Disorders of Foot Alignment

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Ossification Centers

Newborn:

- Metatarsals and phalanges
  - (fetal 8-12 wks)
- Calcaneus
  - (fetal 23-24 wks)
- Talus
  - (fetal 26 wks)
- Cuboid
  - (at birth)
Navicular bone:
• 2-5 years
• eccentric ossification
Terminology

- **Talipes**: (Latin *talus* = ankle, *pes* = foot) congenital foot and ankle deformity
- **Pes**: (Latin: foot) “acquired” foot deformity
Terminology

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

Varus (inversion, supination)
Radiologic Evaluation

• AP and lateral **weight-bearing** or simulated weight-bearing
• Additional:
  - flexion (dorsal or plantar)
  - tangential (Harris-Beath)
  - 45 degree medial oblique views
Normal Anatomy
Lateral View (weight-bearing)
Normal Anatomy
Lateral View (weight-bearing)
Normal Anatomy
Lateral View (weight-bearing)

• Tibial-calcaneal angle
  = 70 - 90°
Equinus
Equinus

- Fixed calcaneal plantarflexion
- Tibial-calcaneal angle $>90^\circ$
Calcaneus

- Fixed calcaneal dorsiflexion
- Tibial-calcaneal angle $< 60^\circ$
Normal Anatomy
Lateral View (weight-bearing)
Normal Anatomy
Lateral View (weight-bearing)

- Talo-calcaneal angle = $30^\circ$ - $45^\circ$
Normal Anatomy
AP View (weight-bearing)
- Talo-calcaneal angle = 30° - 45° (decreases with age)
Everything revolves around the talus
Hindfoot valgus
Hindfoot valgus
Hindfoot varus
Hindfoot Valgus

- Axis of talus is medial to 1st MT
- Talo-calcaneal angle > 45°
Hindfoot Valgus
Hindfoot Valgus

- Increased talo-calcaneal angle > 45°
Hindfoot Varus

- Axis of talus is lateral to 1\textsuperscript{st} MT
- Talo-calcaneal angle < 30°
Hindfoot Varus
Hindfoot Varus

- Talo-calcaneal angle < 30°
Hindfoot Alignment

Valgus

Normal

Varus

midline
Metatarsus Adductus

- 10x’s more common than clubfoot
- “Intrauterine packing”
- 1-10% incidence of developmental dysplasia of the hip (DDH)
- Radiographs: rigidity, other deformities
Metatarsus Adductus

- Normal talo-calcaneal angle
- Adducted forefoot
Clubfoot
(talipes equinovarus)

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

- Equinus
- Hindfoot varus
Clubfoot

- Hindfoot varus
Clubfoot

- Hindfoot varus
- Forefoot varus
Additional Views
Maximal Dorsiflexion

- For clubfoot
  - Tibial-calcaneal angle (does equinus alignment improve?)
  - Talo-calcaneal angle
Flexible Flatfoot
(pes planus, flattened longitudinal arch)

- Standard in infants, common in children
- Radiographs for rigidity, loss of subtalar motion
- Treatment for pain, severe progression
- Longitudinal arch reconstitutes
Flexible Flatfoot

- Normal heel
- Hindfoot valgus
- “Relaxed talus”
- Talonavicular association on lateral view maintained
Hindfoot Valgus

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

- Most severe form of congenital rigid flatfoot
- Plantar surface of foot is convex (rocker-bottom)
- Associated with neuromuscular imbalance
- Contracted soft tissues; all eventually need surgery
Congenital Vertical Talus

- Equinus heel
- Extremely plantarflexed talus
- Hindfoot valgus
- Talonavicular dissocation
Additional Views
Maximal Plantarflexion

• For congenital vertical talus – does talo-navicular dissociation persist? (use cuboid if navicular is unossified)
<table>
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<th>Congenital Rigid (congenital vertical talus)</th>
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<td>Talonavicular association</td>
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<td>Reconstituted arch</td>
<td>No change with flexion</td>
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Skewfoot
(Z-foot, S-foot)

- Rigid
- Hindfoot valgus: resembles flatfoot
- Forefoot varus: resembles clubfoot
Skewfoot (Z-foot, S-foot)

- Hindfoot valgus,
- Rigid forefoot varus
Adolescent Bunion
\textit{(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)

bunio (Latin)
Adolescent Bunion
(hallux valgus)

• Medial prominence, uncovering of head of 1st metatarsal
• Incr intermetatarsal angle (>10°)
• Incr 1st metatarsal-phalangeal angle (>15°)
• Lateral subluxation of sesamoid bones
Bunionette
Alan E. Oestreich

How to Measure Angles from Foot Radiographs

A Primer
YOUR TURN
• >90 degrees: equinus
• >90 degrees: equinus
• Incr talo-calc angle: hindfoot valgus
• >90 degrees: equinuus
• Incr talo-calc angle: hindfoot valgus
• Plantar-flexed talus with presumed talo-navicular dissociation =
• CONGENITAL VERTICAL TALUS
Thank you!