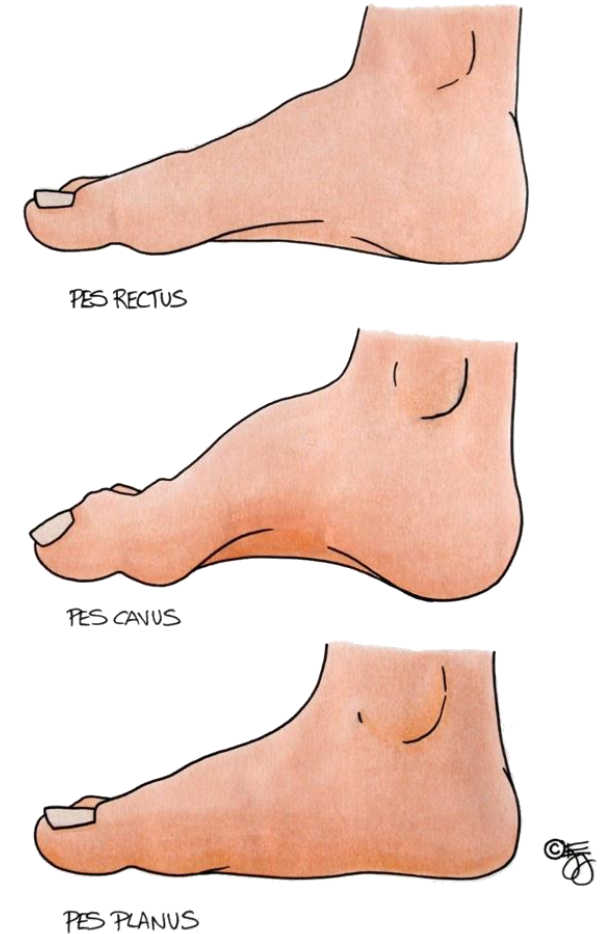


Posterior Tibial Tendinitis/Dysfunction

Pes Planovalgus

- 25% of the US population has flat feet
- So, one in four people need FOs, right?
- Is flatfoot always symptomatic?
- Is flatfoot preventable?
- It's better to have high arches, right?



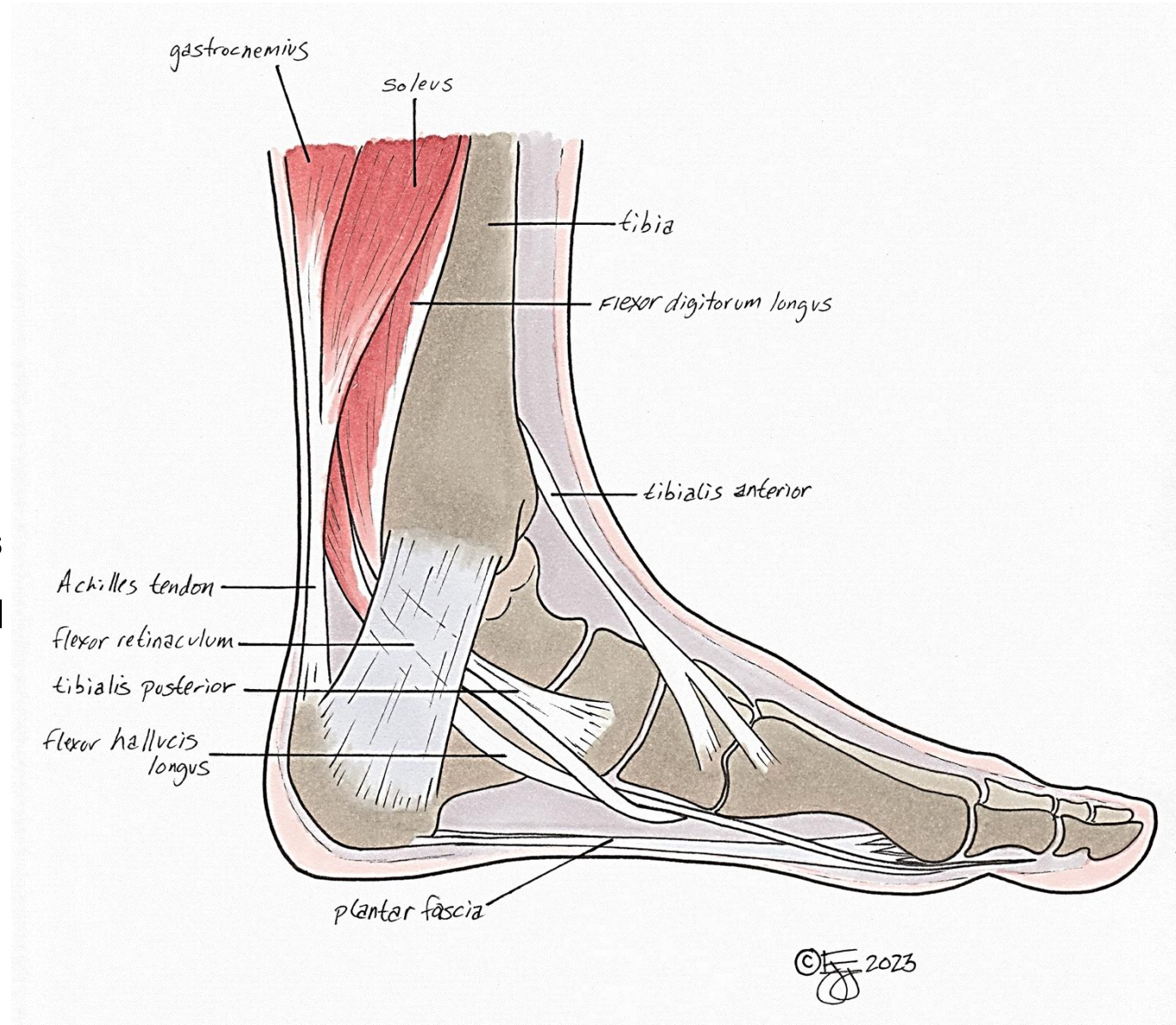
Adult Acquired Flatfoot Deformity

- AAFD is a common yet complex deformity. It can be described as a marked collapse of the medial longitudinal arch, followed by progressive overall deformity of the foot and ankle complex.
- Formally referred to as *posterior tibial tendon dysfunction*. That nomenclature has fallen out of use in recent years due to the fact that the failure of several other structural components are integral to the development of the deformity. AAFD is a more apt descriptor.



Tibialis Posterior

- Action: Generally speaking, plantarflexion and inversion
- Tibialis posterior is a biphasic muscle/tendon.
 - Swing phase, fires to position foot in supination at heel strike. Relaxes immediately thereafter.
 - Stance phase, fires again as body mass passes over dorsum of foot to lock the tarsal joints and, in effect, create a rigid lever arm of the first ray to effect toe off.
- Tibialis posterior tendon is also frequently described as “maintaining the medial longitudinal arch”. While this is technically accurate, it is a gross oversimplification and a mischaracterization to blame adult acquired flatfoot solely on PTT dysfunction.

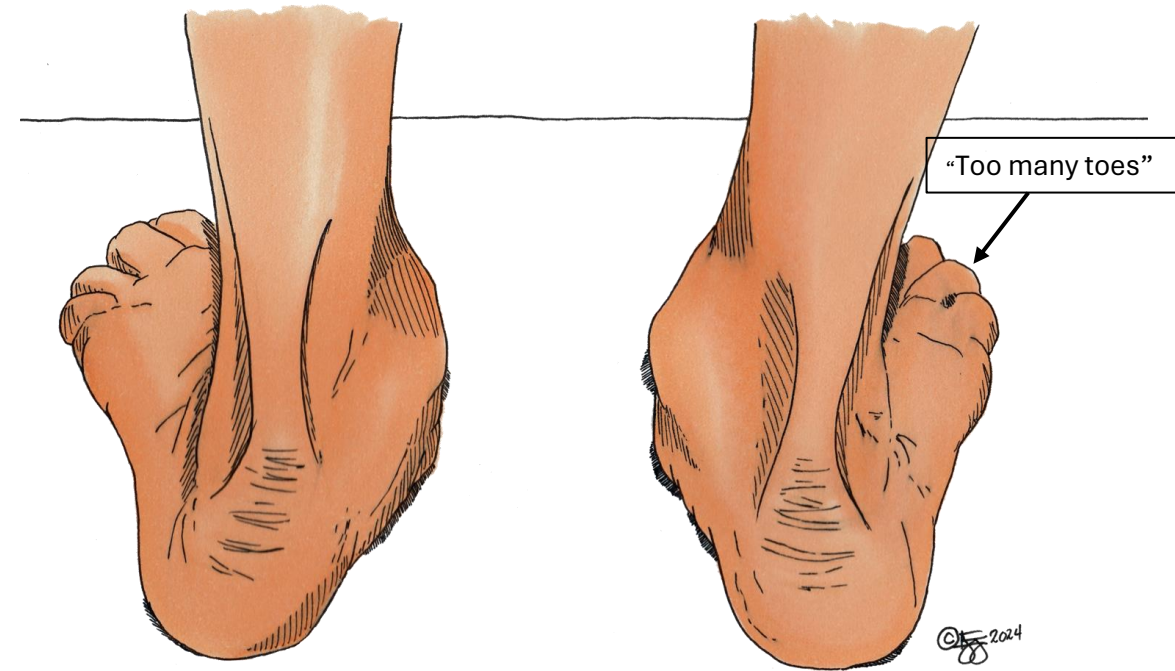


Adult Acquired Flatfoot Deformity

- Grading system (I to III) is the Johnson and Strom grading system (1989). Grade IV was added by Myerson in 1997.
 - Stage I – posterior tibial tendon tenosynovitis w/ no deformity
 - Stage II – arch collapse, inability to perform a single limb heel rise
 - IIa – arch collapse and hindfoot valgus but no midfoot abduction
 - IIb – arch collapse and hindfoot valgus with midfoot abduction
 - Stage III – fixed deformity with hindfoot valgus and forefoot abduction
 - Stage IV – ankle valgus secondary to weakened deltoid ligament

Adult Acquired Flatfoot Deformity

- Etiology is multifactorial
 - Pre-existing congenital flatfoot
 - Obesity
 - Hypovascularity of posterior tibial tendon
 - Previous trauma
 - History of corticosteroid injections
 - Arthritis
 - Diabetes
 - Neuromuscular conditions
 - Pregnancy
 - Genetic conditions (E.g., Down syndrome, Marfan syndrome, Ehlers-Danlos syndrome)
 - Neuroarthropathy

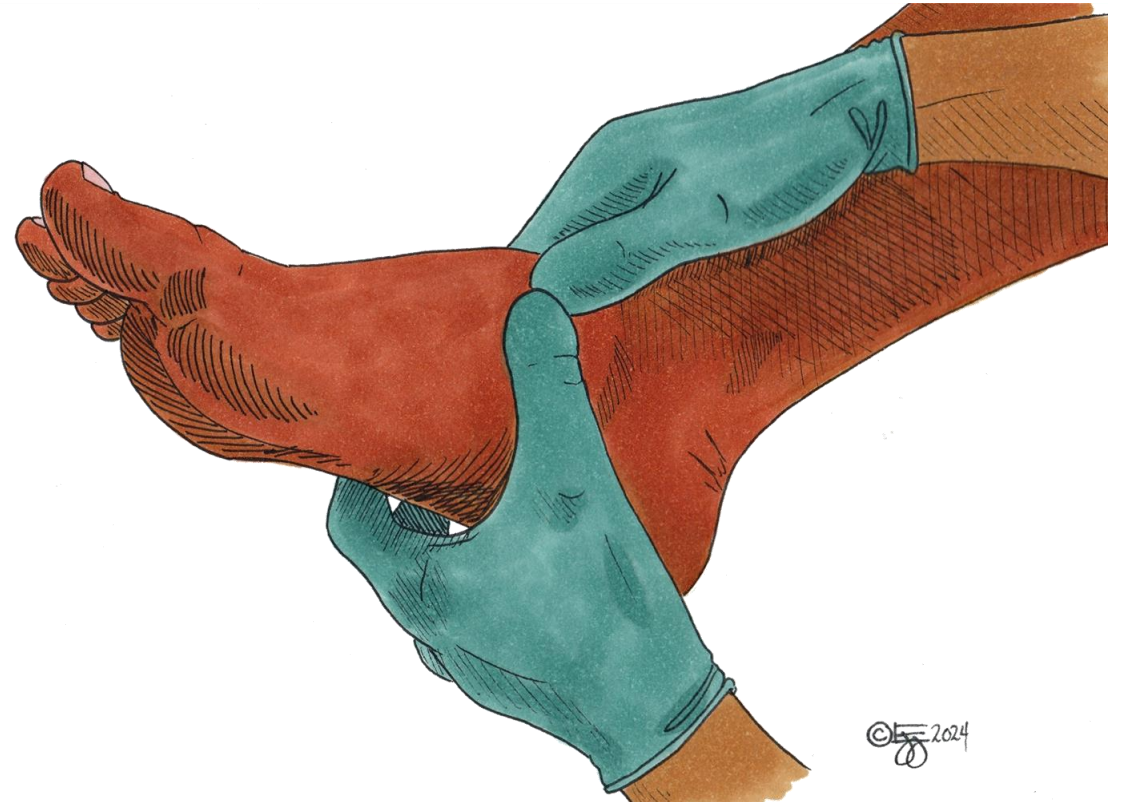


Adult Acquired Flatfoot Deformity

- Pathophysiology
 - PTT deficiency creates instability in transverse tarsal joints and forefoot abduction, leaving the peroneus brevis unopposed.
 - Plantar fascia weakens.
 - Abduction of forefoot and transverse tarsal joints displace force on the Achilles tendon laterally, worsening the overall valgus foot deformity.
 - The spring ligament fails and leads to medial and plantar subluxation of the talar head relative to the navicular.
 - Talonavicular joint capsule fails.
 - The deltoid ligament fails and leads to valgus positioning of the talus within the ankle mortise.
 - Talocalcaneal interosseus ligament fails.
 - These events typically occur in a stepwise fashion, but not always.

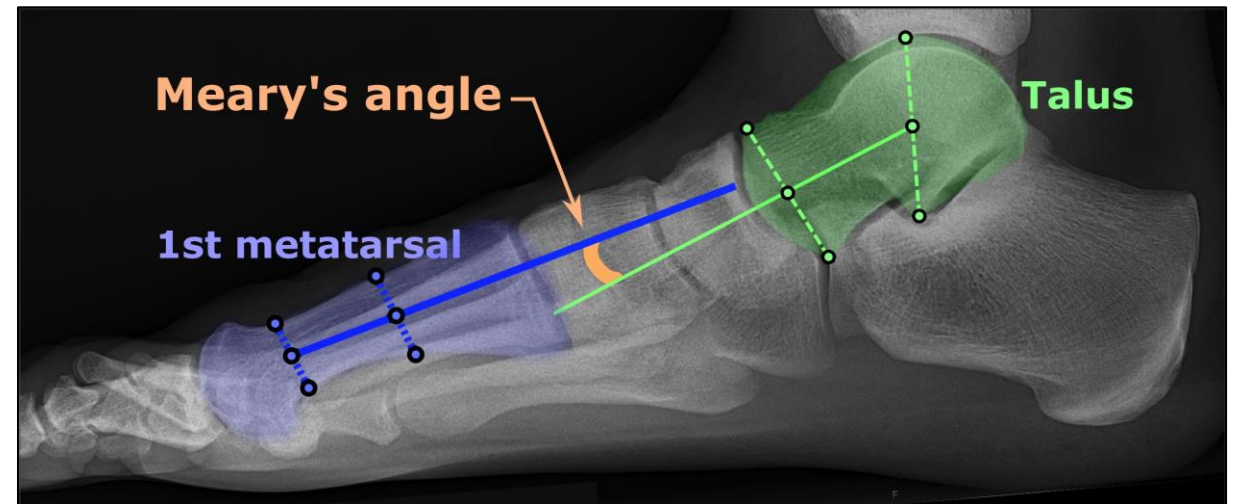
Adult Acquired Flatfoot Deformity

- History and Physical
 - Weight-bearing exam
 - “Too many toes” sign – more than 5th toe and part of 4th toe visible from directly behind
 - Swelling and/or pain over posterior tibial tendon at medial malleolus
 - Lateral impingement pain
 - Single and double limb heel rise tests
 - Failure to invert foot is indicative of posterior tibial tendon dysfunction
 - Assessment of ankle and subtalar joint ROM



Adult Acquired Flatfoot Deformity

- Evaluation: Weight-bearing radiographs
 - Meary's angle
 - Used to identify the apex of deformity in patients with pes cavus and pes planus on lateral weight-bearing foot radiographs.
 - Measurement
 - It is the angle between a line drawn from the centers of longitudinal axes of the talus and the first metatarsal.
 - Interpretation
 - In the normal weight-bearing foot, the midline axis of the talus is in line with the midline axis of the first metatarsal.
 - Normally Meary's angle is 0° , with abnormal values considered:
 - Angle $>4^{\circ}$ convex upward: pes cavus
 - Angle $>4^{\circ}$ convex downward: pes planus
 - It can also be used to classify the severity of deformity:
 - Mild $<15^{\circ}$
 - Moderate: $15-30^{\circ}$
 - Severe: $>30^{\circ}$



Clinical Management

American College of Foot and Ankle Surgeons Clinical Consensus Statement: Appropriate Clinical Management of Adult-Acquired Flatfoot Deformity (2017)

The panel reached consensus that the following statements pertaining to AAFD were “appropriate”:

- Obesity (elevated body mass index [BMI]) may contribute to the development of flatfoot but is unlikely a sole cause of the deformity.
- Equinus deformity (*tendoachilles contracture*) may be a factor in the development of flatfoot; however, equinus is unlikely a sole cause of flatfoot deformity.
- Spring ligament damage is an important component of the flatfoot deformity.
- Triplane correction should be considered when addressing the flexible AAFD. Medial incision approach does not increase risk of complication when performing hindfoot fusion.

American College of Foot and Ankle Surgeons Clinical Consensus Statement: Appropriate Clinical Management of Adult-Acquired Flatfoot Deformity (2017)

The panel reached consensus that the following statements pertaining to AAFD were neither “appropriate” nor “inappropriate”:

- Single heel raise is not pathognomonic for the diagnosis of symptomatic adult-acquired flatfoot resulting from posterior tibial tendon insufficiency.
- Intrinsic valgus deformity of the talus may be a predisposing factor in the development of symptomatic adult-acquired flatfoot.
- Symptomatic adult-acquired flatfoot may be adequately managed with an ankle-foot orthosis.
- Patient satisfaction can be found with foot orthoses in symptomatic adult-acquired flatfoot.
- Eccentric strengthening exercises of the posterior tibial tendon can reduce symptoms in early management of symptomatic adult-acquired flatfoot with the use of an orthotic.

American College of Foot and Ankle Surgeons Clinical Consensus Statement: Appropriate Clinical Management of Adult-Acquired Flatfoot Deformity (2017)

The panel reached consensus that the following statements pertaining to AAJD were neither “appropriate” nor “inappropriate”:

- Congenital factors play an important role in the development of a flatfoot deformity.
- Radiographs provide adequate information for the evaluation of a flatfoot deformity.
- Subtalar arthroereisis should not be considered as a single corrective procedure for stage IIB AAJD.
- Stage IIB AAJD often requires a lateral column lengthening procedure to address forefoot abduction.
- Medial displacement calcaneal osteotomy should be considered in cases of flexible adult-acquired flatfoot correction.
- Rigid flatfoot deformity may be effectively treated by talonavicular and subtalar joint fusion in combination or in isolation.

Surgical Management

Flatfoot Reconstruction

Comprehensive surgical treatment for AAFD usually involves a combination of several procedures:

- **Achilles Lengthening**

- In AAFD, the Achilles tendon becomes tight and contracted. Almost every surgical procedure for AAFD includes some kind of Achilles tendon lengthening.

- **Medializing (Evans) Calcaneal Osteotomy**

- Also called a heel slide, this procedure involves cutting the heel bone to shift it back into correct alignment under the leg. The bone is then held in place with hardware.

Flatfoot Reconstruction

- **Tendon Transfers**

- FDL to PTT to help bring some strength back to the posterior tibial tendon. It is cut in the foot and transferred to the navicular bone. Sometimes, tendon transfers on the lateral aspect of the foot are also done to help realign the forces working on the foot.

- **Ligament Repairs**

- The spring ligament and the deltoid ligament are two ligaments that help hold the correct alignment of the foot and ankle. In patients with severe disease, one or both ligaments may be torn and may be repaired.

Flatfoot Reconstruction

- **Lateral Column Lengthening**

- Either the calcaneus is "lengthened" or the bone wedge (or spacer) is inserted into the CC joint itself. Hardware is often used to help hold the bones in position while they heal.

- **Cotton (Medial Cuneiform) Osteotomy**

- The medial cuneiform bone is cut through a dorsal incision. Spreading the cut bone apart with a bone or metal wedge helps recreate an arch.

Flatfoot Reconstruction

- **Midfoot Fusion**

- Some patients with arthritis and/or deformity of their midfoot may require a midfoot fusion. This may involve one or more of the multiple midfoot joints, including the tarsometatarsal joints or the naviculocuneiform joint. This procedure is also useful for restoring the arch.

- **Subtalar Fusion**

- This procedure is done for more severe deformities. The talus and the calcaneus bones are fused together, which allows more correction of the deformity.

- **Double or Triple Arthrodesis**

- This procedure is done for the most severe deformities or ones with arthritis. In a triple arthrodesis, three joints are fused: the subtalar, talonavicular, and calcaneocuboid joints. Often, just the subtalar and talonavicular joints are fused (double arthrodesis). The foot will be stiff after this surgery, but usually pain and alignment are improved, and the foot feels more stable for walking.

All or nothing?

- **Achilles Lengthening**
- **Medializing Calcaneal Osteotomy**
- **Tendon Transfers**
- **Ligament Repairs**
- **Lateral Column Lengthening**
- **Cotton Osteotomy**

- **Midfoot Fusion**
- **Subtalar Fusion**
- **Double or Triple Arthrodesis**

- Conti MS, Jones MT, Savenkov O, Deland JT, Ellis SJ. **Outcomes of Reconstruction of the Stage II Adult-Acquired Flatfoot Deformity in Older Patients.** Foot Ankle Int. 2018 Sep;39(9):1019-1027.
- This study measured clinical outcomes using the Foot and Ankle Outcome Score (FAOS) and compared preoperative and postoperative scores at a minimum of 2 years. Findings indicated that patients in the older group did not demonstrate any differences in their outcomes compared with patients in the young and middle-aged groups.
- Additionally, older patients were not more likely to undergo a subsequent removal of hardware or revision procedures than patients in the younger cohorts.

Pedorthic/Orthotic Management

Objectives

- Relieve stress and strain on symptomatic posterior tibial tendon
- Compensate for other compromised structures
- Correct alignment to normalize gait
- Passively recreate medial longitudinal arch to minimize lateral impingement of ligamentous tissue and/or calcaneofibular abutment

Considerations

- What stage is the deformity?
- Is it correctable?
- Should we try to correct it or do our best to accommodate and mitigate pain and complications?
- Patient...
 - Underlying foot structure
 - Body structure
 - Occupational or activity-related footwear requirements
- Prognosis/Intent of treatment plan

Adult Acquired Flatfoot Deformity

- Stage I
 - Early pain and localized tenderness along tendon
 - Underlying mechanical fault may predispose symptomology
 - TCO w/ arch support and medial post, supportive shoe, SCFO



Adult Acquired Flatfoot Deformity

- Stage II
 - More pain, mild weakness, mild deformity
 - TCO w/ arch support and medial post, supportive shoe
 - UCBL, SCFO, AZ AFO, Short Articulated AFO



Adult Acquired Flatfoot Deformity

- Stage III
 - Significant dysfunction, forefoot abduction, sinus tarsi pain
 - AZ AFO +/- posted TCO, may need to re-last shoe



Adult Acquired Flatfoot Deformity

- Stage IV
 - End stage, very restricted motion, significant deformity
 - Medial flare/stabilizer, re-last, AZ AFO, custom shoe(?), accommodative FO



Flexible Flatfoot Deformity

- TCO w/ medial hindfoot and lateral forefoot post



Flatfoot Miscellany / Wrap-up

- Is a flat foot correctable?
 - Via surgery, yes.
 - Via “special” shoes or infomercial arch supports, no.
 - Via physical therapy or exercises, no.
 - Via barefoot running, no.
- Does everyone with flat feet need FOs?
 - No. A flexible, *asymptomatic*, mild flatfoot is actually a quite functional foot.
- I have flat feet, what can I do to prevent my kid from getting flat feet?
 - Depends who you ask?
 - Especially if you ask Lynn T. Staheli, MD.

The End