

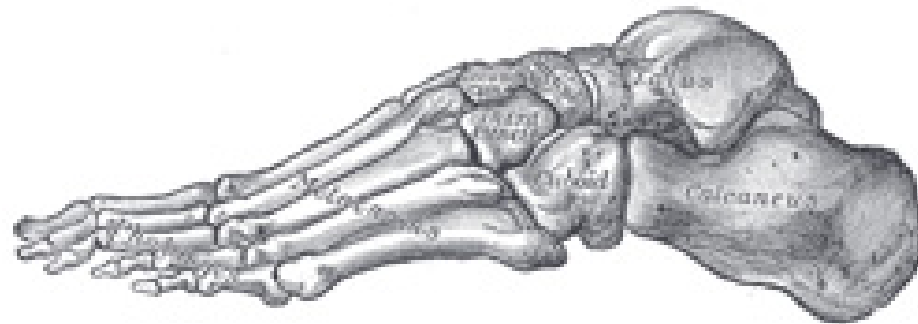
Foot and Ankle Seminar

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Foot Anatomy Review

- Bony Anatomy

- Talus
- Calcaneus
- Tarsals
 - 5 bones
- Metatarsals
 - 5 bones
- Phalanges
 - 14 bones



Foot Anatomy

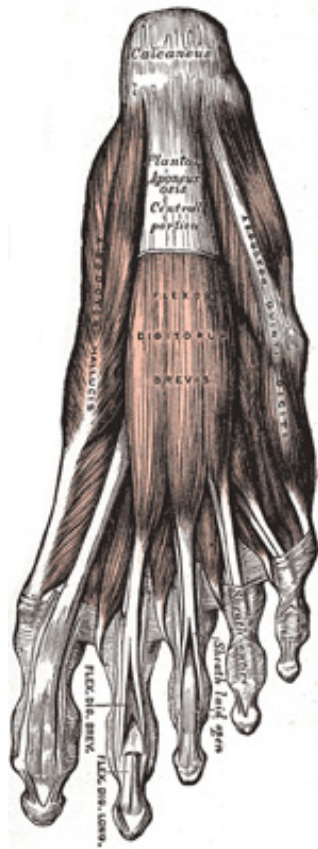


Figure One

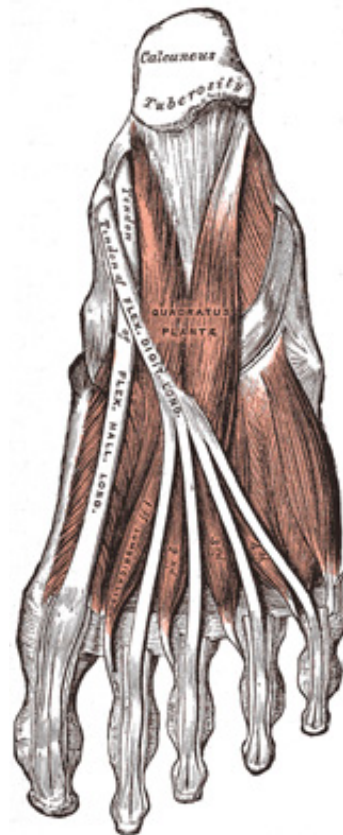


Figure Two

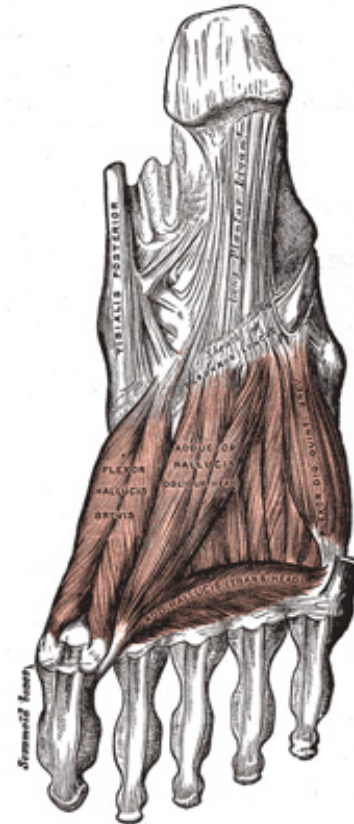
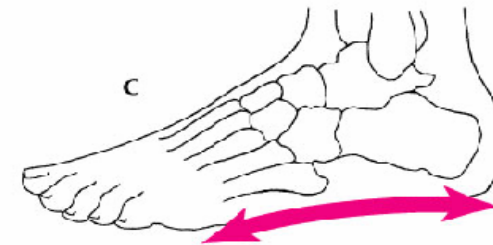
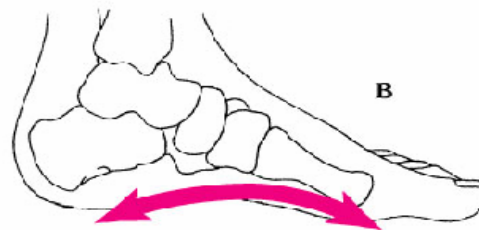
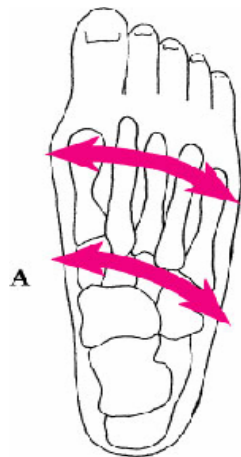


Figure Three

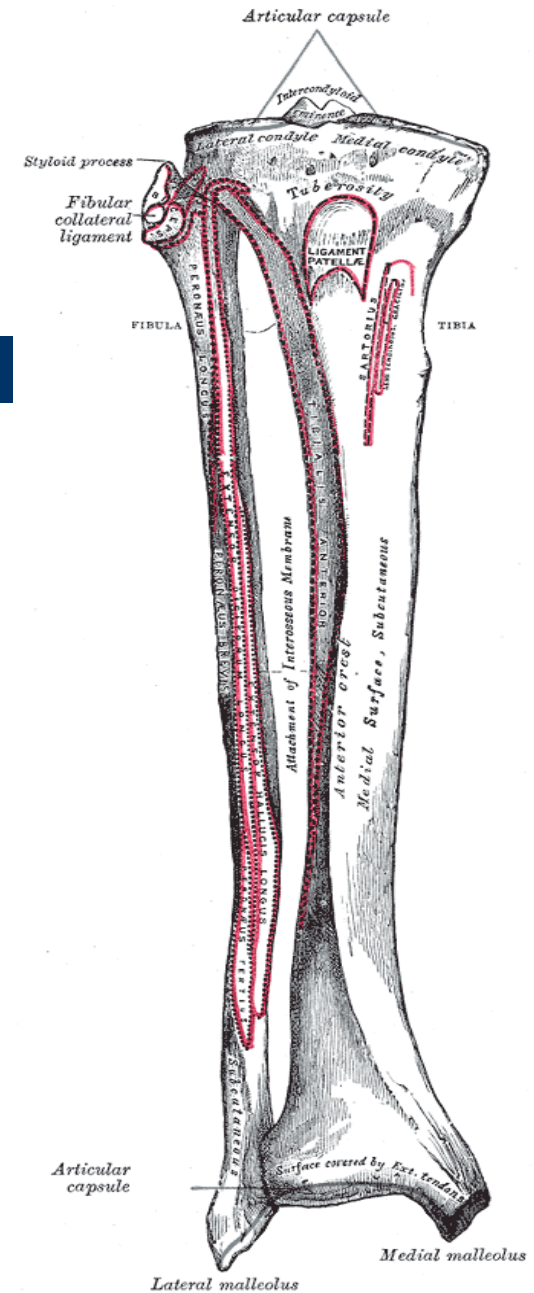
Foot Biomechanics

- Transverse Arch (A)
- Medial Longitudinal Arch (B)
- Lateral Longitudinal Arch (C)



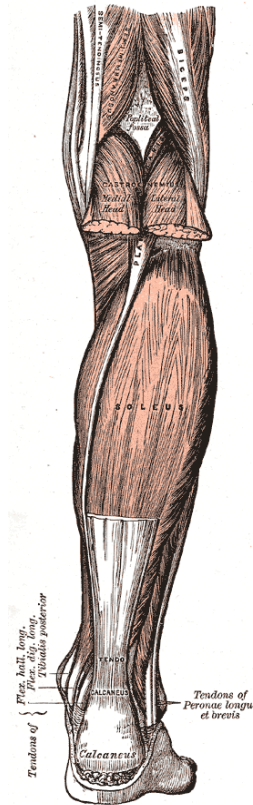
Lower Leg Anatomy

- Bony
 - Tibia
 - Fibula



Lower Leg Anatomy

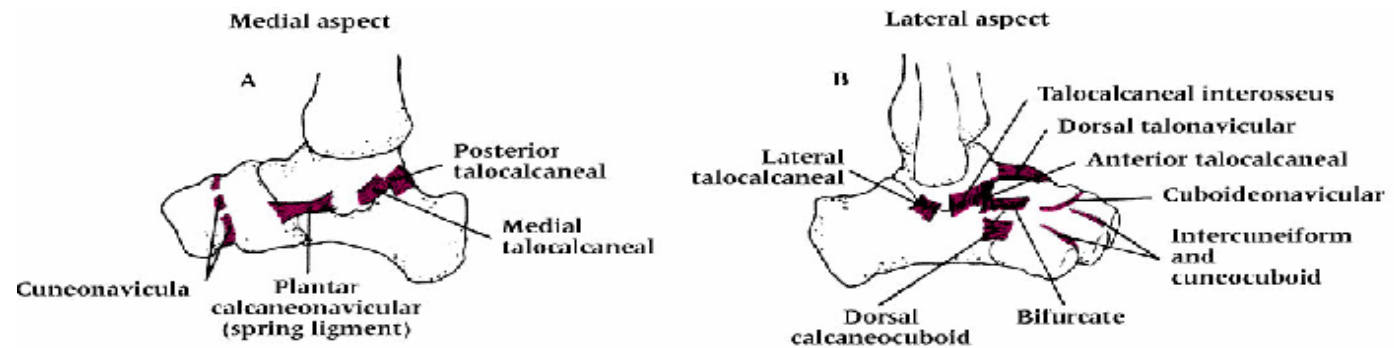
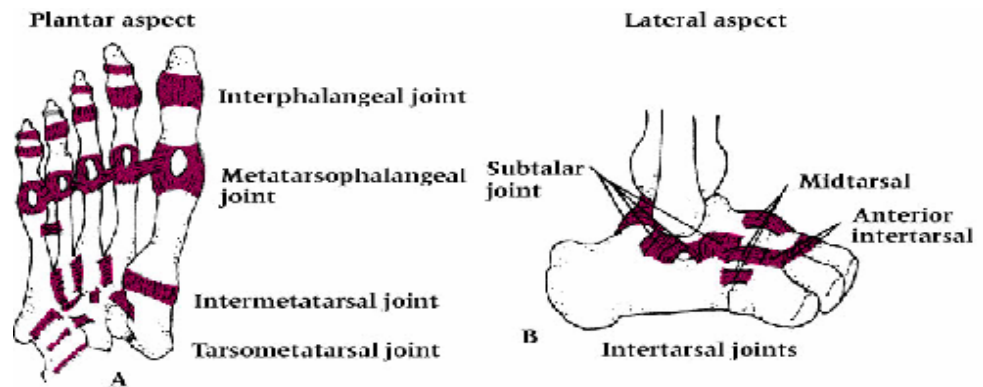
- Musculature
 - Anterior
 - Tibialis Anterior
 - Medial
 - Tom, Dick and Harry
 - Tibialis Posterior
 - Extensor Digitorum Longus
 - Extensor Hallicus Longus
 - Lateral
 - Peroneals
 - Posterior
 - Gastrocnemius
 - Soleus



Lower Leg Anatomy

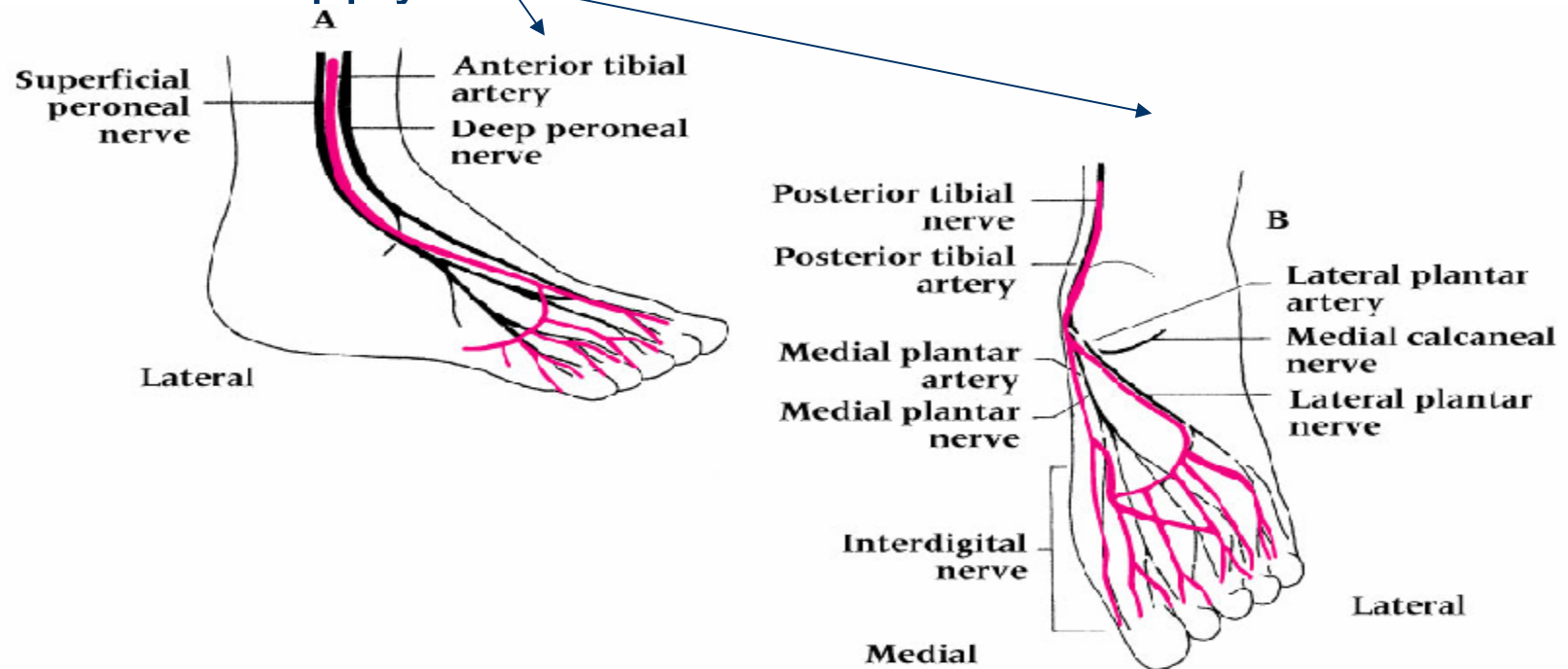
- Other Structures

- Joints
- Ligament
- Cartilage



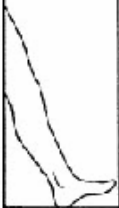


Foot / Ankle Anatomy

- Nerve Supply
- Blood Supply



Foot Biomechanics – Normal Gait

- Two phases:
 - Stance or support phase which starts at initial heel strike and ends at toe-off
 - Swing or recovery which represents time from toe-off to heel strike
- Foot serves as shock absorber at heel strike and adapts to uneven surface during stance
- At push-off foot serves as rigid lever to provide propulsive force
- Initial heel strike while running involves contact on lateral aspect of foot with subtalar joint in supination

| | Stance Phase | | Swing Phase |
|--|--|--|--|
| | 25% | 40% | 35% |
| | Contact | Midstance | Propulsion |
| |  |  |  |
| | Heel contact | Midstance | Heel off |
| | External rotation of leg | Internal rotation of leg | |
| | Supination | Pronation | |
| | | | Toe off |
| | | | External rotation of leg |
| | | | Supination |

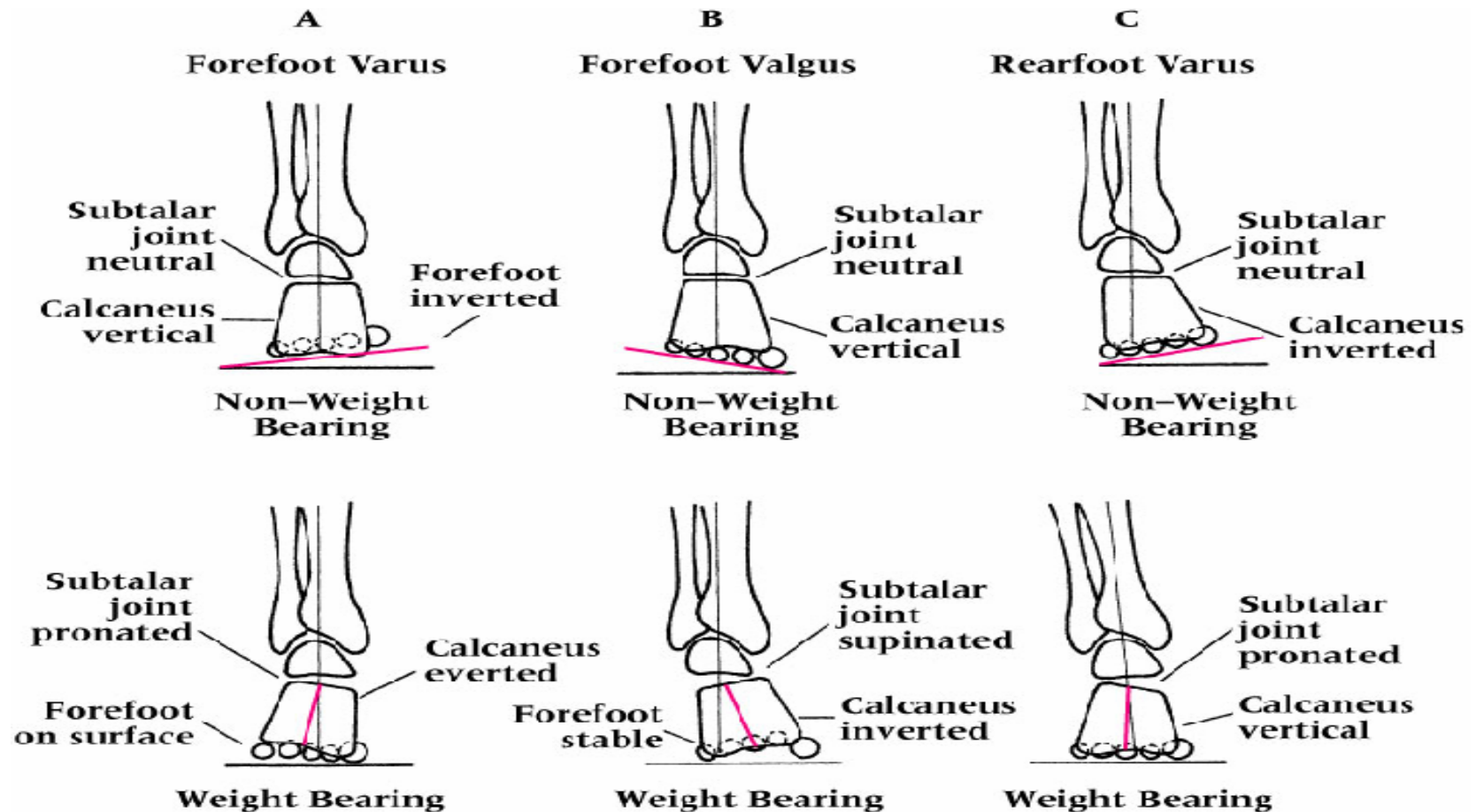
Foot Biomechanics – Normal Gait

- 80% of distance runners follow heel strike pattern
- Sprinters tend to be forefoot strikers
- With initial contact there is obligatory external rotation of the tibia with subtalar supination
- As loading occurs, foot and subtalar joint pronates and tibia internally rotates (transverse plane rotation at the knee)
- Pronation allows for unlocking of midfoot and shock absorption
- Also provides for even distribution of forces throughout the foot
- Subtalar joint will remain in pronation for 55-85% of stance phase
 - occurring maximally as center of gravity passes over base of support
- As foot moves to toe-off, foot supinates, causing midtarsal lock and lever formation in order to produce greater force

Foot Biomechanics – Pronation & Supination

- Excessive or prolonged pronation or supination can contribute to overuse injuries
- Subtalar joint allows foot to make stable contact with ground and get into weight bearing position
- Excessive motion, compensates for structural deformity
- Structural Deformities
 - Forefoot and rearfoot varus are usually associated with over-pronation
 - Forefoot valgus causes excess supination
 - May interfere with shock absorption

Foot Biomechanics – Pronation & Supination



Foot Biomechanics – Excessive Pronation

- Excessive Pronation
 - Major cause of stress injuries due to overload of structures during extensive stance phase or into propulsive phase
 - Results in loose foot, allowing for more midfoot motion, compromising first ray and attachment of peroneus longus
 - Negative effect on pulley mechanism of cuboid relative to peroneal, decreasing stability of first ray
 - Causes more pressure on metatarsals and increases tibial rotation at knee
 - Will not allow foot to resupinate to provide rigid lever = less powerful and less efficient force produced
 - May also result in 2nd metatarsal stress fracture, plantar fasciitis posterior tibialis tendinitis, Achilles tendinitis, tibial stress syndrome and medial knee pain

Foot Biomechanics – Excessive Supination

- Excessive Supination

- Causes foot to remain rigid decreasing mobility of the calcaneocuboid joint and cuboid
- Results in increased tension of peroneus longus and decreased mobility in first ray causing weight absorption on 1st and 5th metatarsals and inefficient ground reaction force absorption
- Limits internal rotation and can lead to inversion sprains, tibial stress syndrome, peroneal tendinitis, IT-Band friction syndrome and trochanteric bursitis

Foot Evaluation (History)

- Generic history questions
 - Past history
 - Mechanism of injury
 - When does it hurt?
 - Type of, quality of, duration of pain?
 - Sounds or feelings?
 - How long were you disabled?
 - Swelling?
 - Previous treatments?
- Questions specific to the foot
 - Location of pain - heel, foot, toes, arches?
 - Training surfaces or changes in footwear?
 - Changes in training, volume or type?
 - Does footwear increase discomfort?

Student-athlete Injury Report

University of Colorado at Colorado Springs
Athletic Training

Name: _____
Sport: _____
Level of Sport: FR JV V
Year: _____
Injury Date: _____
Evaluation Date: _____

HISTORY:
Location: _____
Mechanism: _____
Pain Level: W/ ACTIVITY _____ /10
W/O ACTIVITY _____ /10
Previous Injury: _____
Unusual Sounds: _____
Miscellaneous Info: _____

OBSERVATIONS:
Obvious Deformity: _____
Swelling: 1^o 2^o 3^o Location: _____
Discoloration: _____
Gait Abnormality: No ABN Slight ABN Severe ABN W/ _____
Miscellaneous Info: _____

PALPATIONS:
Bony: _____ Soft Tissue: _____
ROM: _____ WNL STRENGTH: _____ / 5
_____ WNL _____ / 5
_____ WNL _____ / 5

Special Testing: _____
FRACTURE TESTS: BUMP + - TAP + - SQUEEZE + -
Did Not Perform Referred for x-rays

SEVERITY OR ASSESSMENT:
Side: Right / Left / Bilateral
Place of Injury: Practice / Event
Severity: Minor / Moderate / Severe
Sprains: 1^o + 2^o + 3^o
Strains / Concussions: Gr I + Gr II + Gr III
Contusions / "blisters": Mild Moderate Severe

ASSESSMENT:
INITIAL STATUS: FULL GO TO TOLERANCE LIMITED ALT. ACTIVITY NO ACTIVITY

Certified Athletic Trainer

Foot Evaluation (Observation)

- Observations
 - Does athlete favor a foot, limp, or is unable to bear weight?
 - Does foot color change w/ weight bearing?
 - Is there pes planus/cavus?
 - How is foot alignment?
 - Structural deformities?
- To assess structural deformities, subtalar neutral must be established
- Subtalar neutral
 - Palpate the talus, inverting and everting foot so talus produces even pressure under index finger and thumb
 - Once subtalar joint is neutral, mild dorsiflexion is applied to observe metatarsal head position relative to plantar surface of calcaneus
 - Degrees of forefoot and rearfoot valgus and varus can then be assessed
 - An equinus foot serves as a poor shock absorber
 - Forefoot is pronated relative to rearfoot when ankle is at 90 degrees of flexion
 - Similar to a plantar flexed first ray relative to the rearfoot
- Shoe Wear Patterns
 - Over pronators tend to wear out shoe under 2nd metatarsal
 - Athletes often mistakenly perceive wear on the outside edge of the heel as being the result of over-pronation
 - Generally the result of the tibialis anterior causing foot inversion (while dorsiflexing) prior to heel strike to prevent foot from slapping ground
 - Wear on the lateral border of the shoe is a sign of excessive supination
 - Heel counter and forefoot should also be examined

Foot Evaluation (Palpation)

- Bony Palpation
 - Medial calcaneus
 - Calcaneal dome
 - Medial malleolus
 - Sustentaculum tali
 - Talar head
 - Navicular tubercle
 - First cuneiform
 - First metatarsal and metatarsophalangeal joint
 - First phalanx
 - Lateral calcaneus
 - Lateral malleolus
 - Sinus tarsi
 - Peroneal tubercle
 - Cuboid bone
 - Styloid process
 - Fifth metatarsal
 - Fifth metatarsalphalangeal joint
 - Fifth phalanx
 - Second, third and fourth metatarsals, metatarsophalangeal joints, phalanges
 - Third and fourth cuneiform
 - Metatarsal heads
 - Medial calcaneal tubercle
 - Sesamoid bones
 - Tibialis posterior

Foot Evaluation (Palpation)

- Soft Tissue
 - Flexor hallucis longus
 - Flexor digitorum longus
 - Deltoid ligament
 - Calcaneonavicular ligament
 - Medial longitudinal arch
 - Plantar fascia
 - Transverse arch
 - Anterior talofibular ligament
 - Calcaneofibular ligament
 - Posterior talofibular ligament
 - Peroneus longus tendon
 - Peroneus brevis tendon
 - Peroneus tertius
 - Extensor hallucis longus
 - Extensor digitorum longus tendon
 - Extensor digitorum brevis tendon
 - Tibialis anterior tendon

Foot Evaluation (Special Testing)

- Manual Muscle Testing
 - Five Point grading system
 - 5 = Complete ROM against gravity, with full resistance
 - 4 = Complete ROM against gravity, with some resistance
 - 3 = Complete ROM against gravity, with no resistance
 - 2 = Complete ROM, with gravity omitted
 - 1 = Some muscle contractility with no joint motion
 - 0 = No muscle contractility
 - Toe Flexion
 - Toe Extension

Foot Evaluation (Special Testing)

- End Feel Categories

- Normal End Feels

- Soft-tissue approximation – Soft, spongy and gradual painless stop (elbow flexion)
 - Capsular – An abrupt hard, firm end-point with only little give (shoulder rotation)
 - Bone-to-bone – A distinct and abrupt end point where two hard surfaces come in contact with one another (elbow extension)

- Abnormal End Feels

- Empty – Movement defined beyond the anatomical limit, or pain prevents the body part from moving through the available ROM (ligament rupture)
 - Spasm – Involuntary muscle contraction that prevents normal ROM due to pain (guarding)
 - Loose – Extreme hypermobility (chronic ankle sprains)
 - Springy Block – A rebound at the end point of motion (meniscal tear)

Foot Evaluation (Special Testing)

- Tinel's Sign
 - Tapping over posterior tibial nerve producing tingling distal to area
 - Numbness & paresthesia may indicate presence of tarsal tunnel syndrome
- Morton's Test
 - Transverse pressure applied to heads of metatarsals causing pain in forefoot
 - Positive sign may indicate neuroma or metatarsalgia
- Neurological Assessment
 - Reflexes and cutaneous distribution of nerves must be tested
 - Skin sensation and alteration should be noted
 - Tendon reflexes (such as Achilles) should elicit a response when gently tapped
 - Sensation can be tested by running hands over all surfaces of foot and ankle

Foot Evaluation (Special Testing)



Foot Common Injuries

- Tarsal Region
 - Fractures (Calcaneus, Talus, Etc.)
 - Stress Fractures
 - Sever's Disease
 - Bursitis / Contusions
 - Subluxations
 - Tarsal Tunnel Syndrome
 - LisFranc Injury

Foot Common Injuries

- Metatarsal Region
 - Pes Plantus / Cavus
 - Strains
 - Fascitis /Sesmoiditis
 - Fractures (Jones') / Stress Fractures
 - Bunion / Bunionette
 - Metatarsalgia / Neuroma

Ankle Evaluation (History)

- Generic history questions
 - Past history
 - Mechanism of injury
 - When does it hurt?
 - Type of, quality of, duration of pain?
 - Sounds or feelings?
 - How long were you disabled?
 - Swelling?
 - Previous treatments?



Ankle Evaluation (Observation)

- Observations
 - Postural deviations?
 - Genu valgum or varum?
 - Is there difficulty with walking?
 - Deformities, asymmetries or swelling?
 - Color and texture of skin, heat, redness?
 - Patient in obvious pain?
 - Is range of motion normal?

Ankle Evaluation (Palpation)

- Bony Anatomy
 - Fibular head and shaft
 - Lateral malleolus
 - Tibial plateau
 - Tibial shaft
 - Medial malleolus
 - Dome of talus
 - Calcaneus
- Soft Tissue Anatomy
 - Peroneus longus
 - Peroneus brevis
 - Peroneus tertius
 - Flexor digitorum longus
 - Flexor hallucis
 - Posterior tibialis
- Soft Tissue Anatomy (Cont.)
 - Anterior tibialis
 - Extensor hallucis longus
 - Extensor digitorum longus
 - Gastrocnemius
 - Soleus
 - Achilles tendon
- Other Structures
 - Anterior/posterior talofibular ligament
 - Calcaneofibular ligament
 - Deltoid ligament
 - Anterior tibiofibular ligament
 - Posterior tibiofibular ligament

Ankle Evaluation (Special Testing)

- Fracture Tests
 - Tap / Percussion / Bump
- Active / Passive Range of Motion (R.O.M.)
 - Dorsiflexion 0° to 20°
 - Plantar Flexion 0° to 45°
 - Inversion 0° to 35°
 - Eversion 0° to 35°
- Manual Muscle Testing
 - Check all motions of the Foot and Ankle as well as in PNF Diagonals
- Joint Stability Tests
 - Anterior Drawer / Calcaneal Rock / Talar Tilt / Kleiger's test
- Special Pathology Tests
 - Thompson Test / Syndesmoic Sprain

Ankle Evaluation (Special Tests)

Fracture Test

Compression Test



Percussion Test



Ankle Evaluation (Special Tests)

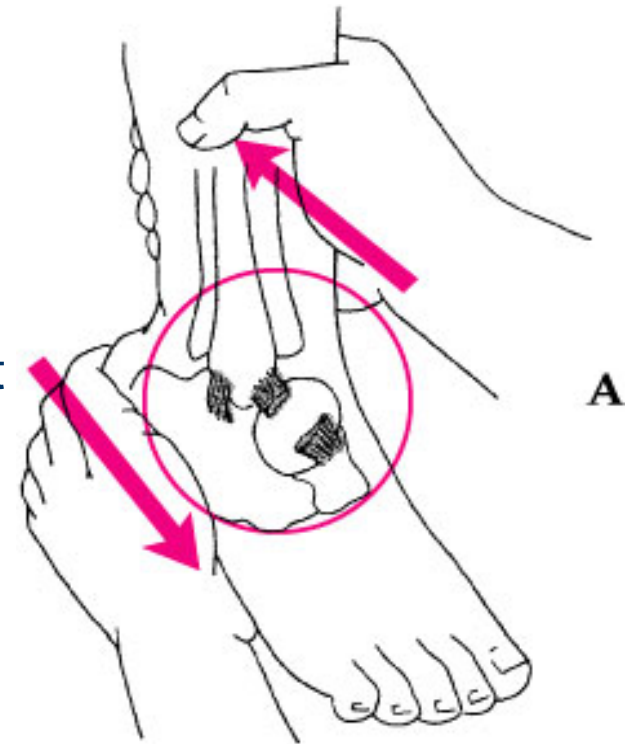
Range of Motion

Ankle Evaluation (Special Tests)

- Manual Muscle Testing
 - Five Point grading system
 - 5 = Complete ROM against gravity, with full resistance
 - 4 = Complete ROM against gravity, with some resistance
 - 3 = Complete ROM against gravity, with no resistance
 - 2 = Complete ROM, with gravity omitted
 - 1 = Some muscle contractility with no joint motion
 - 0 = No muscle contractility
- Dorsiflexion / Plantar Flexion / Inversion / Eversion / PNF Diagonal Patterns

Ankle Evaluation (Special Tests)

- Ankle Stability Tests
 - Anterior drawer test
 - Used to determine damage to anterior talofibular ligament primarily and other lateral ligament secondarily
 - A positive test occurs when foot slides forward and/or makes a clunking sound as it reaches the end point

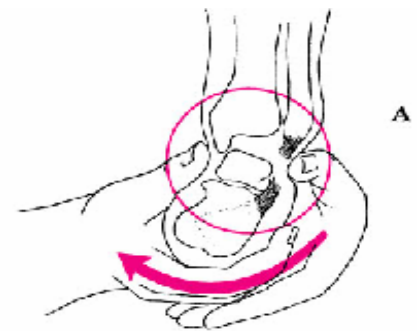


Anterior Drawer Test

B

Ankle Evaluation (Special Tests)

- Talar tilt test (ATF,CF,PTF)
 - Performed to determine extent of inversion or eversion injuries
 - With foot at 90 degrees calcaneus is inverted and excessive motion indicates injury to calcaneofibular ligament and possibly the anterior and posterior talofibular ligaments
 - If the calcaneus is everted, the deltoid ligament is tested



Talar Tilt Test

Ankle Evaluation (Special Tests)

- Kleiger's test
 - Used primarily to determine extent of damage to the deltoid ligament and may be used to evaluate distal ankle syndesmosis, anterior/posterior tibiofibular ligaments and the interosseus membrane
 - With lower leg stabilized, foot is rotated laterally to stress the deltoid

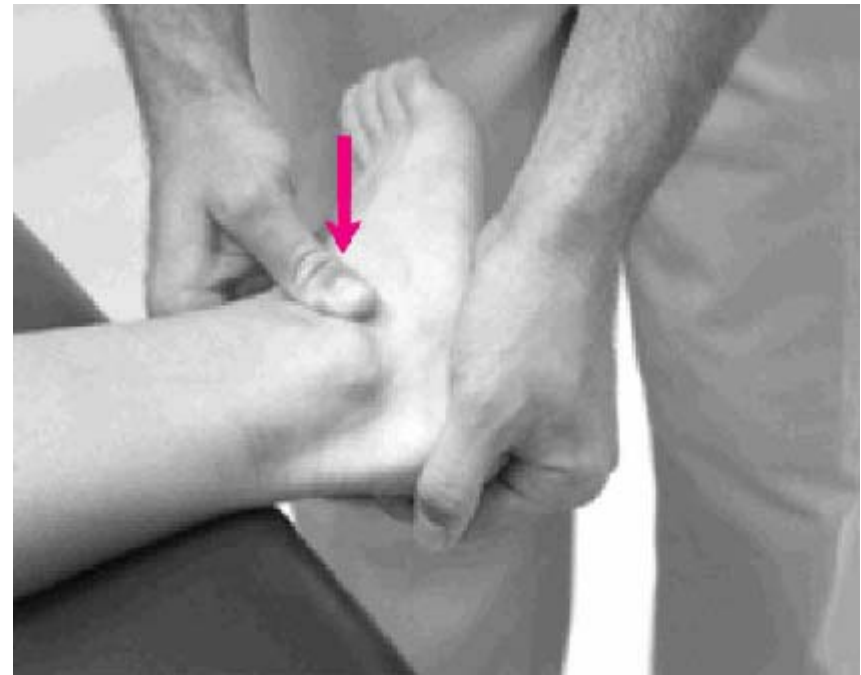
Kleiger's Test



Ankle Evaluation (Special Tests)

- Calcaneal Rock
 - Performed to determine presence of excessive medial translation of the calcaneus on the talus
 - Talus is stabilized in subtalar neutral, while other hand glides the calcaneus, medially
 - A positive test presents with excessive movement, indicating injury to the lateral ligaments

Calcaneal Rock Test



Ankle Evaluation (Special Tests)

- Other Special Tests
 - Thompson's Test
 - Squeeze calf muscle, while foot is extended off table to test the integrity of the Achilles tendon
 - Positive tests results in no movement in the foot



Ankle Evaluation (Special Tests)

- Homan's test
 - Test for deep vein thrombophlebitis
 - With knee extended and foot off table, ankle is moved into dorsiflexion
 - Pain in calf is a positive sign and should be referred



Ankle Evaluation (Special Tests)

- Syndesmotic Sprain
 - Commonly referred to as a “high ankle sprain”
 - This sprain effects the interosseous membrane between the fibula and tibia.
 - Mechanism is the spreading of the two lower leg bones

Foot Rehabilitation

- Bag of Tricks
 - Postural Stability
 - Core Stability training
 - Neuromuscular Control
 - Proprioceptive Neuromuscular Facilitation
 - Rang of Motion
 - Joint Mobilization, Soft-Tissue Mobilization
 - Muscular Strength, Endurance, and Power
 - Plyometrics, Open KC, Closed KC, Isokinetics, Aquatics
 - Cardiovascular Endurance

Foot Rehabilitation

- Three simple keys
 - Range of Motion
 - Needed to increase motion and return to function as quickly as prudent and possible
 - Strength
 - Needed to deter further problems or protect the area of injury from further injury
 - Functionality
 - Needed to return the student-athlete or patient to normal daily activities within reason.

Foot Rehabilitation

- Flexibility
 - Must maintain or re-establish normal flexibility of the foot
 - Full range of motion is critical
 - Stretching of the plantar fascia and Achilles is very important for a number of conditions



Foot Rehabilitation

- Range of Motion
 - Joints
 - Joint Mobilization
 - BAPS Board / Disc
 - Functionality of foot
 - Plantar Fascia
 - Towel pulls
 - Cotton ball movement
 - Gastroc / Soleus
Stretching

Joint Mobilizations

Can help normalize joint motion



Foot Rehabilitation

- Strengthening
 - Towel Pulls
 - Cotton Ball Pick-up
 - Thera-band Exercises
 - Dorsiflexion, Plantar Flexion, Inversion, Eversion
 - Isometric Exercises
 - Dorsiflexion, Plantar Flexion, Inversion, Eversion
 - PNF Diagonals / D1 and D2 Patterns
 - Proprioception
 - Dyna-Disc / Wobble Boards / Couch Cushions / Etc.

Foot Rehabilitation

Towel Exercises



Foot Rehabilitation

- Neuromuscular Control (NC)
 - Critical to re-establish as it is the single most important element dictating movement strategies w/in the kinetic chain
 - Muscular weakness, proprioceptive deficits and ROM deficits challenge the athlete's ability to maintain center of gravity w/in the base of support w/out losing balance
 - Must be able to adapt to changing surfaces
 - Involves highly integrative, dynamic process involving multiple neurological pathways.
 - NC relative to joint position sense, proprioception and kinesthesia is essential

Foot Rehabilitation

- Rehab plans are focusing more on closed kinetic chain activities
- Exercises should incorporate walking, running, jumping in multiple planes and on multiple surfaces



Foot Rehabilitation

- Weight Bearing
 - If unable to walk without a limp, crutch or can walking may be introduced
 - Poor gait mechanics will impact other joints within the kinetic chain
 - Progressing to full weight bearing as soon as tolerable is suggested

Foot Rehabilitation

- General Body Conditioning
 - Because a period of non-weight bearing is common, substitute means of conditioning must be introduced
 - Pool running & upper body ergometer
 - General strengthening and flexibility as allowed by injury



Ankle Rehabilitation

- General Body Conditioning
 - Must be maintained with non-weight bearing activities
- Weight Bearing
 - Non-weight bearing vs. partial weight bearing
 - Protection and faster healing
 - Partial weight bearing helps to limit muscle atrophy, proprioceptive loss, circulatory stasis and tendinitis
 - Protected motion facilitates collagen alignment and stronger healing

Ankle Rehabilitation

- Joint Mobilizations
 - Movement of an injured joint can be improved with manual mobilization techniques
- Flexibility
 - During early stages inversion and eversion should be limited
 - Plantar flexion and dorsiflexion should be encouraged
 - With decreased discomfort inversion and eversion exercises should be initiated
 - BAPS board progression

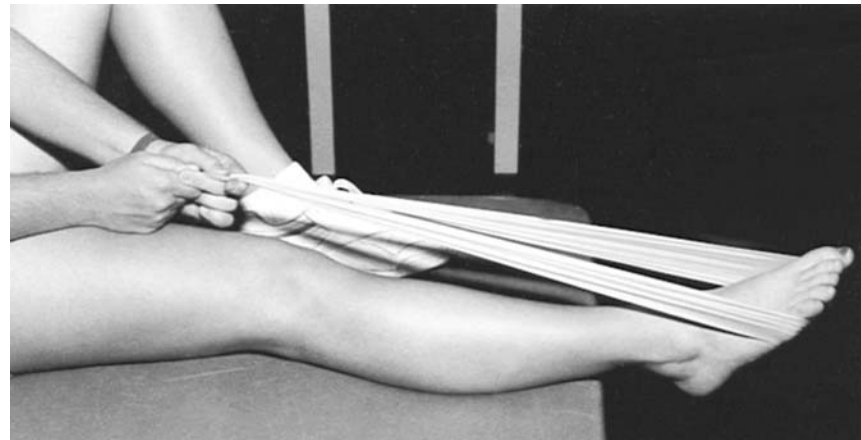
Ankle Rehabilitation

- **Strengthening**
 - Isometrics (4 directions) early during rehab phase
 - With increased healing, aggressive nature of strengthening should increase (isotonic exercises)
 - Pain should serve as the guideline for progression
 - Tubing exercises allows for concentric and eccentric exercises
 - PNF allows for isolation of specific motions
- **Proprioception Neuromuscular Control**
 - Deficits can predispose individuals to injury
 - Athletes should engage in proprioception progression including double and single leg stances, eye open and closed, single leg kicks and alternating apparatuses and surfaces

Ankle Rehabilitation



Ankle Rehabilitation



Ankle Rehabilitation

- Taping and Bracing
 - Ideal to have athlete return w/out taping and bracing
 - Common practice to use tape and brace initially to enhance stabilization
 - Must be sure it does not interfere with overall motor performance
- Functional Progressions
 - Severe injuries require more detailed plan
 - Typical progression initiated w/ partial weight bearing until full weight bearing occurs w/out a limp
 - Running can begin when ambulation is pain free (transition from pool - even surface - changes of speed and direction)

Ankle Rehabilitation



Ankle Rehabilitation

- Return to Activity
 - Must have complete range of motion and at least 80-90% of pre-injury strength before return to sport
 - If full practice is tolerated w/out insult, athlete can return to competition
 - Must involve gradual progression of functional activities, slowly increasing stress on injured structure
 - Specific sports dictate specific drills