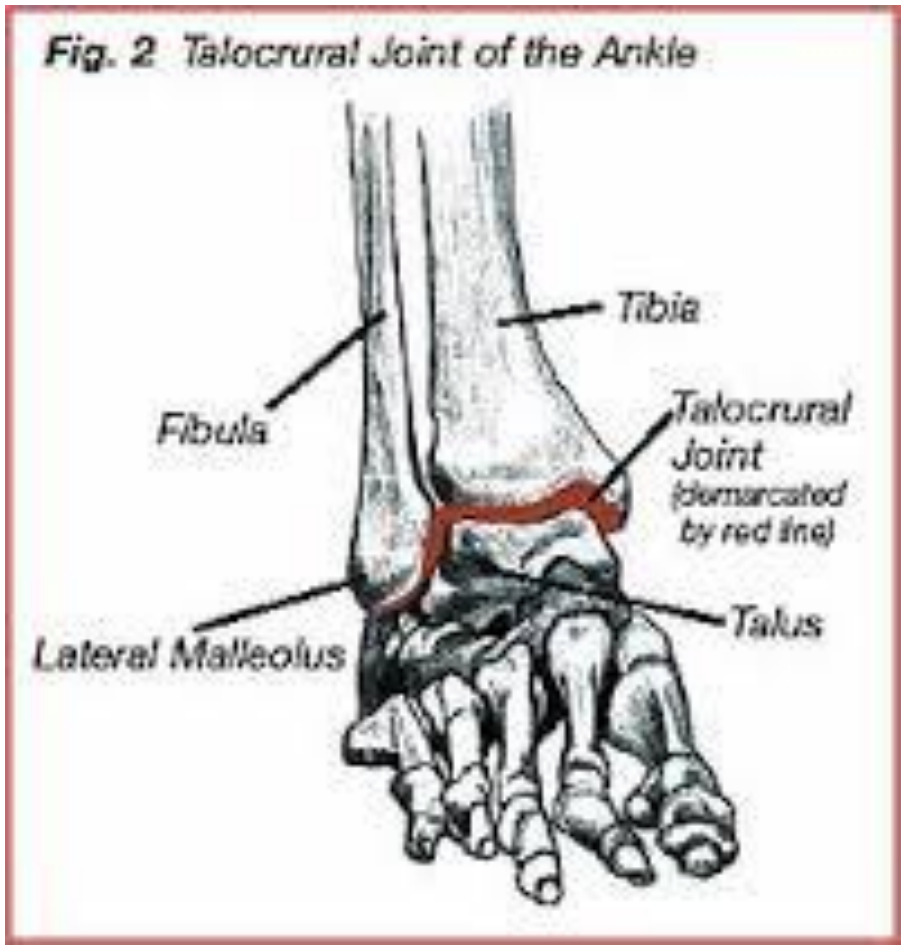


Fig. 2 Talocrural Joint of the Ankle
Tibia
Fibula
Talocrural Joint
(demarcated by red line)
Talus
Lateral Malleolus

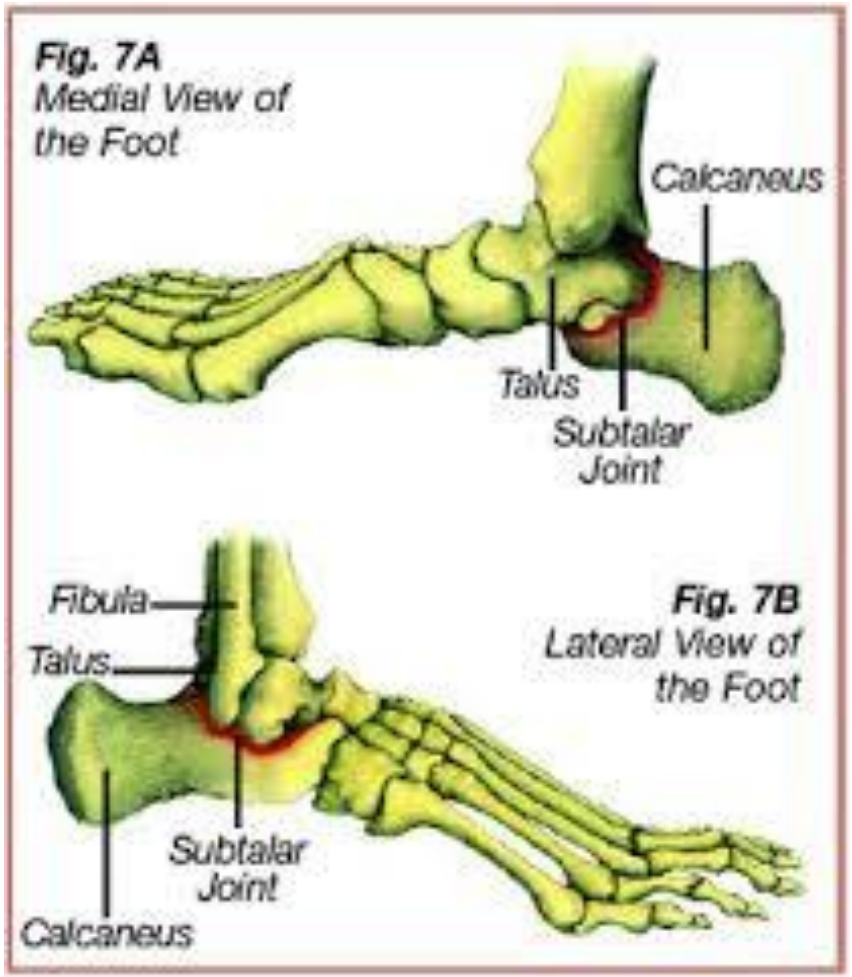
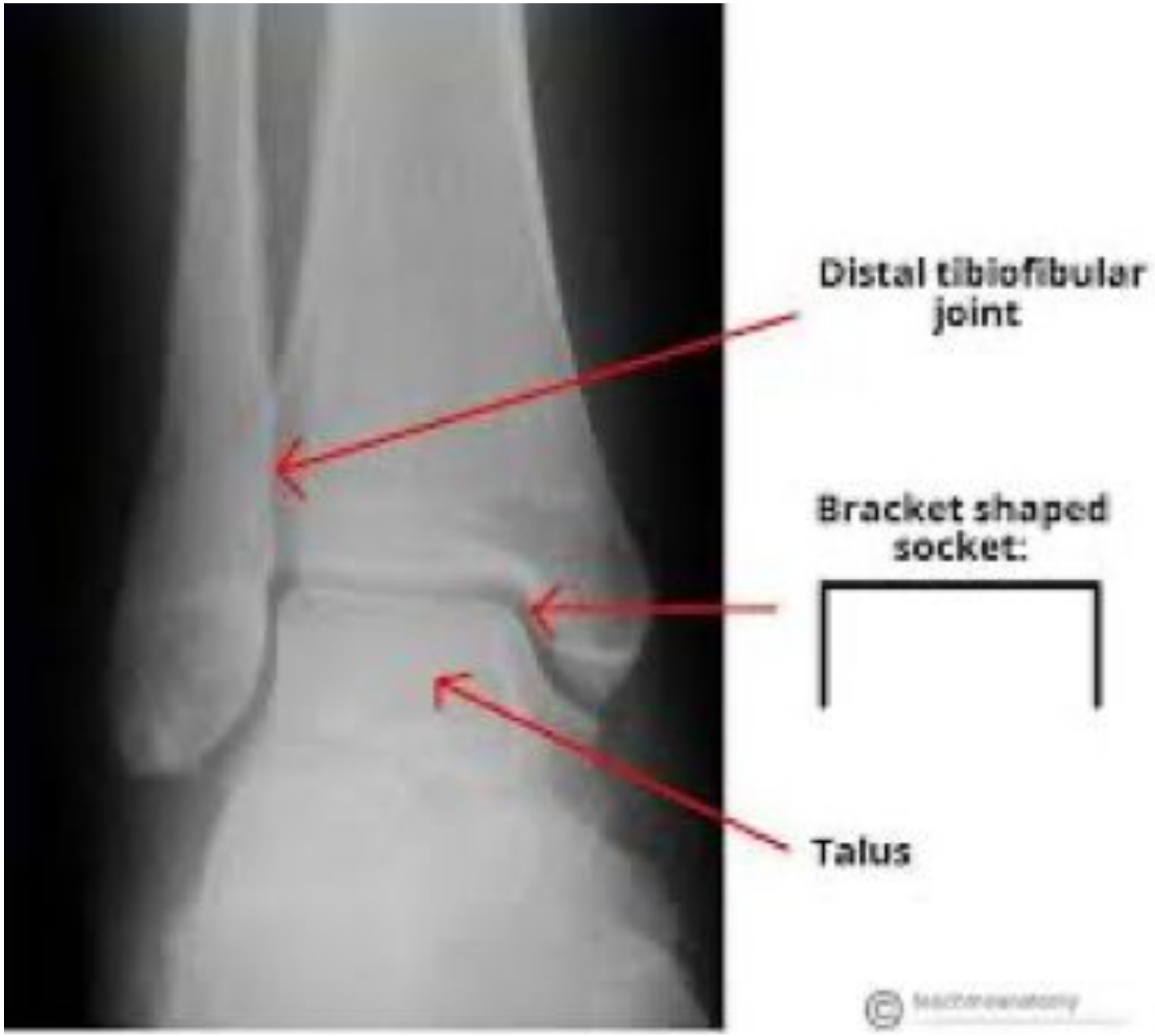
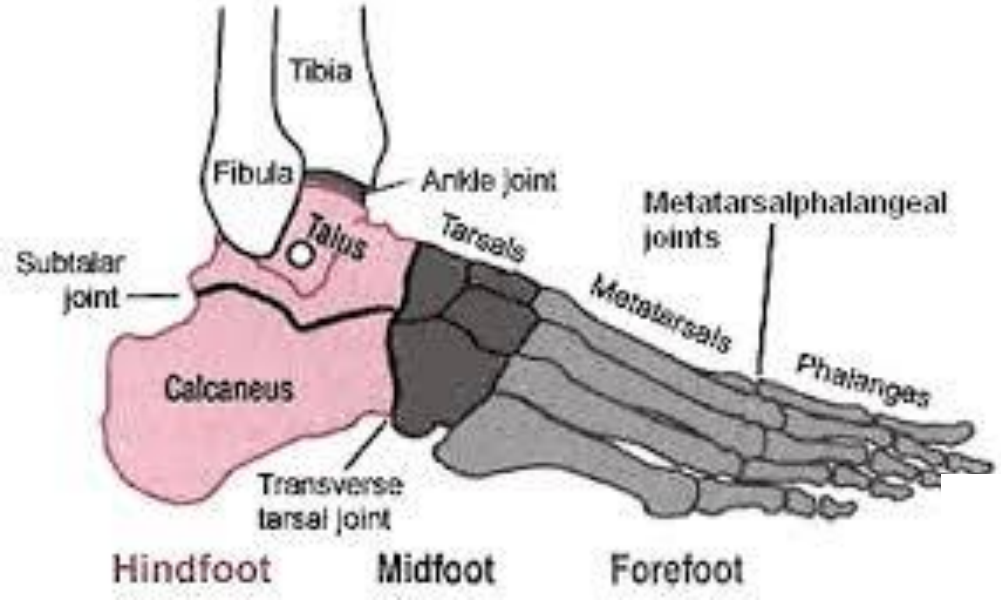


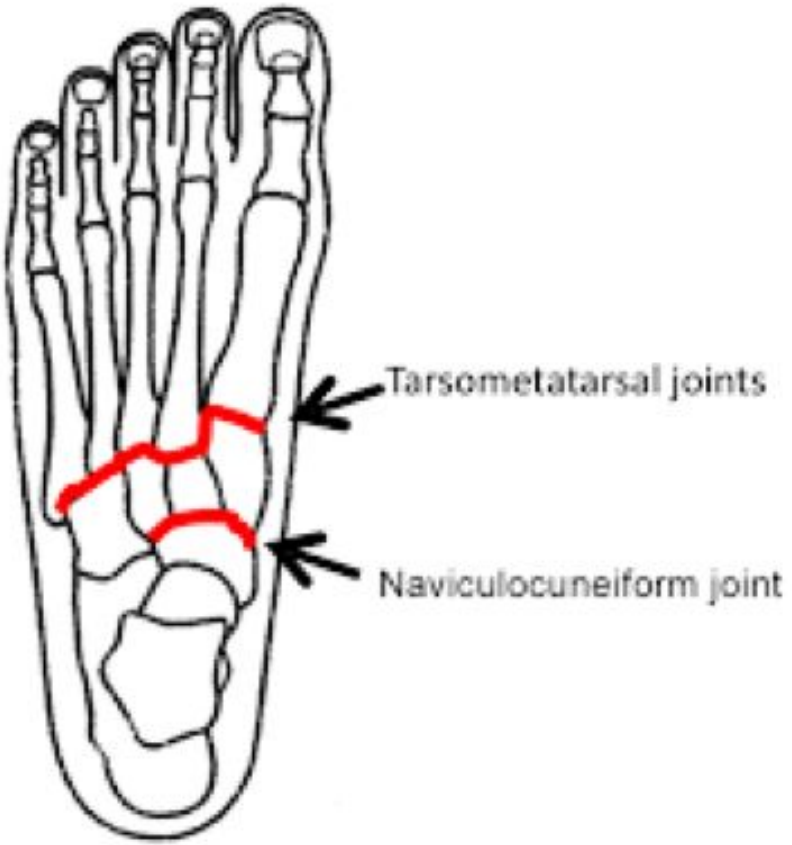
Fig. 7A
Medial View of the Foot
Calcaneus
Talus
Subtalar Joint
Fibula
Talus
Subtalar Joint
Calcaneus
Fig. 7B
Lateral View of the Foot


Distal tibiofibular joint
Bracket shaped socket:
Talus

Midfoot

- The Transverse Tarsal Joint is a combination of the talonavicular and calcaneocuboid joint
- *Pronation and Supination* occur at this joint
  - Adds to pronation and supination happening at subtalar joint therefore helping to absorb rotary force of lower leg
  - Helps keep forefoot as flat as possible on the ground

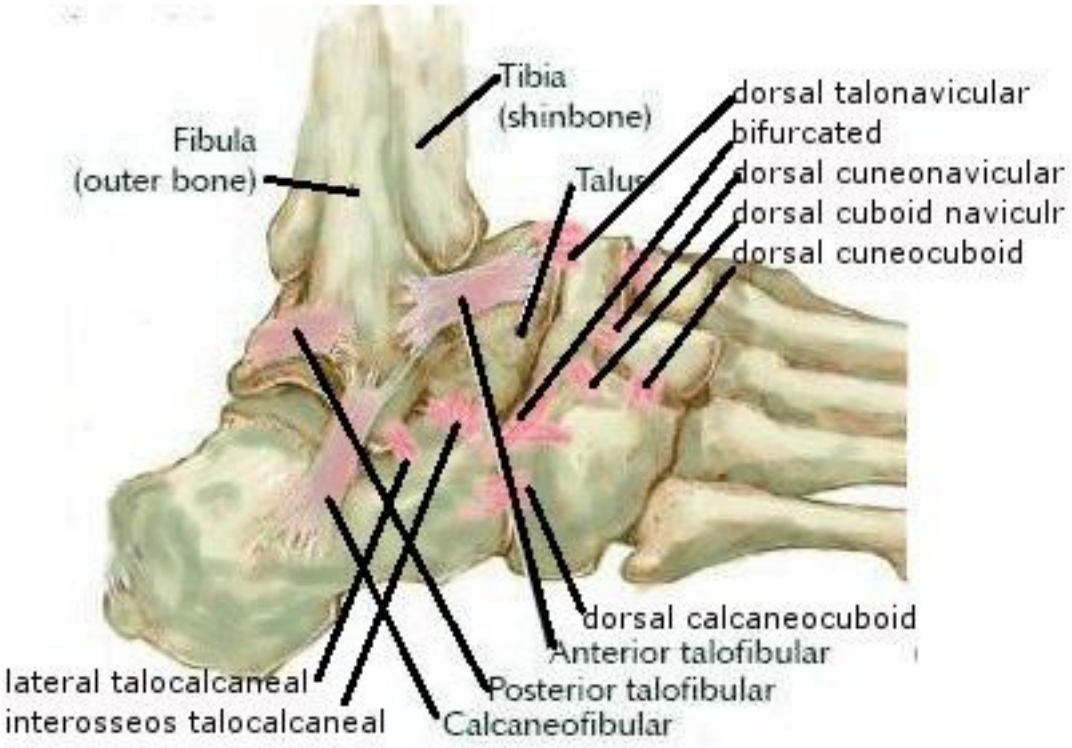

Tibia
Fibula
Ankle joint
Talus
Tarsals
Metatarsalphalangeal joints
Subtalar joint
Metatarsals
Phalanges
Calcaneus
Transverse tarsal joint
Hindfoot
Midfoot
Forefoot


Tarsometatarsal joints
Naviculocuneiform joint

Midfoot

- Cuneonavicular, Intercuneiform, Cubonavicular & Cuneocuboid Joints – allow small gliding movements which contribute to the flexibility of the foot
  - *Stability and mobility* of this area is related directly to the hindfoot. Hence why proper biomechanics at the hindfoot are essential to avoid faulty mechanisms leading to injury of the entire foot.

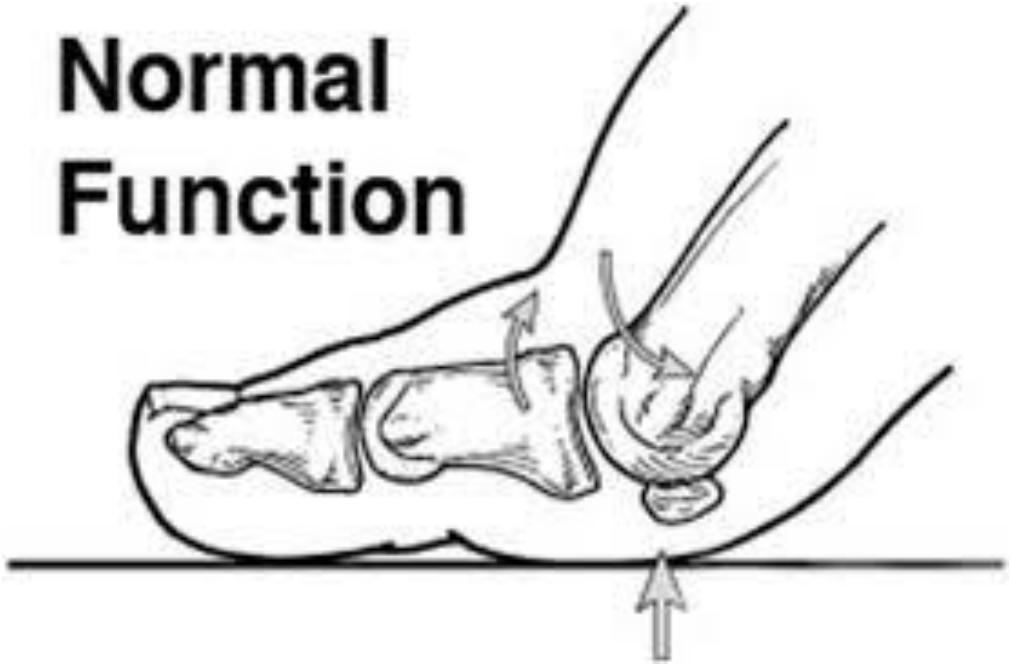
Midfoot Joints



Forefoot

- The metatarsals and phalanges
- Tarsometatarsals - independent joint movements at each of the TMT joints allows the entire foot to undergo a *pronation or supination* twisting action to counteract what happens in the hindfoot and keep as much contact with the floor as possible
- Metatarsophalangeal joints – allow *flexion*, *extension & adduction, abduction.* Extension is more free than flexion, which allows for the metatarsal break in the foot as the heel lifts when walking.

Metatarsophalangeal Joint



Forefoot

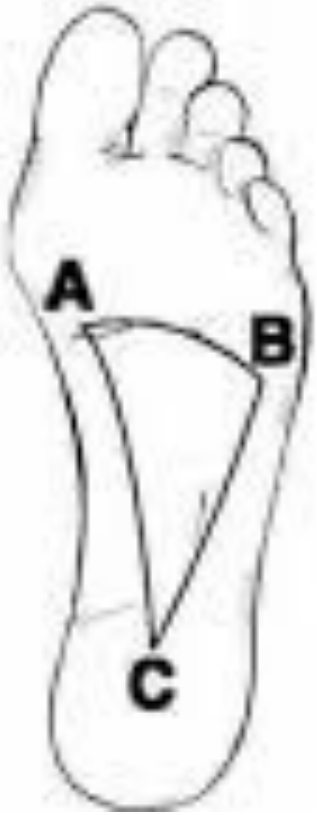
- Interphalangeal Joint – allows flexion/extension
  - The toes smooth the transfer of weight onto the opposite foot during gait
  - They help stabilize by pressing against the ground in standing
  - The big toe takes the greatest load during the push-off portion of gait, with 40% of the body weight on the other 4 toes, making them important for stability

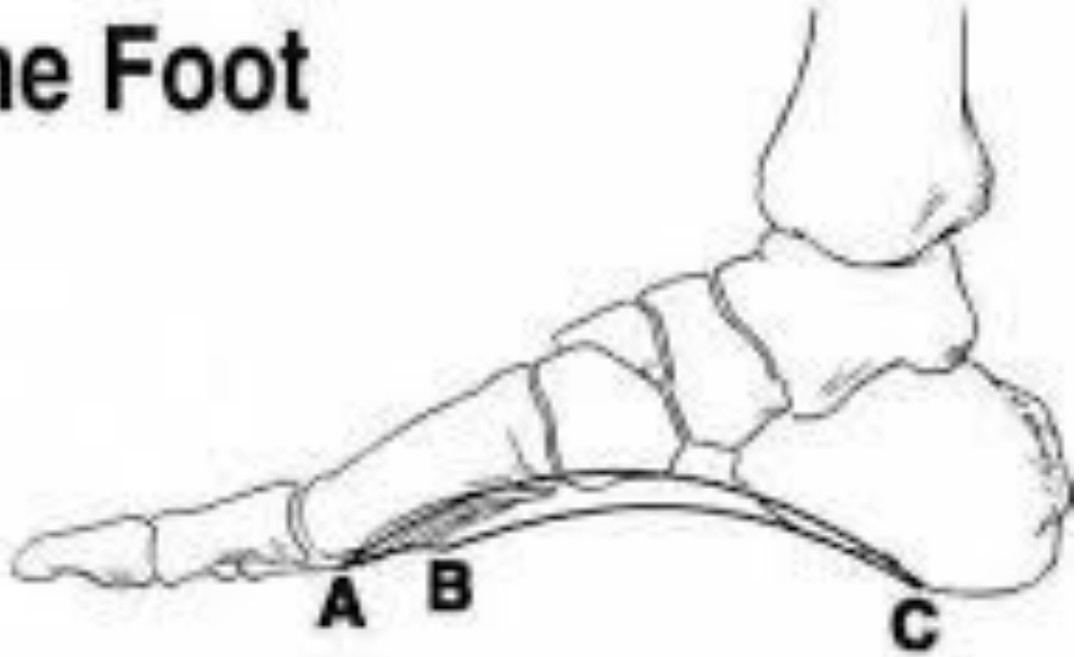
Push-off Portion of Gait

Arches of the Foot

- Medial Longitudinal Arch – Highly elastic, contributes greatly to shock absorption
- Lateral Longitudinal Arch – makes contact with ground during gait, supports during weightbearing
- Transverse arch – provides significant support in weightbearing
- Tibialis Posterior is the only extrinsic (Def: It's origin is not close to the moving part-www.merriam-webster.com,) muscle that contributes significantly to arch support

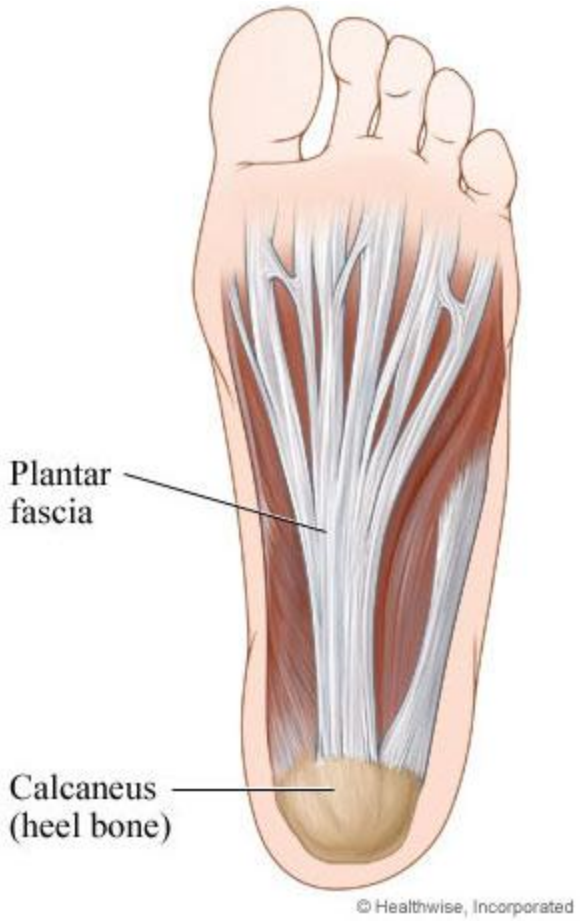
Arches of the Foot





A-B Anterior Transverse Arch
B-C Lateral Longitudinal Arch
A-C Medial Longitudinal Arch

Plantar Fascia



Arches & Plantar Fascia

- Although the shape of the bones provide some stability to the arches, by far the most important support structures are:
  - The plantar ligaments
  - The plantar musculature
  - The plantar fascia - a spring-like structure which not only supports the arches, but protects other structures of the foot. It is most important in supporting the medial arch in the end part of the stance phase of gait

Ideal function of Foot and Ankle

- Major source of propulsion
- Must have ability to adjust to various ground surfaces and speeds of movement
- Both flexibility and rigidity are important for optimal function

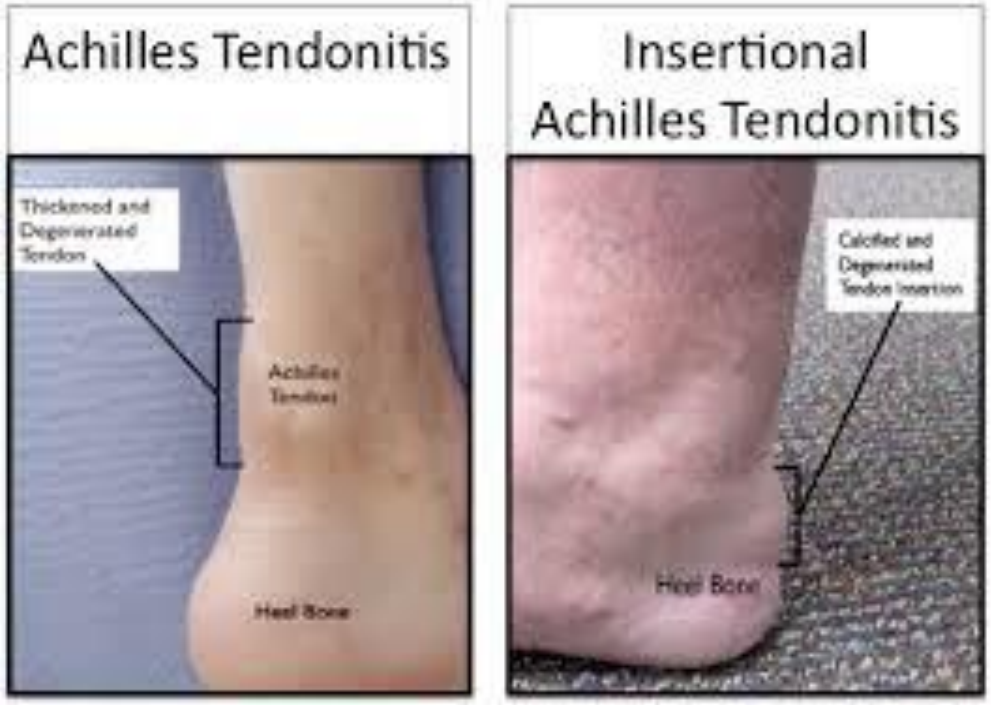
Dysfunctions of the Ankle & Foot

- Achilles Tendinopathy
- Compartment Syndrome
- Shin Splints (inflammation)
- Plantar Fasciitis
- Hallux Valgus (Bunions)
- Bone

What is difference b/w compartment syndrome and shin splints?

Achilles Tendinopathy

- The achilles tendon is the thickest & strongest tendon in the body. It is a combined tendon of the gastrocnemius, soleus and plantaris muscles.
- Tendinopathy is an injury to the tendon causing pain and swelling, which makes it difficult to move. Tendinopathy can be either a:
  - Tendonitis—inflammation of the tendon or a
  - Tendinosis—tiny tears in the tendon with no significant inflammation


Achilles Tendonitis
Thickened and Degenerated Tendon
Achilles Tendon
Heel Bone
Insertional Achilles Tendonitis
Calcified and Degenerated Tendon Insertion
Heel Bone


Achilles tendon
Tear
Tendonitis
Heel bone

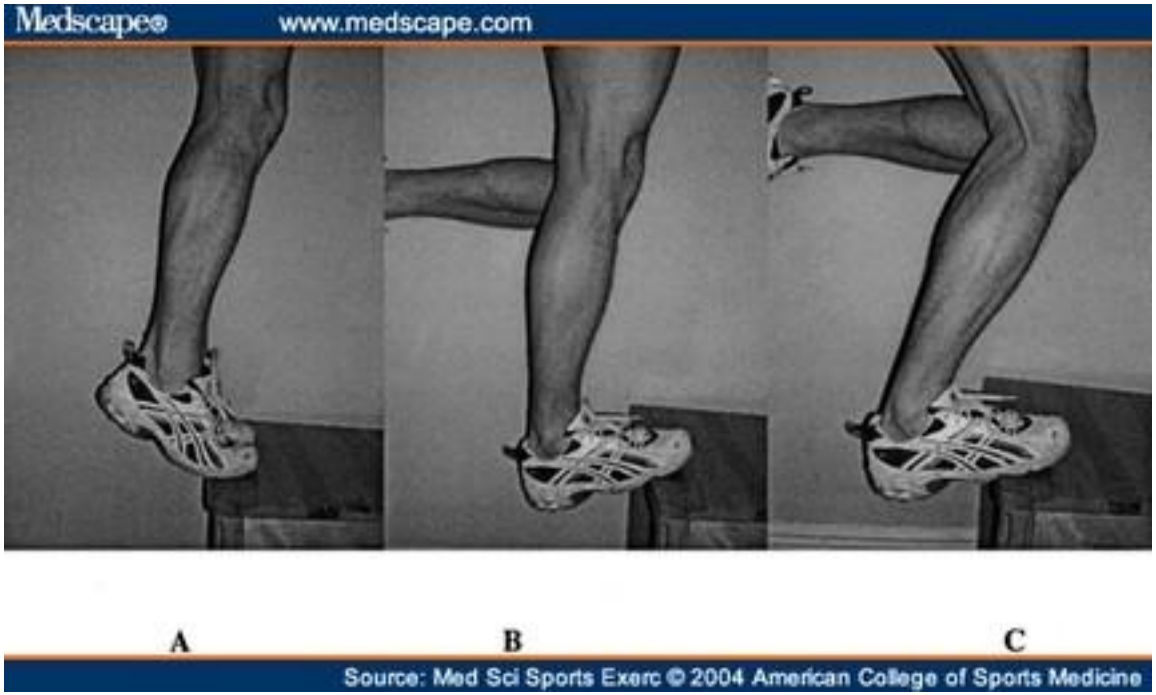
Achilles Tendinopathy

- Causes: - improper training; too much too soon
  - –A single event involving a violent muscle action, such as a sprint
  - –improper footwear
  - –Excessive pronation
  - –Calf weakness or tightness causing restriction in dorsiflexion
  - –If not treated can result in full rupture of the tendon

Achilles Tendinopathy

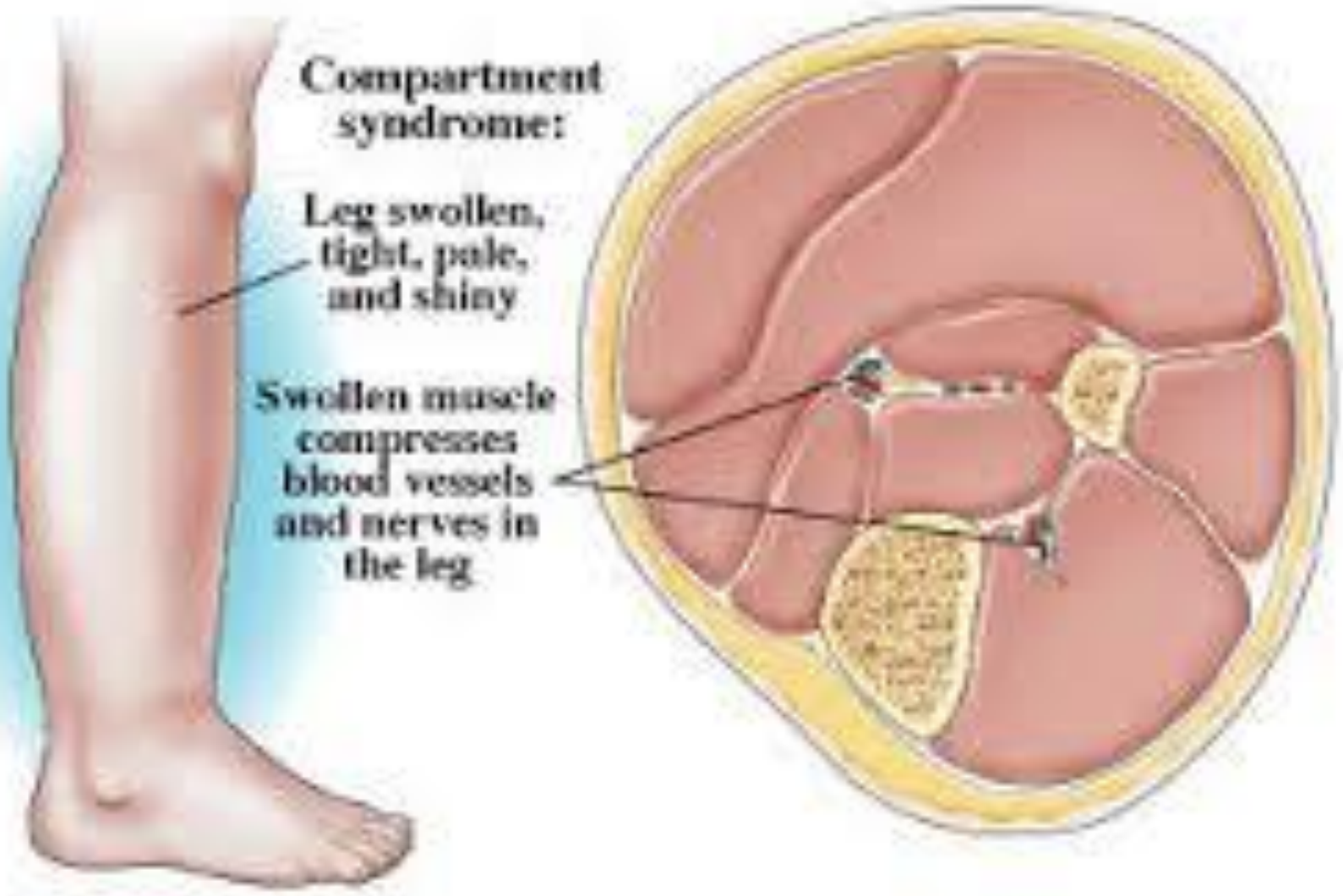
- Exercises
  - Work on eccentric strengthening
  - Emphasize heel drops with extended and bent knees
  - Ankle exercises using a flex band
  - Client may feel pain with exercises at first, avoid increasing load until previous exercise can be done pain-free
  - Ensure all joints are moving throughout all exercises

Heel Drops


Medscape®
www.medscape.com
A
B
C
Source: Med Sci Sports Exerc © 2004 American College of Sports Medicine

Compartment Syndrome

- Nerve and vascular compression occur as a result of hypertrophy in the muscle, causing an impingement of the nerves and blood vessels
  - May be caused by a decrease in the elasticity of the fascia surrounding the muscle, resulting in an inability of the compartment to expand
  - Can occur in either the **anterior compartment** (tibialis anterior, extensor digitorum longus, extensor hallucis longus, peroneus tertius) or the **posterior compartment** (flexor digitorum longus, flexor hallucis longus, tibialis posterior)


Compartment syndrome:
Leg swollen, tight, pale, and shiny
Swollen muscle compresses blood vessels and nerves in the leg

Compartment Syndrome

- Causes: - Typically an overuse injury resulting in inflammation and sometimes pain
  - Recurrent exertional compartment syndrome due to overuse behaviors such as running or speed walking cause aching and painful shins. These systems often create a bursting feeling that increases with exertion and decreases with rest.
  - Complication resulting from fracture or soft tissue injury

Compartment Syndrome

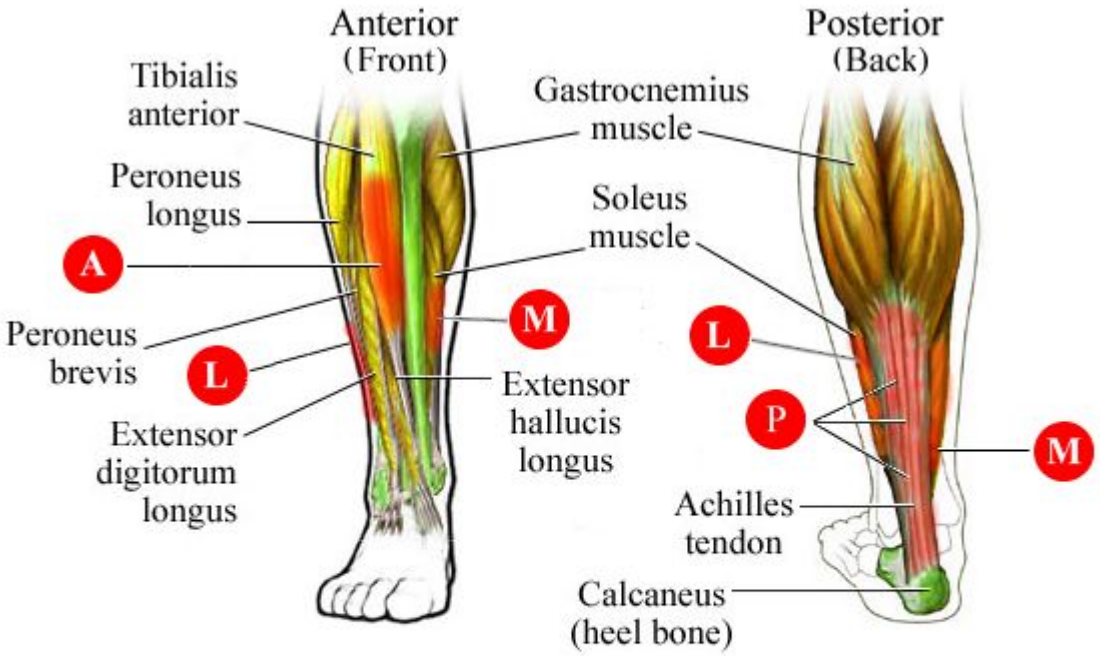
- Exercises
  - Begin all exercise in non-weightbearing
  - Retrain all lumbopelvic and lower exetremity biomechanics and movement patterns
    - aka…?
  - May require surgery or extended rest

Tibial Torsion

Shin Splints

- Typically associated with overuse or malalignment
- May cause pain during the night or upon getting up
- Common in athletes who jump with improper mechanics or who jump on unforgiving surfaces like cement regularly

Shin Splints



Typical Areas for "Shin Splints"

A Anterior M Medial L Lateral P Posterior

Shin Splints

- Causes: - Excessive training
  - Improper mechanics
  - Reduced bone density due to low estrogen levels in women
  - Standing/jumping on cement or similar surfaces for extended periods

Shin Splints

- Exercises:
  - non-weightbearing
    - Low load
    - Work on correcting biomechanics
    - Footwork with a flex band
    - Ankle exercises with a band

Plantar Fasciitis

- Inflammation of the Plantar Fascia on the underside of the foot
- Irritation usually occurs at area of attachment to medial calcaneous
- Prevalent in people with high arches

Plantar Fasciitis

- Causes:
  - HT Achilles tendon
  - Leg length discrepency
  - Poor biomechanics; excessive pronation or supination and maximal ankle plantar flexion and simultaneous dorsiflexion of metatarsophalangeal joints
  - Footwear

Plantar Fasciitis

- Exercises:
  - avoid full range of plantar flexion
    - –Emphasize heel drop and eccentric lengthening of gastrocnemius and soleus
    - –Circumduction of ankle with a flex band
    - –Walking on a pool noodle
      - »Arches, balls, heels
      - »Roll out entire foot on noodle
      - »Stretch calf on noodle

Plantar Fasciitis Rehabilitation Exercises

Prone hip extension

Towel stretch

Standing calf stretch

Sitting plantar fascia stretch

Achilles stretch

Frozen can roll

Plantar Fasciitis Rehabilitation Exercises

Towel pickup

Balance and reach exercise A

Balance and reach exercise B

Heel raise

Side-lying leg lift

Bunions

- Excessive bony protrusion develops around the base of the 1st metatarsal
- Bursitis may develop over the area
- In severe cases ROM is limited in 1st metatarsal
- Painful with pressure
- May have pain with loading of metatarsals due to inability to withstand load

Bunions

Bunionette - 5th Metatarsal

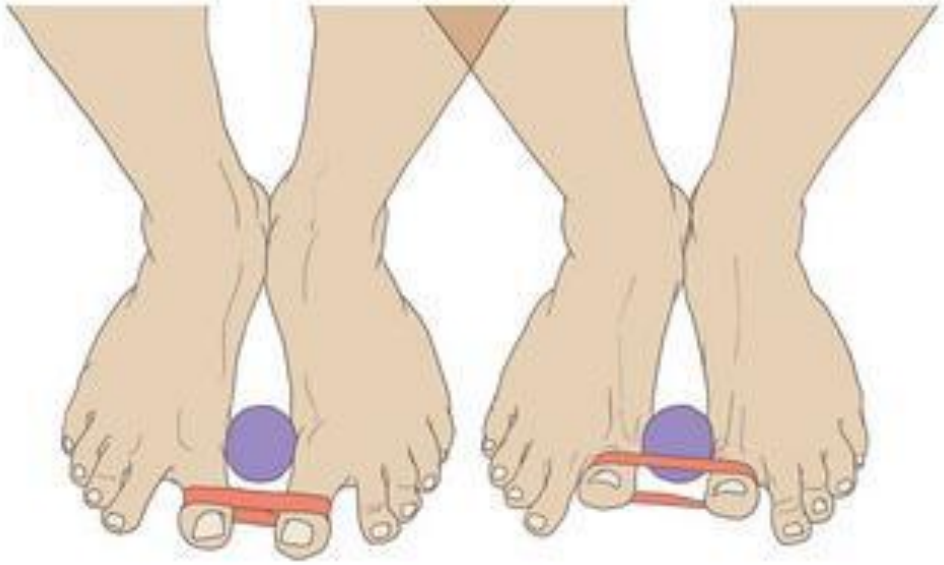
Bunions

- Causes:
  - compression of the forefoot medially and laterally can lead to bunions
  - Common with excessive pronation during propulsion stage of gait
  - Improper or ill-fitting shoes (narrow-toed high heels, pointe shoes in ballet)
  - Genetics

Bunions

- Exercises:
  - avoid weightbearing until able
  - Low load
  - Correct biomechanics
  - Toe extension
  - Towel pick-up
  - Calf raises
  - Ankle eversion with band
  - Ankle inversion with band
  - Toe spacers - start non-weight bearing

Bunions



Bone Spurs

- **Bone spurs** are bony projections that develop along the edges of **bones**. Also called osteophytes, **bone spurs** often form where **bones** meet each other — in your joints. The main cause of **bone spurs** is the wear-and-tear damage associated with osteoarthritis.
- www.mayoclinic.org/diseases.../**bone-spurs**/basics/**definition**/con-20024478

Bone Spurs

Bone Spurs

- Causes: -osteoarthritis
  - –Extra bone build up due to excess pull of tense muscles/fascia
    - »Can result from overuse due to poor mechanics

Bone Spurs

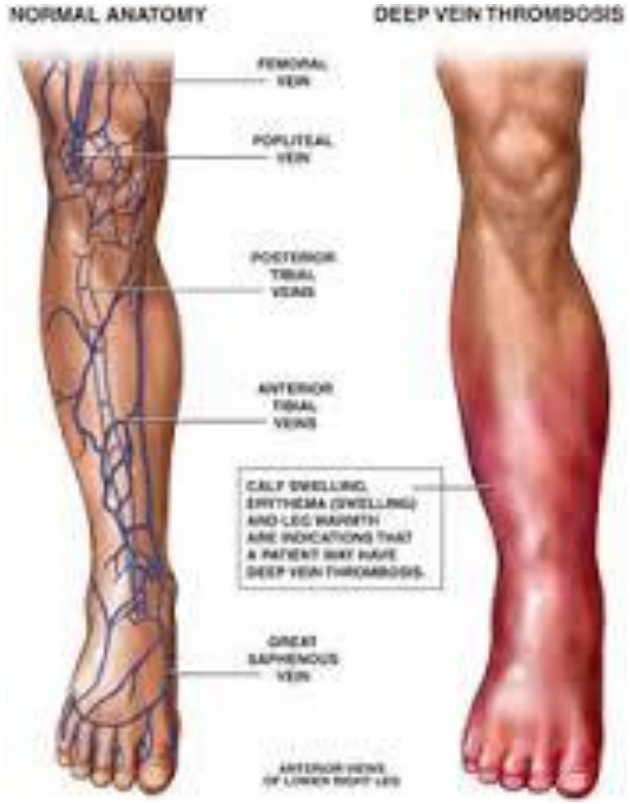
- Exercises:
  - Calf Raises
  - Calf stretches
  - Support back of ankle with heel pointing down and try to pull heel to the floor, release and repeat.
  - Piano Toes
    - Separate toes and try to tap or wiggle each one individually

Heel Spurs

Deep Venous Thrombosis

- Serious, possibly life-threatening condition
- Can be mistaken for calf pain/injury/overuse
- Can result from sitting too long with pressure on leg, ie. On an airplane
- Presents as calf pain, tenderness, increased temperature and/or swelling of the calf and pain with passive ankle dorsiflexion

Deep Venous Thrombosis



Deep Venous Thrombosis

- If you suspect a deep venous thrombosis, send your client for a physician consult immediately
- Avoid massage or exercise until diagnosed

Ankle Sprains

- Lateral ankle sprains most common
- Involve the posterior tibiofibular ligament, posterior talofibular ligament or calcaneofibular ligament

Ankle sprains

- Non weight bearing is typical in the acute stage
- In a subacute stage ROM is encouraged
- Muscle strength especially foot everters need to be stregthened
- Balance needs to be regained
- If they want to return to a specific sport dynamic (jumping) activities may be needed

Fractures

- Any fracture in the ankle / foot that requires casting or immobilization will require a rehabilitation program once the fracture has healed

Fractures

Goals - Once casts have been removed

- Re-establish ROM in non-weight bearing then weight bearing
- Stretch shortened structures
- Restore strength
- Improve balance
- Improve cardiovascular endurance

Flexibility exercises for ankle region

Page 888

Increase ankle dorsiflexion

Increase ankle inversion

Increase ankle planterflexion and eversion

Increase ankle dorsiflexion and eversion

Flexibility exercises for limited mobility in toes

Page 892

Adduction with inversion and abduction with eversion using weights

Dorsiflexion

All ankle motions

closed-chain exercises

Page 892

Stabilization exercises

Dynamic strength training

Resisted walking

Functional progression for the ankle and foot

Implement a progression of exercises that prepares the patient recovering from structural or functional impairments to return safely to work and activities.

A patient must develop sufficient strength, endurance, and flexibility, as well as power, balance, coordination, agility aerobic fitness, and task-specific skills.

See pages 907-935 for examples

Hand in

Independent learning activities page 894

Due next class