Pediatric Foot Disorders

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Ossification Centers

Newborn:

- Calcaneus
- Talus
- Cuboid
- Metatarsals and phalanges

Navicular: 2-5 years, off-center ossification

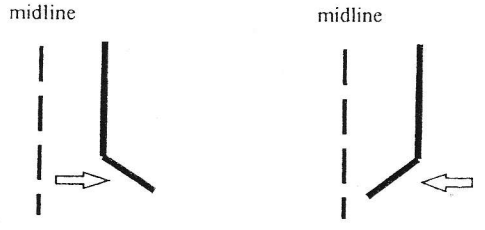
Terminology

- *Talipes*: any congenital foot deformity
- *Pes*: (Latin for foot) any acquired foot deformity

Terminology

- *Hindfoot:* talus and calcaneus
- *Midfoot: (*navicular), cuneiforms, cuboid
- *Forefoot:* metatarsals, phalanges

Valgus *Varus*



Terminology

Valgus:

- Bending **outward** of distal part from midline
- (in the forefoot = *eversion, pronation*)

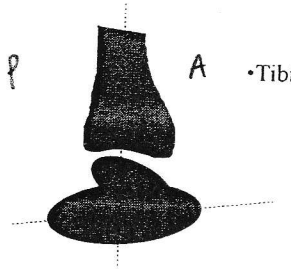
Varus:

- Bending **inward** of distal part toward midline
- (in the forefoot = *inversion, supination*)

Radiologic Evaluation

- AP and lateral *weight-bearing* or simulated weight-bearing
- Additional: flexion (dorsal or plantar), tangential (Harris) views, oblique

Normal Anatomy



- Tibial-calcaneal angle = 70-90°

Terminology

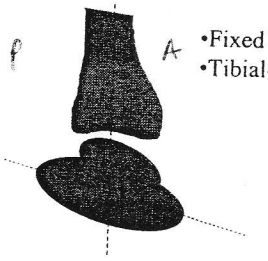
Equinus:

- Fixed plantarflexion of the hindfoot
- Tibial-calcaneal angle > 90 degrees

Calcaneus:

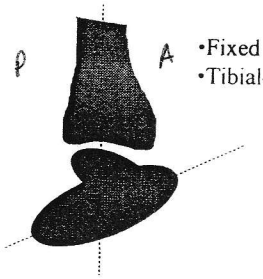
- Fixed dorsiflexion of the calcaneus
- Tibial-calcaneal angle < 60 degrees

Equinus



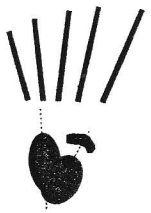
- Fixed calcaneal plantarflexion
- Tibial-calcaneal angle > 90°

Calcaneus



- Fixed calcaneal dorsiflexion
- Tibial-calcaneal angle < 60°

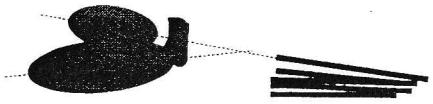
Normal Anatomy
AP View (weight-bearing)



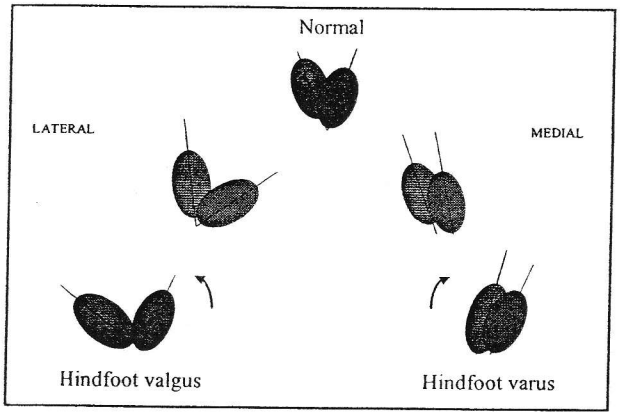
- Talocalcaneal angle = 30-45° (decr with age)

Normal Anatomy
Lateral View (weight-bearing)

•Talocalcaneal angle = 30°-45°



Everything revolves around the talus

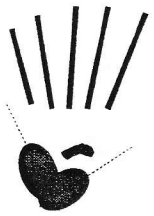


Terminology

Hindfoot valgus:

- Outward slant of heel (>5-10 degrees)
- Bottom of calcaneus faces laterally
- Talo-calcaneal angle is increased
- Axis of talus is medial to 1st metatarsal

Hindfoot Valgus



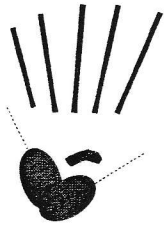
•Talocalcaneal angle
> 45 degrees

Hindfoot Valgus

•Increased
talocalcaneal angle



Hindfoot Valgus



•Talocalcaneal angle
> 45 degrees



Terminology

Hindfoot varus:

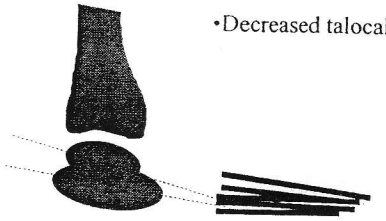
- Inward slant of heel (<5-10 degrees)
- Bottom of calcaneus faces medially
- Talocalcaneal angle is decreased
- Axis of talus is lateral to 1st metatarsal

Hindfoot Varus



•Talocalcaneal angle
< 30°

Hindfoot Varus

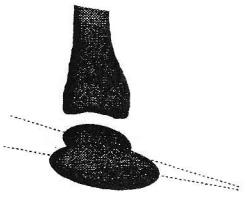


•Decreased talocalcaneal angle

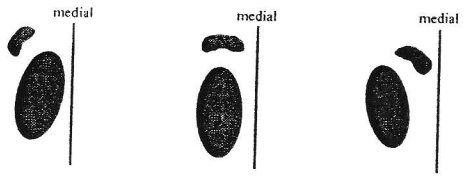
Hindfoot Varus



•Decreased talocalcaneal angle



Hindfoot Alignment

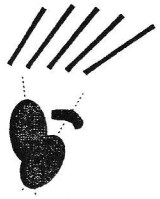


Valgus Normal Varus

Metatarsus Adductus

- 10x's more common than clubfoot
- "Intrauterine packing"
- 1-10% incidence of DDH
- Radiographs: rigidity, other deformities

Metatarsus Adductus



- Adducted forefoot
- Normal talocalcaneal angle

Clubfoot
(*talipes equinus varus*)

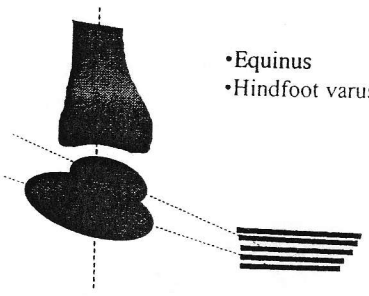
- 1-4:1000 live births
- Boys > girls
- Unilateral > bilateral
- Multifactorial inheritance modified by intrauterine and environmental factors

Clubfoot



- Hindfoot varus
- Forefoot adductus

Clubfoot



- Equinus
- Hindfoot varus

Calcaneovalgus Foot

- Common congenital foot abnormality
- Foot is markedly dorsiflexed
- Frequently bilateral
- Flexible
- Calcaneus heel (vs. equinus heel of congenital vertical talus)

Flexible Flatfoot
(*pes planus*)

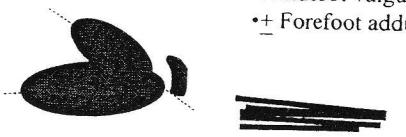
- Standard in infants and common in young children
- Longitudinal arch is reconstituted when foot hangs freely

Flexible Flatfoot
(*pes planus*)

- Radiographs for rigidity, loss of subtalar motion
- Treatment for pain, severe progression

Planus Foot

- Flattened arch
- "Relaxed" talus
- Hindfoot valgus
- ± Forefoot adductus



Congenital Vertical Talus
(*congenital flatfoot with talonavicular dissociation, congenital rigid rocker-bottom foot)*

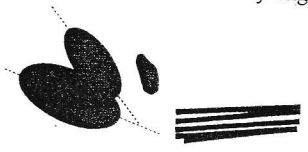
- Most severe form of congenital rigid flatfoot
- Associated with neuromuscular imbalance
- Contracted soft tissues; all eventually need surgery

Congenital Vertical Talus

- Talus in extreme plantarflexion
- Fixed dorsal dislocation of navicular
- Plantar surface of foot is convex (rocker-bottom)
- No change in alignment with plantarflexion (vs pes planus)

Congenital Vertical Talus

- Plantarflexed talus, equinus heel
- Dorsal dislocation of navicular
- Hindfoot valgus
- Forefoot dorsally angulated



Peroneal Spastic Flatfoot

- Developmental rigid flatfoot
- Associated with any cause of subtalar irritation
- Most common cause: tarsal coalition

Tarsal Coalition

- Abnormal fusion between tarsal bones (failure of segmentation in fetus)
- Fibrous, cartilaginous, osseous
- Restricts motion
- Common cause of foot pain, ankle sprains in adolescents

Tarsal Coalition

- Most often: talocalcaneal and calcaneonavicular
- Other fusions associated with other congenital abnormalities

Tarsal Coalition

Calcaneonavicular:

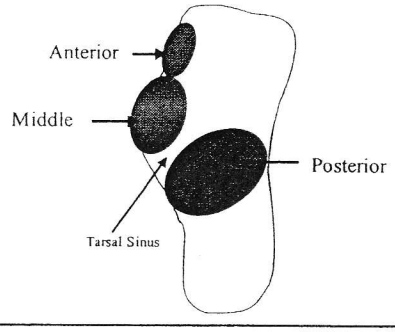
- Best seen with a 45 degree oblique radiograph

Tarsal Coalition

Talocalcaneal:

- Best seen with direct coronal imaging (CT, MRI)
- CT: 1-3mm contiguous slices with feet flat on table and knees flexed, reconstruct in other planes

Calcaneal Facets



Tarsal Coalition

- Narrowed joint
- Dorsal talar beaking
- "Anteater" sign
- "C" sign
- "Ball-and-socket" ankle
- Peroneal spastic flatfoot

Flat Foot

Flexible (*pes planus*)	**Congenital Rigid** (*congenital vertical talus*)
Valgus heel	Valgus heel
Sagging longitudinal arch	Equinus heel
Normal arch with hanging	Mid/forefoot dorsally displaced

Flat Foot

Developmental Rigid

(*peroneal spastic flatfoot associated with tarsal coalition*)

Valgus heel

Sagging longitudinal arch

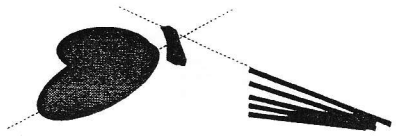
Secondary signs of coalition, arthritis, trauma

Terminology

- *Cavus foot*: abnormally high longitudinal arch
- *Planus foot*: flattened longitudinal arch

Cavus Foot

- High longitudinal arch
- Dorsiflexed calcaneus

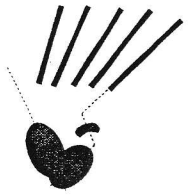


Skewfoot
(*Z-foot, S-foot*)

- Rigid forefoot adduction (varus)
- Hindfoot valgus
- Mid- and hindfoot resemble flatfoot
- Surgery: failed conservative treatment, symptoms, severe deformity

Skewfoot (*z-foot, s-foot*)

- Hindfoot valgus,
- Rigid forefoot varus



Adolescent Bunion (*hallux valgus*)

- Girls > boys
- 12-15 years
- Normal range of motion, no arthritis, less severe deformity (vs adults)
- Surgery: pain, difficulty with shoes

Adolescent Bunion (*hallux valgus*)

- Medial prominence, uncovering of head of 1st metatarsal
- Incr 1st metatarsal-phalangeal angle (>15°)
- Incr intermetarsal angle (>10°) (*metatarsus primus varus*)
- Lateral subluxation of sesamoid bones

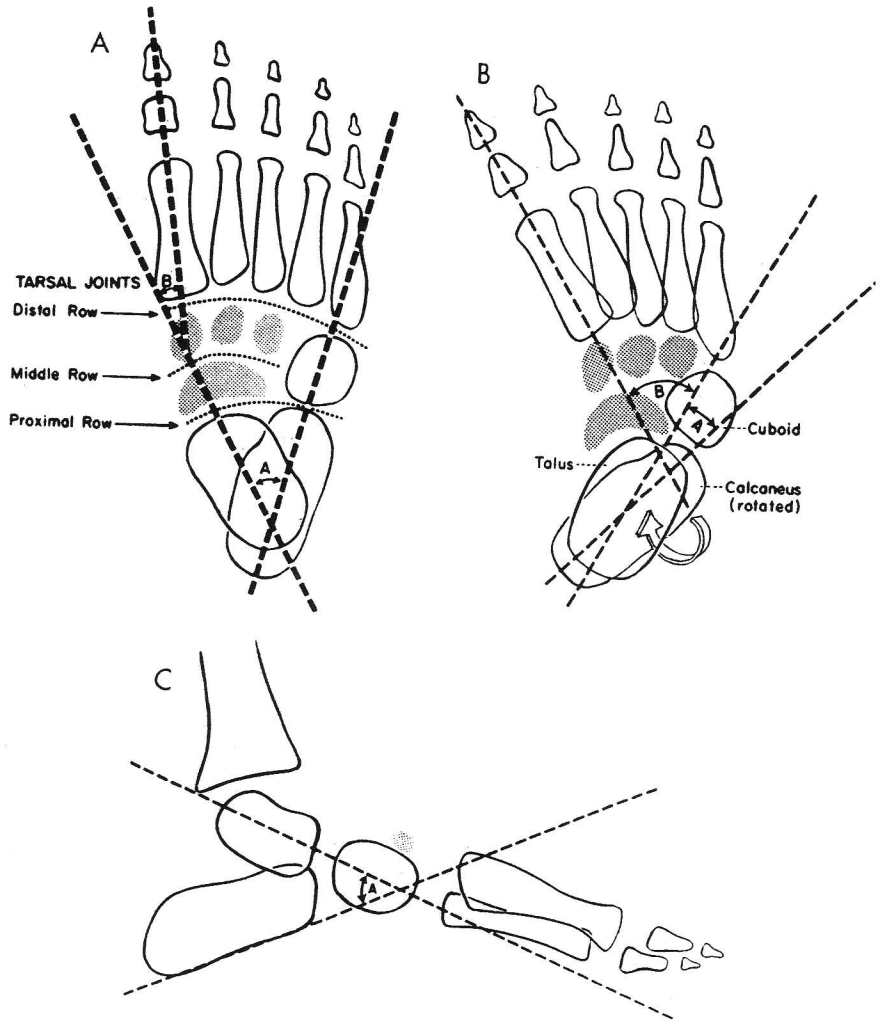


FIG 21–315.
Drawings of a normal foot with lines commonly used to evaluate clubfoot and flatfoot deformities. **A,** anteroposterior projection. The talocalcaneal angle *(A)* is measured by the lines representing the estimated longitudinal axes of the two bones. The range of normal for young children is 20 to 40 degrees. The talo–first metatarsal angle *(B)* is defined by the talar axis line and a line in the axis of the first metatarsal bone; the range of normal is 0 to −20 degrees. **B,** anteroposterior projection of a foot with hindfoot varus. Rotation of the calcaneus under the talus decreases the talocalcaneal angle below the normal range, and talonavicular subluxation with forefoot adduction is indicated by the positive talo–first metatarsal angle. A lateral projection would show the talocalcaneal angle to be less than 35 degrees, with the axes approaching parallelism. **C,** lines for angles in a lateral projection of the foot. The talocalcaneal angle *(A)* is subtended by the axial line of the talus and a line along the plantar margin of the calcaneus. Its range of normal is 35 to 55 degrees. (From Simons GW: Analytical radiography of club feet. *J Bone Joint Surg [Br]* 1977; 59:485–489. Used by permission.)