

Pedorthic Management of the Pediatric Foot

Disorders of the Pediatric Foot

Flat Feet

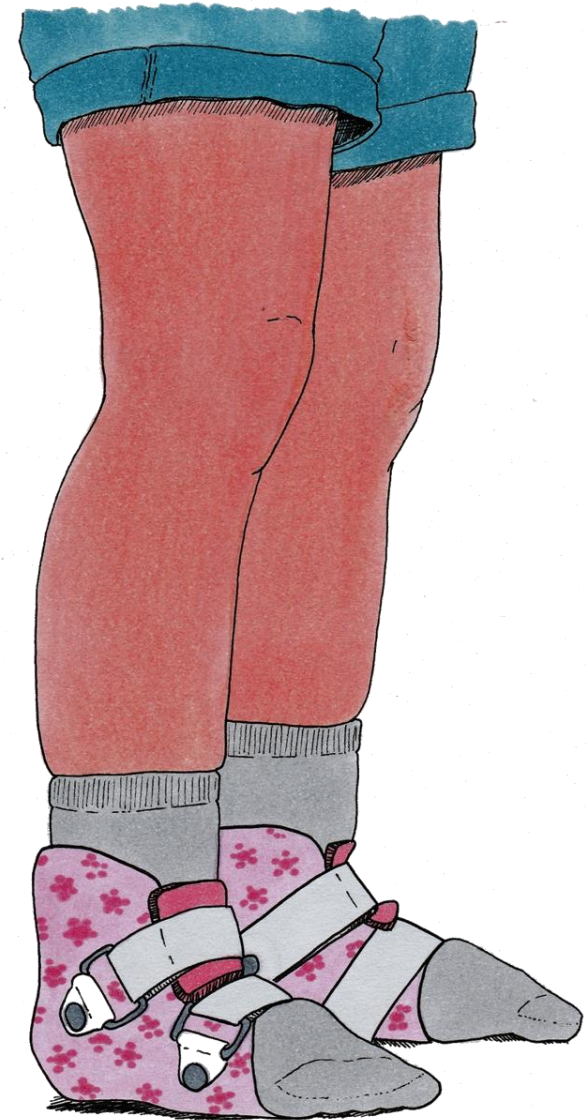
- Very common, usually asymptomatic presentation in young children, especially toddlers.
- May complain of arch or pretibial pain
- In the overwhelming majority of cases, the child will either develop a medial longitudinal arch as they mature skeletally, or the flatfoot will remain but will not become problematic.
- Rigid flatfoot
 - No medial longitudinal arch present WB and NWB
- Flexible flatfoot
 - Medial longitudinal arch is appreciable in NWB, but flattens significantly with WB



juvenile pes planovalgus

Flat Feet

- Hypermobile flexible pes planovalgus is most common presentation
- Hyperpronation
 - Dorsiflexion, inversion, forefoot abduction and calcaneal valgus
- Can be associated with:
 - Ligamentous laxity
 - Overall hypermobility
 - Congenital deformity
 - Tarsal coalition



Flat Feet

- Conservative treatment is for *symptomology*.
- Little evidence exists to support the idea that corrective footwear and/or inserts can alter the natural progression of a flatfoot in children.
 - Wenger DR, Mauldin D, Speck G, Morgan D, Lieber RL. Corrective shoes and inserts as treatment for flexible flatfoot in infants and children. J Bone Joint Surg Am. 1989 Jul;71(6):800-10. PMID: 2663868.
 - **Conclusions:** *We concluded that wearing corrective shoes or inserts...does not influence the course of flexible flatfoot in children.*
 - Kanatlı U, Aktas E, Yetkin H. Do corrective shoes improve the development of the medial longitudinal arch in children with flexible flat feet? J Orthop Sci. 2016 Sep;21(5):662-6. doi: 10.1016/j.jos.2016.04.014. Epub 2016 May 17. PMID: 27212230.
 - **Conclusions:** *Corrective shoes for flexible flatfoot was found not effective on development of foot arches. Therefore, they should be limited only for selected cases.*

Flat Feet

- Conservative treatment
 - Properly fitted, supportive footwear.
 - Consider high-top shoe +/- Thomas heels
 - Supramalleolar orthoses (SMO)
 - Foot orthoses with medial wedge
 - UCBL

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Thomas heel

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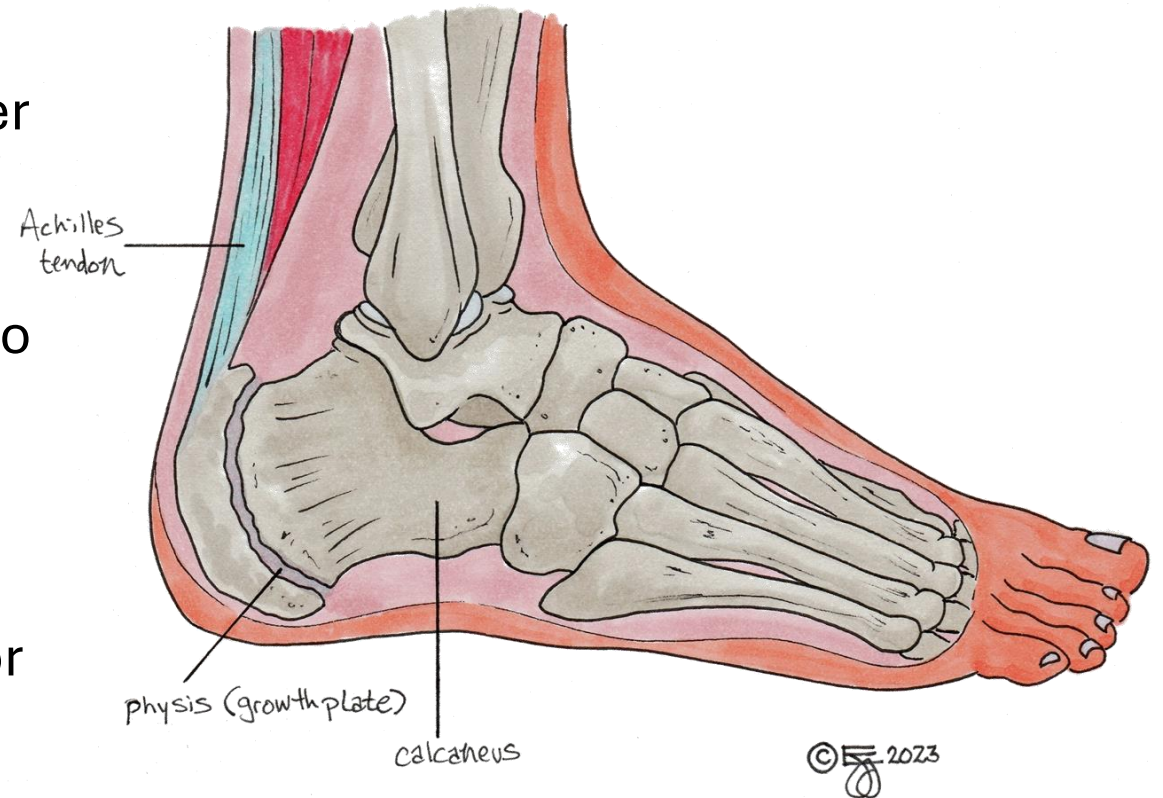


Sever's Disease

- Calcaneal apophysitis
 - Common cause of heel pain in skeletally immature athletes.
 - Result of an overuse injury to the secondary ossification center by a traction apophysitis at the Achilles tendon insertion site on the calcaneus.
 - Often coincides with the onset of the patient's rapid growth spurt and/or due to a sudden increase in sports-related activity, especially repetitive running and jumping.
 - It is a self-limiting condition.

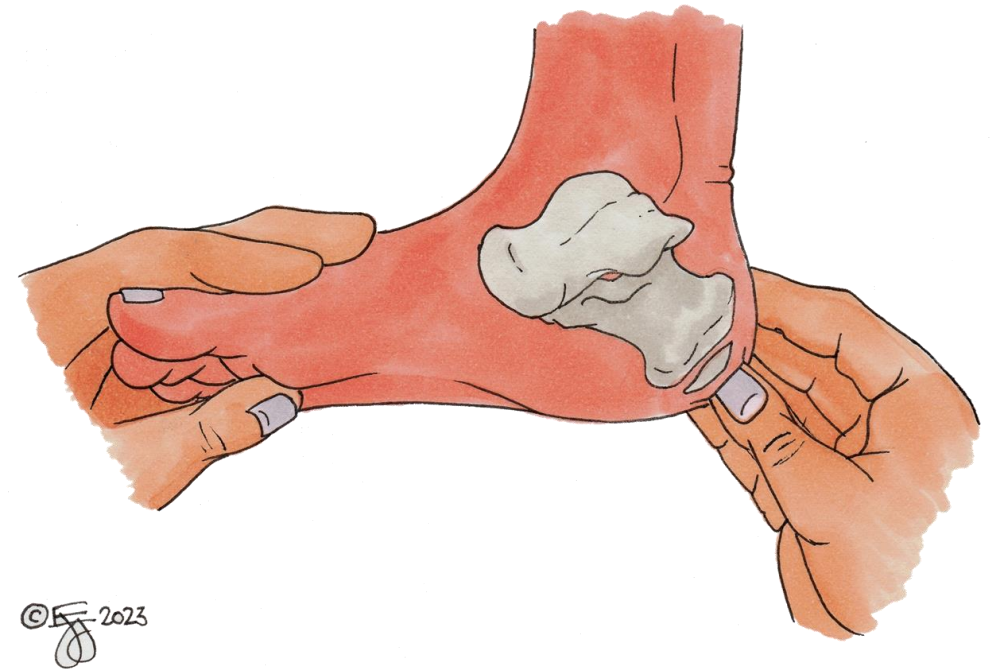
Pathophysiology

- In a growing child, the posterior calcaneus develops as a secondary ossification center to which the Achilles tendon attaches.
- During the early adolescent growth spurt, bone growth exceeds the ability of the muscle-tendon unit to stretch sufficiently to maintain previous flexibility. This creates increased tension across the apophysis.
- The apophysis is the weakest point in the muscle-tendon-bone-attachment (as opposed to the tendon being the weakest link in an adult), and therefore it is at risk for overuse injury from repetitive stress.
- Excessive and repetitive traction from the strong Achilles tendon results in microtrauma and chronic irritation causing thickening and pain at the apophysis.



Sever's Disease

- Most commonly occurs during a period of rapid growth in active adolescent patients between 9 and 12 years of age and is the most common cause of heel pain in this specific age group.
- Up to 60% of cases can present with bilateral pain.
- Boys > girls



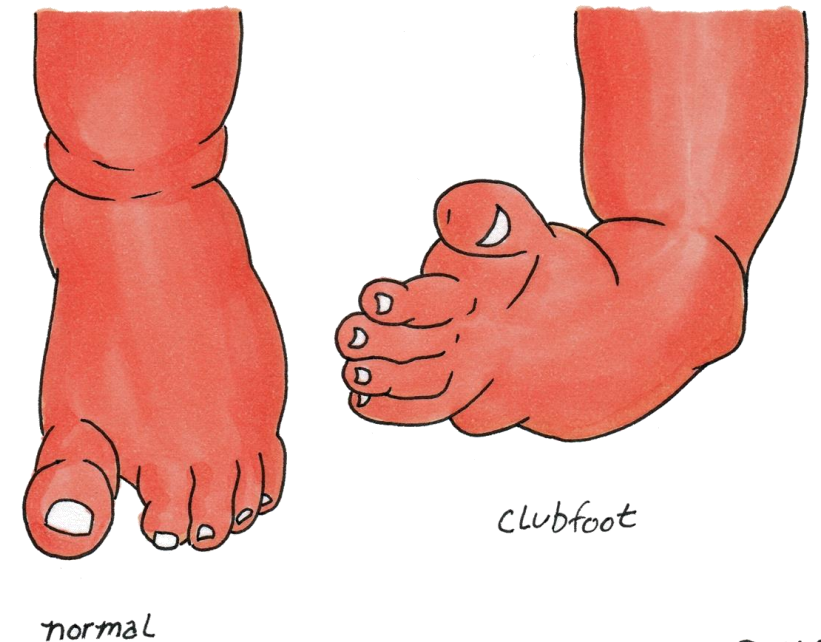
Sever's Disease

- Treatment
 - Rest (guided by pain), including holding out of sports activity until symptoms are resolved
 - Immobilization including periods of casting or use of a CAM boot may be necessary depending on symptom severity
 - Foot orthoses or heel cups to attenuate shock on heel strike; +/- heel lift
 - Achilles tendon stretches
 - Icing before and after sporting activity
 - NSAIDs
 - Footwear should be well-maintained, up-to-date and activity-appropriate



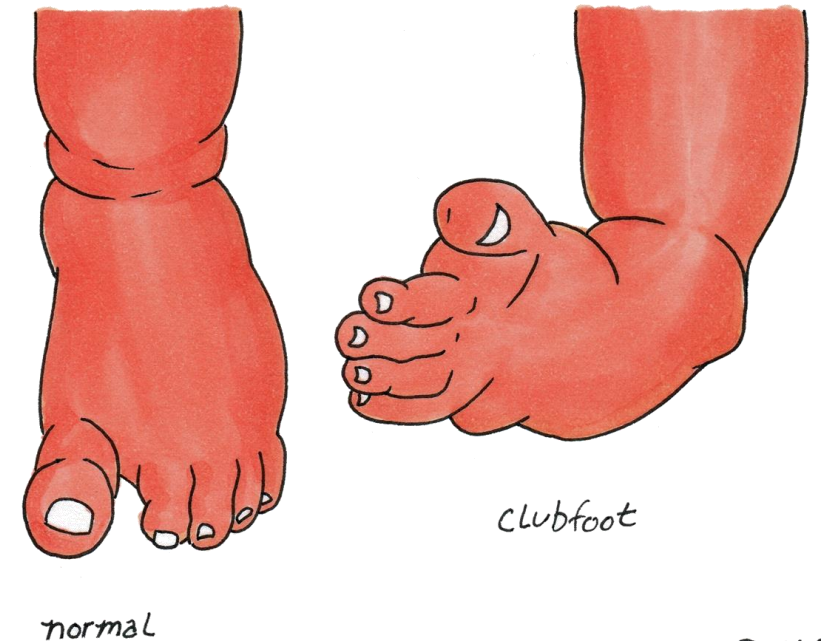
Equinovarus Foot

- May be a congenital deformity known as talipes equinovarus (clubfoot)
 - Most common musculoskeletal birth defect (1:1000)
 - 2:1 male
 - 50% are bilateral
 - In 80% of cases clubfoot is isolated deformity
- Common foot deformity also associated with:
 - Cerebral palsy (usually spastic hemiplegia)
 - Duchenne muscular dystrophy
 - Spina bifida
- Pathomechanics:
 - Imbalance of invertors and evertors (invertors overpower the evertors)
 - relative overpull of
 - tibialis posterior and/or
 - tibialis anterior
 - gastroc-soleus complex
 - example: in cerebral palsy, the causative muscles for the varus are the:
 - anterior tibialis (AT) in 1/3 of patients
 - posterior tibialis (PT) in 1/3 and
 - both the AT and PT in the remaining 1/3



Equinovarus Foot

- Nonoperative treatment
 - Ankle foot orthosis (AFO)
 - Helps provide stability for the foot and a more stable base of support during gait
 - Should have a "wrap around" hindfoot component of the brace to help control the varus and minimize pressure points
 - Ponseti method serial casting (>90% success)
 - Indication: rigid deformity
 - Botulinum toxin injection into tibialis posterior and/or gastrocnemius
 - Indications:
 - Flexible or dynamic deformities
 - Desire to delay surgery



Juvenile Cavovarus Foot Deformity

- Pedorthic and Orthotic Treatment:
 - Accommodative shoe wear
 - Rarely sufficient except in mild deformity
 - Full-length semi-rigid foot orthosis with first ray cutout and lateral wedge
 - Mild cavus foot deformity in adult (not indicated in children)
 - Supramalleolar orthosis (SMO)
 - More severe cavovarus deformity recalcitrant to footwear accommodations
 - Ankle foot orthosis (AFO)
 - May be needed if equinus also present, resulting in equinocavovarus foot deformity
 - Works best if equinus is a dynamic deformity (not rigid)
 - Gauntlet-style ankle brace and/or high-top shoe or boots
 - May be useful in moderate deformities if patient cannot tolerate more rigid bracing with an SMO or AFO

Spina Bifida (Myelodysplasia)

- Condition that occurs when the spine and spinal cord don't form properly. It's a type of neural tube defect. The neural tube is the structure in a developing embryo that later becomes the baby's brain and spinal cord and the tissues that enclose them.
 - Typically, the neural tube forms early in pregnancy and closes by the 28th day after conception. In babies with spina bifida, a portion of the neural tube doesn't close all the way. This affects the spinal cord and bones of the spine.
 - Spina bifida can range from being mild to causing serious disabilities. Symptoms depend on where on the spine the opening is located and how big it is. Symptoms also depend on whether the spinal cord and nerves are involved. When necessary, early treatment for spina bifida involves surgery.
- **Mobility complications:**
 - The nerves that control the leg muscles don't work properly below the area of the spinal cord that is affected causing lower extremity muscle weakness. May cause paralysis. Whether a child can walk depends on the location of the spine that's affected and the size of the opening in the neural tube. Ability to walk also depends on the care received before and after birth.
 - **Orthopedic complications.**
 - Possible orthopedic issues may include:
 - Scoliosis
 - Clubfoot
 - Dislocation of the hip
 - Other bone and joint conditions
 - Muscle contractures

Cerebral Palsy

- Foot conditions are the most common deformity seen in cerebral palsy which are caused by lower extremity spasticity and can take several forms including:
 - Equinus
 - Hallux valgus
 - Equinocavovarus
 - Equinoplanovalgus.
- Diagnosis is made clinically with presence of spasticity/contracture of the gastrocnemius complex in equinus, presence of a spastic hallux valgus, and supination deformities of the midfoot and forefoot.
- Treatment is usually bracing and shoe modifications for mild and flexible conditions.
- Surgical management is indicated for progressive deformities that are not amenable to bracing.

Charcot-Marie-Tooth Disease

- Hereditary motor and sensory neuropathy
- Presents with rigid, progressive cavovarus foot
 - Prominent MTHs
 - Possible pain under base of 5th MT
 - Can progress to foot drop
- Gene can mutate between generations



Charcot-Marie-Tooth Disease

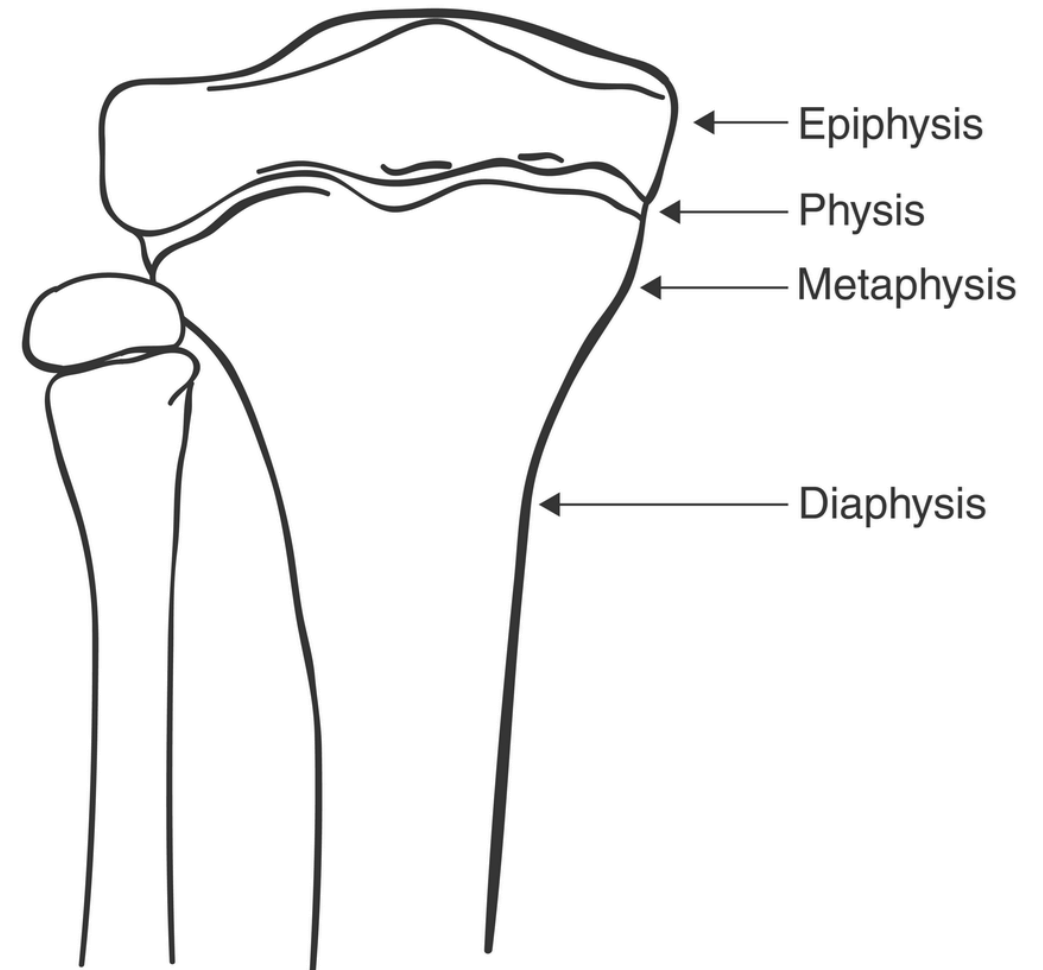
Charcot-Marie-Tooth Disease

- Cavovarus foot, high pressure under MTHs and base of 5th MT, possible foot drop
- Laterally posted FO, MTH relief
- Neutral shoe
- AFO (for footdrop)



Osteochondrosis

- A self-limiting developmental derangement of normal bone growth, primarily involving the centers of ossification in the epiphysis. Typically begins in childhood as a degenerative or necrotic condition. Technically speaking, osteochondrosis is an aseptic ischemic necrosis.
- Central to the definition is the prerequisite that the epiphysis should have been normal, however, there isn't a real good way to prove that an epiphysis was normal to begin with.



Freiberg's Infarction

- Osteochondrosis that affects the lesser metatarsal heads, especially the second.
 - Most commonly seen in females (3:1 over males) aged 13-15.
 - Localized pain over dorsal and plantar MTPJ with swelling of joint area.
 - Osteophyte-like prominences over the MTH can often be palpated.
 - Joint ROM is often limited.
- Pedorthic treatment:
 - Properly selected and fitted shoe to ensure ample forefoot space to prevent side-to-side compression and adequate width to alleviate dorsal pressure on the joint.
 - Foot orthoses designed to offload the affected metatarsal head. Metatarsal pad, horseshoe pad, metatarsal bar, depression, excavation, etc. Combination of cushioning and offloading may be used, but offloading takes precedence.
 - Rocker soles (with distal apex just proximal to MTHs) may also be used to provide additional offloading to the forefoot.

An infarction is an obstruction of the blood supply to an organ or region of tissue causing local death of the tissue.

Kohler's Disease

- Osteochondrosis that affects the navicular.
 - Chronic, yet self-limiting, condition that is generally seen in children aged 3-9 years.
 - Affects boys > girls.
 - Pain at the apex of the medial longitudinal arch. Tenderness through the T-N joint. Localized swelling.
- Pedorthic treatment:
 - Properly fitted shoe that does not increase pressure over the navicular.
 - Foot orthosis to support arch (while at the same time not increasing pressure under navicular). +/- medial wedge.
 - Possible shoe modifications include double-rocker sole, medial heel wedge and re-last.
 - Immobilization via cast or walker boot may be necessary.

Other Common Forms of Osteochondrosis

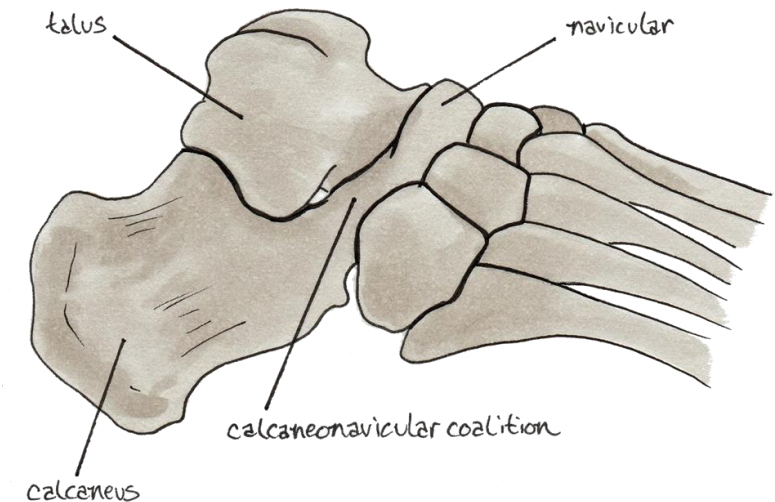
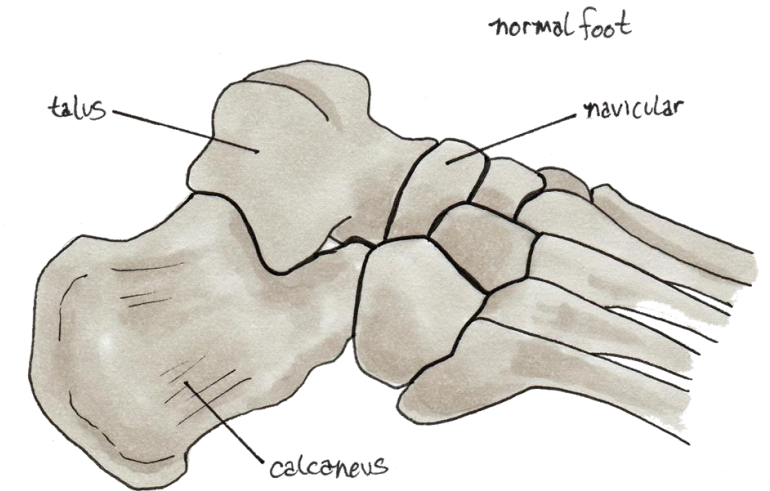
- Osgood-Schlatter's Disease
 - Osteochondrosis of tibial tubercle
 - Boys aged 10-15 years
 - Self-limiting condition
- Legg-Calve-Perthes Disease
 - Osteochondrosis of the capital femoral epiphysis
 - Most common form. Cause a painful limp.
 - Affects children 4-8; boys>girls.
- In both cases, the podiatrist may be called in to provide proper footwear and foot orthoses to reduce biomechanical foot deformities that may be exacerbating the proximal problem(s).

Tarsal Coalitions

- A tarsal coalition is an abnormal connection of two or more bones in the hindfoot and can result in a severe, rigid flatfoot.
- Although tarsal coalition is often present at birth, children typically do not show signs of the disorder until early adolescence. The foot may become stiff and painful, and everyday physical activities are often difficult.
- For many children with tarsal coalition, symptoms are relieved with simple treatments, such as orthotics and physical therapy. If a child has severe symptoms that do not respond to simple treatments and continue to interfere with their daily activities, surgery may be recommended.
- The bones can be connected by a bridge of bone, cartilage, or strong, fibrous tissue. These bridges are often referred to as "bars" and they can cover just a small amount of the joint space between the bones, or a large portion of the space.
- Estimated that 1:100 people have a tarsal coalition.
- Bilateral 50% of the time.
- Symptoms:
 - Stiff, painful feet. The pain usually occurs in the midfoot and hindfoot.
 - A rigid, flat foot that makes it difficult to walk on uneven surfaces. Increased propensity for ankle sprains.
 - Increased pain or a limp with higher levels of activity.

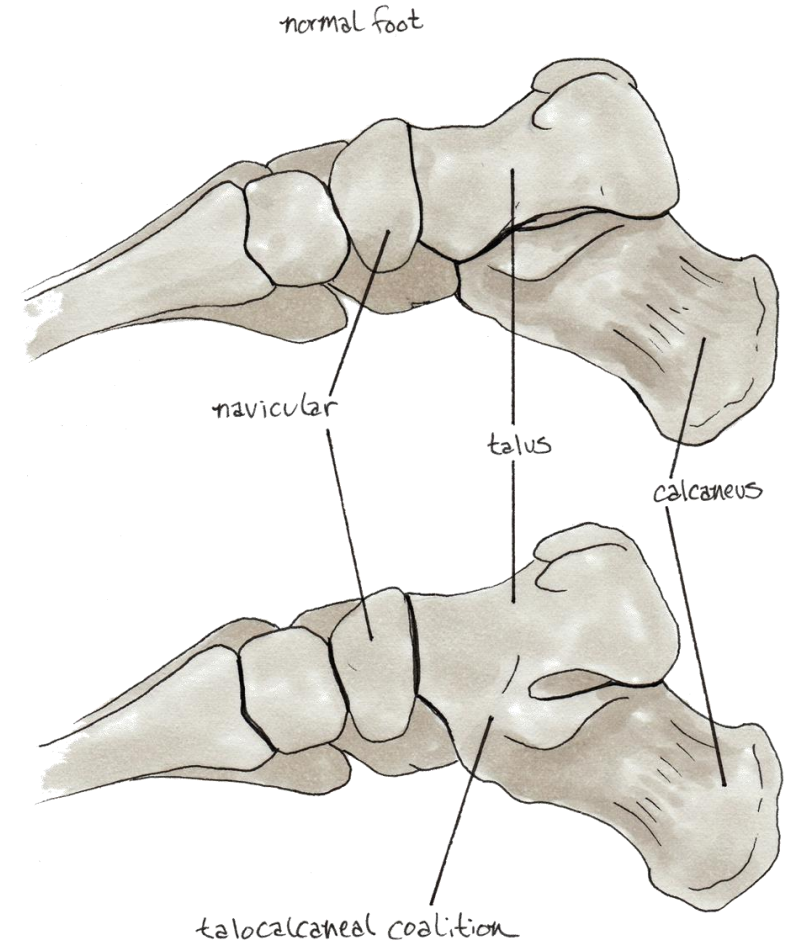
Tarsal Coalitions

- Calcaneonavicular coalition
 - Bar between the calcaneus and the navicular.
 - Pain can be localized to affected joint if bar is fibrous; or surrounding joints if bar is bony.
 - Goal of podiatric treatment is to restrict painful motion.



Tarsal Coalitions

- Talocalcaneal coalition
 - Bar between the calcaneus and the talus.
 - Pain can be localized to affected joint if bar is fibrous; or surrounding joints if bar is bony.
 - Goal of pedorthic treatment is to restrict painful motion. Device may need to extend more proximally than orthotic device for calcaneonavicular coalition.



Juvenile Idiopathic Arthritis (JIA)

- Used to be called Juvenile Rheumatoid Arthritis. JIA is a more accurate descriptor.
- JIA is a heterogeneous group of idiopathic inflammatory arthritis affecting children younger than 16 and duration > six weeks.
- Seven categories:
 - Oligoarthritis
 - Rheumatoid factor (RF) positive polyarthritis
 - RF negative polyarthritis
 - Systemic arthritis
 - Psoriatic arthritis
 - Enthesitis-related arthritis
 - Undifferentiated arthritis

Juvenile Idiopathic Arthritis (JIA)

- Highly unpredictable disease course; in some patients it is observed a self-limiting disease while in others, there is an unremitting disease with a high likelihood of joint destruction.
- JIA has the general pattern of inflammatory joint disease (synovitis, joint effusion, soft tissue swelling, osteopenia, bone edema, and erosions) with some additional elements related to developmental age, such as epiphyseal growth disturbances, premature physeal fusion, and limb length inequality.
- Factors essential to making the diagnosis and classification include: age of onset, the joints affected, the duration of arthritis, the associated symptoms or diseases, and physical and musculoskeletal examinations.

Juvenile Idiopathic Arthritis (JIA)

- Swollen, painful joints.
- Treatment is the same as in adults with foot-related arthritis.
- Arthritic joints hurt when they move. Therefore, decrease painful motion to relieve pain.
- Supportive, yet cushioned, total contact foot orthoses.
- Well-fitted, supportive shoes stiffer outsoles.
- Rigid rocker soles to reduce bending forces and stress through the midfoot and forefoot.

Specialized Children's Footwear

What is a Straight Last Shoe?

- Straight-Lasted Design – is a shoe that, traditionally, has very little waist curve, are completely neutral with no inflare or outflare, and show no readily discernable difference between the left shoe and the right. In modern footwear parlance, a straight last shoe is considered to be one where a straight line can be drawn from the center of the toe to the center of the heel with roughly the same amount of sole width on either side of the line.
- Straight lasted shoes are recommended for “new walkers”, especially toddlers with forefoot varus and/or forefoot abduction (pigeon-toed).



straight-lasting design

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Specialized Children's Footwear Manufacturers

- Markell Shoe Company – www.markellshoe.com
 - Corrective shoes, straight last shoes with Thomas heels
- Apis/Mt. Emey – www.emey.com
 - Straight last shoes; extra roomy shoes; rear-entry shoes
- Stride Rite – www.striderite.com
 - In-depth, multiple widths, adaptable
- Sure Step – www.surestep.net
 - Shoes specifically designed to accommodate SMOs and AFOs
- Billy Shoes – www.billyfootwear.com
 - AFO-friendly shoes with unique zippered vamp and toe box

Challenges...

- Kids
 - Adherence
 - They may outgrow devices in rapid succession. Consider OTC devices?
- Parents
 - Health anxiety by proxy
 - Helicopter parents
 - Cost/coverage concerns

The End