Chapter 18: The Foot
Figure 18-1
Arches of the Foot

Figure 18-2
Achilles Tendon & Plantar Fascia

Figure 18-3
Joints and Ligaments of the Foot

Figure 18-5
Muscle of the Foot and Lower Leg

Figure 18-6
Figure 18-7

A

Flexor digiti minimi brevis
Abductor digiti minimi
Abductor hallucis
Flexor digitorum brevis
Plantar fascia (cut)
Calcaneus

B

Lumbricals
Flexor hallucis longus tendon
Flexor digitorum longus tendon
Abductor hallucis (cut)
Quadratus plantae
Flexor digitorum brevis (cut)

C

Adductor hallucis
Flexor digitorum brevis
Flexor hallucis longus tendon (cut)
Abductor hallucis (cut)
Flexor digitorum longus tendon (cut)
Quadratus plantae (cut)

D

Plantar view

Dorsal view

Interosseous
Nerve Supply and Blood Supply

Figure 18-8 and 18-9
Functional Anatomy of the Foot and Biomechanics

• Athletic trainers must realize that when considering foot, ankle, and leg injuries, that these segments are joined together to form a kinetic chain
• Each movement of a segment, has an effect on proximal and distal segments
• Lower-extremity chronic and overuse injuries have a number of biomechanical factors involved particularly when considering walking and running
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
• **Stance Phase**
  – Accounts for 60% of gait cycle
  – Involves weight bearing in closed kinetic chain
  – Five periods
    • Initial contact (double limb support)
    • Loading response (double limb support)
    • Mid stance (single limb support)
    • Terminal stance (single limb support)
    • Pre swing

• **Swing Phase**
  – Period of non-weight bearing
  – Three periods
    • Initial swing
    • Mid swing
    • Terminal swing

Figure 18-11
• Running and walking gait have same components

• During running gait
  – Loading and mid-stance = more rapid
  – After toe off – period of no ground contact
  – Stance phase = 33% of gait cycle
• 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
• 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
Subtalar Joint Pronation and 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
Figure 18-12

A
Forefoot Varus
Subtalar joint neutral
Calcaneus vertical
Non-Weight Bearing

B
Forefoot Valgus
Subtalar joint neutral
Calcaneus vertical
Non-Weight Bearing

C
Rearfoot Varus
Subtalar joint neutral
Calcaneus inverted
Non-Weight Bearing

A
Subtalar joint pronated
Calcaneus everted
Weight Bearing

B
Subtalar joint supinated
Forefoot stable
Calcaneus inverted
Weight Bearing

C
Subtalar joint pronated
Calcaneus vertical
Weight Bearing

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• **Excessive Pronation**
  – Major cause of stress injuries due to overload of structures during extensive stance phase or prolonged pronation 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 media knee pain

• 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
Prevention of Foot Injuries

• Highly vulnerable area to variety of injuries
• Forces foot encounters can result in acute traumatic and overuse injuries
• Injuries best prevented by selecting appropriate footwear, correcting biomechanical structural deficiencies through orthotics, and paying attention to hygiene
• Selecting Appropriate Footwear
  – Numerous options available
  – Footwear should be appropriate for existing structural deformities (as evaluated by AT)
  – For pronators a rigid shoe is recommended while supinators require more flexible footwear with increased cushioning
  – Basic form shoe is constructed on (last) dictates stability of shoe
    • Slip last shoe (moccasin style) is very flexible
    • Board last provides firm inflexible base
    • Combination last provides rearfoot stability and forefoot mobility
– Shape of last should be considered
  • Straight-lasted vs. curve-lasted
– Midsole design also set to control motion along medial aspect of foot
– Heel counters are used to control motion in the rearfoot
– Other aspects of shoes that may impact foot include outsole contour and composition, lacing systems and forefoot wedges

• Using Orthotics
  – Used to correct for biomechanical problems in the foot
  – Can be constructed of plastic, rubber, cork, or leather
  – Can be prefabricated or custom fitted
• Foot Hygiene
  – Keeping toenails trimmed correctly
  – Shaving down excessive calluses
  – Keeping feet clean
  – Wearing clean and correctly fitting socks and shoes
  – Keeping feet as dry as possible to prevent development of athlete’s foot
Foot Assessment

• History
  – Generic history questions
  – 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?
• Observations
  – Does patient 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?
  – Are there structural deformities?
• To assess structural deformities, subtalar neutral must be established

• Draw line bisecting leg from start of Achilles tendon to distal end of calcaneus

• Palpate the talus, inverting and everting foot so talus produces even pressure under index finger and thumb – results in subtalar neutral
– 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
  • Forefoot varus – metatarsal heads are inverted relative to plane of calcaneus
    – Osseous deformity or soft tissue tightness may cause
  • Forefoot valgus – metatarsal heads are everted relative to plane of calcaneus
– An equinus foot serves as a poor shock absorber
  • Forefoot is plantarflexed 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
- Individuals 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
• Palpation: Bony landmarks

- 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 metatarsophalangeal joint
- Fifth phalanx
Palpation: Bony landmarks and soft tissue

- Second, third and fourth metatarsals, metarsophalangeal joints, phalanges
- Third and fourth cuneiform
- Metatarsal heads
- Medial calcaneal tubercle
- Sesamoid bones
- Tibialis posterior
- Flexor hallucis longus
- Flexor digitorum longus
- Deltoid ligament
- Calcaneonavicular ligament
- Medial longitudinal arch
- Plantar fascia
- Transverse arch

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• Palpation: Soft tissue

• 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
• Pulses
  – Must ensure proper circulation to foot
  – Can be assessed at posterior tibial and dorsalis pedis arteries
  – Dorsalis pedis pulse felt between extensor digitorum and hallucis longus tendons
  – Posterior tibial located behind medial malleolus along Achilles tendon
• Special Tests
  – Movement
    • Extrinsic and intrinsic foot muscles should be assessed for pain, AROM, PROM, RROM
  – Tinel’s Sign
    • Tapping over posterior tibial nerve producing tingling distal to area
    • Numbness & paresthesia may indicate presence of tarsal tunnel syndrome

Figure 18-17
• Morton’s Test
  – Transverse pressure applied to heads of metatarsals causing pain in forefoot
  – Positive sign may indicate neuroma or metatarsalgia

Figure 18-16
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
Recognition and Management of Specific Injuries

• Foot problems are associated with improper footwear, poor hygiene, anatomical structural deviations or abnormal stresses
• Sports place exceptional stress on feet
• Athletic trainers must be aware of potential problems and be capable of identifying, ameliorating or preventing them
Injuries to the Tarsal Region

• Fracture of the Talus
  – Etiology -
    • Occurs either laterally from severe inversion/dorsiflexion force or medially from inversion/plantarflexion force with tibial external rotation
  – Sign & Symptoms -
    • History of repeated ankle trauma, pain with weight bearing, intermittent swelling, catching/snapping, talar dome tender upon palpation
  – Management
    • X-ray required for diagnosis, placed on weight bearing progression, rehab focuses on ROM and strengthening. If conservative management unsuccessful, surgery may be required (return to play in 6-8 months following surgery)

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• Fractures of the Calcaneus
  – Etiology
    • Occurs from jump or fall from height and often results in avulsion fractures anteriorly or posteriorly.
    • May present as posterior tibialis tendinitis
  – Sign and Symptoms
    • Immediate swelling, pain and inability to bear weight, minimal deformity unless comminuted fracture occurs
  – Management
    • RICE immediately, refer for X-ray for diagnosis
    • For non-displaced fracture, immobilization and early ROM exercises when pain and swelling subside

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• Calcaneal Stress Fracture
  – Etiology
    • Occurs due to repetitive trauma and is characterized by sudden onset in plantar-calcaneal area
  – Sign and Symptoms
    • Weight bearing (particularly at heel strike) causes pain, pain continues following exercise,
    • May require bone scan for diagnosis
  – Management
    • Conservative for 2-3 weeks, including rest AROM
    • Non-weight bearing cardio training should continue
    • As pain subsides, activity can be returned gradually
• Apophysitis of the Calcaneus (Sever’s Disease)
  – Etiology
    • Traction injury at apophysis of calcaneus, where Achilles attaches
  – Sign and Symptoms
    • Pain occurs at posterior heel below Achilles attachment in children and adolescent athletes
    • Pain occurs during vigorous activity and ceases following activity
  – Management
    • Best treated with ice, rest, stretching and NSAID’s
    • Heel lift could also relieve some stress
• Retrocalcaneal Bursitis (Pump Bump)
  – Etiology
    • Inflammation of bursa beneath Achilles tendon
    • Result of pressure and rubbing of shoe heel counter
    • Chronic condition that develops over time; may take extensive time to resolve; exostosis may develop (Haglund’s deformity)
  – Sign and Symptoms
    • Pain w/ palpation superior and anterior to Achilles insertion, swelling on both sides of the heel cord
  – Management
    • RICE and NSAID’s used as needed, ultrasound can reduce inflammation
    • Routine stretching of Achilles, heel lifts to reduce stress, donut pad to reduce pressure
    • Possibly invest in larger shoes with wider heel contours
• Heel Contusion
  – Etiology
    • Caused by sudden starts, stops or changes of direction, irritation of fat pad
    • Pain on the lateral aspect due to heel strike pattern
  – Sign and Symptoms
    • Severe pain in heel and is unable to withstand stress of weight bearing
    • Often warmth and redness over the tender area
  – Management
    • Reduce weight bearing for 24 hours, RICE and NSAID’s
    • Resume activity with heel cup or doughnut pad after pain has subsided (be sure to wear shock absorbent shoes)
• Cuboid Subluxation
  – Etiology
    • Pronation and trauma injury
    • Often confused with plantar fascitis
    • Primary reason for pain is stress on long peroneal muscle with foot in pronation
  – Sign and Symptoms
    • Displacement of cuboid causes pain along 4th and 5th metatarsals and over the cuboid
    • May refer pain to heel area and pain may increase following long periods of weight bearing
  – Management
    • Dramatic results may be obtained with jt. mobilization
    • Orthotic can be used to maintain position of cuboid
• Tarsal Tunnel Syndrome
  • Area behind medial malleolus forming tunnel with osseous floor and roof composed of flexor retinaculum

– Etiology
  • Any condition that compromises tibialis posterior, flexor hallucis longus, flexor digitorum, tibial nerve, artery or vein
  • May result from previous fracture, tenosynovitis, acute trauma or excessive pronation

– Sign and Symptoms
  • Pain and paresthesia along medial and plantar aspect of foot, motor weakness and atrophy may result
  • Increased pain at night with positive Tinel’s sign

– Management
  • NSAID’s and anti-inflammatory modalities, orthotics and possibly surgery if condition is recurrent
Tarsometatarsal Fracture Dislocation (Lisfranc Injury)

- Etiology
  - Occurs when foot hyperplantar-flexed with foot already plantar-flexed and rearfoot locked resulting in dorsal displacement of metatarsal bases

- Sign and Symptoms
  - Pain and inability to bear weight, swelling and tenderness localized on dorsum of foot
  - Possible metatarsal fractures, sprains of 4th and 5th tarsometatarsal joints, may cause severe disruption of ligaments

- Management
  - Key to treatment is recognition (refer to physician), realignment and maintaining stability
  - Generally requires open reduction with fixation
    - Complications include metatarsalgia, decreased metatarsophalangeal joint ROM and long term disability
Injuries to Metatarsal Region

• Pes Planus Foot (Flatfoot)
  – Etiology
    • Associated with excessive pronation, forefoot varus, wearing tight shoes (weakening supportive structures) being overweight, excessive exercise placing undo stress on arch
  – Sign and Symptoms
    • Pain, weakness or fatigue in medial longitudinal arch; calcaneal eversion, bulging navicular, flattening of medial longitudinal arch and dorsiflexion with lateral splaying of 1st metatarsal
Management

• If not causing athlete pain or symptoms, nothing should be done to correct “problem”
• If problems develop, orthotic should be constructed with medial wedge, taping of arch can also be used for additional support

Figure 18-22 A
• **Pes Cavus (High Arch Foot)**
  
  – **Etiology**
    • Higher arch than normal; associated with excessive supination, accentuated high medial longitudinal arch
  
  – **Sign and Symptoms**
    • Poor shock absorption resulting in metatarsalgia, foot pain, clawed or hammer toes
    • Associated with forefoot valgus, shortening of Achilles and plantar fascia; heavy callus development on ball and heel of foot
  
  – **Management**
    • If asymptomatic, no attempt should be made to “correct”
    • Orthotics should be used if problems develop (lateral wedge)
    • Stretch Achilles and plantar fascia
• Morton’s Toe
  – Etiology
    • Abnormally short 1st metatarsal, making 2nd toe look longer
    • More weight bearing occurs on 2nd toe as a result and can impact gait
    • Stress fracture could develop
  – Signs and Symptoms
    • Stress fractures S & S with pain during and after activity with possible point tenderness
    • Bone scan positive
    • Callus development under 2nd metatarsal head
  – Management
    • If no symptoms nothing should be done
    • If associated with structural forefoot varus, orthotics with a medial wedge would be helpful
• Longitudinal Arch Strain
  – Etiology
    • Caused by increased stress on arch
    • Flattening of foot during midsupport phase causing
      strain on arch (appear suddenly or develop slowly)
  – Sign and Symptoms
    • Pain with running and jumping, below posterior
      tibialis tendon, accompanied by pain and swelling
    • May also be associated with sprained
      calcaneonavicular ligament and flexor hallucis longus
      strain
  – Management
    • Immediate care, RICE, reduction of weight bearing.
    • Weight bearing must be pain free
    • Arch taping may be used to allow pain free walking
• Plantar Fasciitis
  – Common in athletes and nonathletes
  – Attributed to heel spurs, plantar fascia irritation, and bursitis
  – Catch all term used for pain in proximal arch and heel
  – Plantar fascia, dense, broad band of connective tissue attaching proximal and medially on the calcaneus and fans out over the plantar aspect of the foot
  – Works in maintaining stability of the foot and bracing the longitudinal arch
– Etiology

• Increased tension and stress on fascia (particularly during push off of running phase)
• Change from rigid supportive footwear to flexible footwear
• Poor running technique
• Leg length discrepancy, excessive pronation, inflexible longitudinal arch, tight gastroc-soleus complex
• Running on soft surfaces, shoes with poor support

– Sign and Symptoms

• Pain in anterior medial heel, along medial longitudinal arch
• Increased pain in morning, loosens after first few steps
• Increased pain with forefoot dorsiflexion
– Management

• Extended treatment (8-12 weeks)

• Orthotic therapy is very useful (soft orthotic with deep heel cup)

• Simple arch taping, use of a night splint to stretch

• Vigorous heel cord stretching and exercises that increase great toe dorsiflexion

• Massage of plantar surface of foot using tennis ball or rigid round surface

• NSAID’s and occasionally steroidal injection

Figure 18-25
• Jones Fracture
  – Etiology
    • Fracture of metatarsal caused by inversion and plantar flexion, direct force (stepped on) or repetitive trauma
    • Most common = base of 5th metatarsal
  – Sign and Symptoms
    • Immediate swelling, pain over 5th metatarsal
    • High nonunion rate and course of healing is unpredictable
  – Management
    • Controversial treatment
    • Crutches with no immobilization, gradually progressing to weight bearing as pain subsides
      – May allow athlete to return in 6 weeks
    • If nonunion occurs, internal fixation may be required
    • Bone stimulators have also been suggested
• Metatarsal Stress Fractures
  – Etiology
    • 2nd metatarsal fracture (March fracture)
    • Change in running pattern, mileage, hills, or hard surfaces
    • Forefoot varus, hallux valgus, flatfoot or short 1st metatarsal
    • Occasional 5th metatarsal fracture at base and insertion of peroneus brevis
  – Signs and Symptoms
    • Over 2-3 weeks dull ache during exercise, progressing to pain at rest
    • Progresses from diffuse to localized pain
    • Patient often reports increase in duration/intensity of training
• Metatarsal Stress Fractures
  – Management
    • Bone scan may be necessary
    • 3-4 days of partial weight bearing followed by 2 weeks rest
    • Return to running should be gradual and orthotics should be used to correct excessive pronation
• Bunion (Hallux Valgus Deformity)
  – Etiology
    • Exostosis of 1st metatarsal head; associated with forefoot varus; shoes that are too narrow, pointed or short
    • Bursa becomes inflamed and thickens, enlarging joint, and causing lateral malalignment of great toe
    • Bunionette (Tailor’s bunion) impacts 5th metatarsophalangeal joint - causes medial displacement of 5th toe
  – Sign and Symptoms
    • Tenderness, swelling, and enlargement of joint
    • As inflammation continues, angulation increases causing painful ambulation
    • Tendinitis in great toe flexors may develop
• Management
  – Early recognition and care is critical
  – Wear correct fitting shoes, appropriate orthotics, pad over 1st metatarsal head, tape splint between 1st and 2nd toe
  – Engage in foot exercises for flexor and extensor muscles
  – Bunionectomy may be necessary

Figure 18-27
• Sesamoiditis
  – Etiology
    • Caused by repetitive hyperextension of the great toe resulting in inflammation
  – Sign and Symptoms
    • Pain under great toe, especially during push off
    • Palpable tenderness under first metatarsal head
  – Management
    • Treat with orthotic devices, including metatarsal pads, arch supports, and even metatarsal bars
    • Decrease activity to allow inflammation to subside
• Metatarsalgia
  – Etiology
    • Pain in ball of foot (2nd and 3rd metatarsal heads)
    • Restricted extensibility of gastroc-soleus complex
    • Typically emphasizes toe off phase during gait
    • Fallen metatarsal arch
  – Sign and Symptoms
    • Transverse arch flattened, depressing 2nd, 3rd, 4th metatarsal bones and resulting in pain
    • Cavus foot may also cause problem
  – Management
    • Elevate depressed metatarsal heads or medial aspect of calcaneus
    • Remove excessive callus build-up
    • Stretching heel cord and strengthening intrinsic foot muscles
• Metatarsal Arch Strain
  – Etiology
    • Fallen metatarsals or pes cavus foot
    • Excessive pronation may compromise metatarsal head positioning and weight distribution
  – Signs and Symptoms
    • Pain or cramping in metatarsal region
    • Point tenderness, weakness, positive Morton’s test
  – Management
    • Pad to elevate metatarsals just behind ball of foot
• Morton’s Neuroma
  – Etiology
    • Thickening of nerve sheath (common plantar nerve) at point where nerve divides into digital branches
    • Commonly occurs between 3rd and 4th met heads; medial and lateral plantar nerves come together
    • Irritated by collapse of transverse arch of foot, putting transverse metatarsal ligaments under stretch, compressing digital nerves and vessels
    • Excessive pronation can be a predisposing factor
  – Signs and Symptoms
    • Burning paresthesia and severe intermittent pain in forefoot
    • Pain relieved with non-weight bearing
    • Toe hyperextension increases symptoms
• Management
  – Must rule out stress fracture
  – Teardrop pad can be placed between met heads to increase space, decreasing pressure on neuroma
  – Shoes with wider toe box would be appropriate
  – Surgical excision may be required
Injuries to the Toes

• Sprained Toes
  – Etiology
    • Generally caused by kicking non-yielding object
    • Pushes joint beyond normal ROM or imparting a twisting motion on the toe- disrupting ligaments and joint capsule
  – Sign and Symptoms
    • Pain is immediate and intense but short lived
    • Immediate swelling and discoloration occurring w/in 1-2 days
    • Stiffness and residual pain will last several weeks
  – Management
    • RICE, buddy taping toes to immobilize
    • Begin weight bearing as tolerable
• Great Toe Hyperextension (Turf Toe)
  – Etiology
    • Hyperextension injury resulting in sprain of 1st metatarsophalangeal joint
    • May be the result of single or repetitive trauma
  – Signs and Symptoms
    • Pain and swelling which increases during push off in walking, running, and jumping
  – Management
    • Increase rigidity of forefoot region in shoe
    • Taping the toe to prevent dorsiflexion
    • Ice and ultrasound
    • Rest and discourage activity until pain free
• Fractures and Dislocations of the Phalanges
  – Etiology
    • Kicking unyielding object, stubbing toe, being stepped on
    • Dislocations are less common than fractures
  – Signs and Symptoms
    • Immediate and intense pain
    • Obvious deformity with dislocation
  – Management
    • Dislocations should be reduced by a physician
    • Casting may occur with great toe or multiple toe fractures
    • Buddy taping is generally sufficient
• Hallux Rigidus
  – Etiology
    • Development of bone spurs on dorsal aspect of first metatarsophalangeal joint resulting in impingement and loss of active and passive dorsiflexion
    • Degenerative arthritic process involving articular cartilage and synovitis
    • If restricted, compensation occurs with foot rolling laterally
  – Signs and Symptoms
    • Forced dorsiflexion causes pain
    • Walking becomes awkward due to weight bearing on lateral aspect of foot
– Management
  • Stiffer shoe with large toe box
  • Orthosis similar to that worn for turf toe
  • NSAID’s
  • Osteotomy to surgically remove mechanical obstructions in effort to return to normal functioning
• Hammer Toe, Mallet Toe or Claw Toe
  – Etiology
    • Hammer toe is a flexible deformity that becomes fixed due to a flexion contracture in the PIP joint
    • Mallet toe is a flexion contracture of the DIP which also can become fixed
    • Claw toe is a flexion contracture of the DIP joint but there is hyperextension at the MP joint
    • Often time conditions caused by wearing short shoes over and extended period of time
  – Signs and Symptoms
    • The MP, DIP, and PIP can all become fixed
    • Exhibit swelling, pain, callus formation and occasionally infection
• Hammer Toe, Mallet Toe or Claw Toe (continued)
  – Management
  • Conservative treatment involves wearing footwear with more room for toes
  • Use padding and taping to prevent irritation
  • Shave calluses
  • Once fixed, surgery will be required to correct
• Overlapping Toes
  – Etiology
    • May be congenital or brought upon by improperly fitting footwear (narrow shoes)
  – Signs and Symptoms
    • Outward projection of great toe articulation or drop in longitudinal arch
  – Management
    • In cases of hammer toe, surgery is the only cure
    • Some modalities, such as whirlpool baths can assist in alleviating inflammation
    • Taping may prevent some of the contractual tension w/in the sports shoe
• Subungual Hematoma
  – Etiology
    • Direct pressure, dropping an object on toe, kicking another object
    • Repetitive shear forces on toenail
  – Signs and Symptoms
    • Accumulation of blood underneath toenail
    • Likely to produce extreme pain and ultimately loss of nail

Figure 18-37
• Subungual Hematoma (continued)

  – Management
  • RICE immediately to reduce pain and swelling
  • Relieve pressure within 12-24 hours (lance or drill nail) – must be sterile to prevent infection

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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

Figure 18-38
• 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
• Joint Mobilizations
  – Can be very useful in normalizing joint motions

Figure 18-39
• 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

Figure 18-40
• **Strengthening**
  – A number of exercises can be performed
    • Writing alphabet
    • Picking up objects
    • Ankle circumduction
    • Gripping and spreading toes
    • Towel gathering
    • Towel Scoop

*Figure 18-41 & 42*
• Neuromuscular Control (NC)
  – Critical to re-establish as it is the single most important element dictating movement strategies within the kinetic chain
  – Muscular weakness, proprioceptive deficits and ROM deficits challenge the athlete’s ability to maintain center of gravity within the base of support without 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
• Rehab plans are focusing more on closed kinetic chain activities
• Exercises should incorporate walking, running, jumping in multiple planes and on multiple surfaces
Exercise Sandals

• Used in closed kinetic chain exercises
  – Increases proprioceptive demands
• Progression
  – Requires use of intrinsic foot muscles
  – Must be able to perform single leg stance prior to sandal use
  – Progress to walking in place
  – Walking forward with short steps
• Foot Orthotics
  – Use of orthotics is common practice - used to control abnormal compensatory movement of the foot by “bringing the floor up to meet the foot”
  – Orthotic works to place foot in neutral position, preventing compensatory motion
  – Also works to provide platform for foot that relieves stress being placed on soft tissue, allowing for healing
  – Three types
    • Pad and soft flexible felt - soft inserts, readily fabricated and used for mild overuse problems
• Semi-rigid orthotics- composed of flexible thermoplastics, rubber or leather; molded from a neutral cast, well tolerated by athletes whose sports require speed and jumping

• Functional or rigid orthotic - made from hard plastic or from neutral casting; allow control for most overuse symptoms

– Many athletic trainers make neutral casts which are sent to a manufacturing laboratory and processed over several weeks

– Others will construct the orthotic from start to finish, requiring a more skilled technician than does the mail in method
• Correcting Pronation and Supination
  – To correct forefoot varus, a rigid orthotic should be used with a medial post along the medial longitudinal arch and the medial aspect of the calcaneus for comfort
  – Forefoot valgus deformity will require a semi-rigid orthotic with a lateral wedge under the 5th metatarsal head and lateral calcaneus
  – Correcting for rearfoot varus involves a semi-rigid orthotic with medial posting at the calcaneus and head of the first metatarsal
• Functional Progression
  – Patients must engage in a functional progression to gradually regain the ability to walk, jog, run, change directions and hop