Paediatric Foot Disorders

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Anatomy

"Yeah, I'm here for the VP of Human Resources job. Why do I have to know anatomy?"
Bones of the foot

- Tibia
- Talus
- Navicular
- Cuneiforms
- Metatarsals
- Calcaneus
- Cuboid
- Tarsal-metatarsal joints
- Phalanges
- Metatarsophalangeal joints

Foot Disorders
Valgus

Deviation of the distal body part away from the midline
Varus

Deviation of the distal body part *towards* the midline
Adduction

Movement of forefoot *towards* the midline
Abduction

Movement of forefoot *away from* the midline
Inversion
deviation of foot **medially** at the subtalar joint
Eversion

deviation of foot *laterally* at the subtalar joint
Plantarflexion

deviation of foot **downwards** at the ankle joint
Dorsiflexion

deviation of foot *upwards* at the ankle joint
Pronation

Combined dorsiflexion, eversion and abduction
Supination

Combined plantarflexion, inversion and adduction
Cavus

elevated longitudinal arch of the foot
Planus

flattened longitudinal arch of the foot
Calcaneus

extreme dorsiflexion deformity of the hindfoot
Equinus

extreme plantarflexion deformity of the hindfoot
Congenital Talipes Equinovarus

- Also known as Clubfoot
- Characterised by deformity CAVE
  - Cavus of the midfoot arch
  - Adduction of the forefoot
  - Varus of the hindfoot
  - Equinus of the hindfoot
CTEV
Incidence

- Usual: 1 per 1,000
- M:F: 2.5 : 1
- Bilateral: 50%
- Maoris: 7 per 1,000
- Risk: 2-5% in siblings
  25% if both parent and sibling affected
Associated conditions

- Neurological
  - Myelomeningocele
  - Spina bifida occulta
- Arthrogryposis Congenita Multiplex
- Chromosome Abnormalities
  - Trisomy 13 & 18
Aetiology

- Unknown
- Theories
  - Packaging defect (*Hippocrates*)
  - Neuromuscular defect
  - Reduced anterior horn cells (*Swart*)
  - Increase in type I (slow) fibres
  - Arrest of foetal development
  - Primary germ plasm defect of talus
  - Retracting fibrosis
Diagnosis

- Prenatal Ultrasound
- Structural
- Postural
Treatment
Ponseti

- Serial casting to correct deformity
- Often requires achilles tendon tenotomy to correct equinus
Ponseti - Boots and Bars
Relapse
Surgery

Staged surgery
- Posteromedial release
- Posterolateral release
Relapse
Congenital Talipes Calcaneovalgus
CALCANEOVALGUS FOOT

- 1:1000 live births
- Intrauterine Positioning
- Associated with lateral tibial torsion
- Common in first born
- Dorsiflexion/eversion/abduction
- Passively correctable
- Resolves spontaneously - passive stretches & splints may be used
METATARSUS ADDUCTUS
METATARSUS ADDUCTUS

- 1:1000 incidence
- 50% bilateral
- Results from intrauterine position
- Forefoot adducted at TMT joint, sole is kidney shaped, heel is NOT equinus
METATARSUS ADDUCTUS

- 86% resolve spontaneously by age 6, 95% by age 16.
- 10-15% also have DDH
- Medial skin crease suggestive of resistant case
Metatarsus Adductus Grading System

- Grade I
  - Overcorrects

- Grade II
  - Corrects to neutral

- Grade III
  - Does not correct to neutral
Metatarsus Adductus Treatment

- Correctable
  - No treatment

- Not correctable
  - Serial casting
  - ?straight medial border shoes

- Not correctable and symptomatic
  - ? Surgery
Long term results of patients with mild-moderate residual deformity after treatment are good.

SURGERY indicated in children >5yo with severe symptomatic residual metatarsus adductus.
Surgical treatment
Metatarsus Adductus

- Adductor Hallucis release
- Medial opening cuneiform and lateral closing cuboid osteotomies
Skewfoot

- Combination of forefoot deformity of metatarsus adductus and hindfoot deformity of valgus flatfoot
Skewfoot

- Rare
- Aetiology unknown
  - ? iatrogenic
  - ? muscle imbalance
  - often syndromal
- Natural history unknown?
  - Little evidence of disability
Skewfoot

- Symptoms: Pain over talar head, 1st MT head, 5th MT base
- Treatment in young children: Serial casts as for metatarsus adductus with varus stress on heel
- Aim to convert foot to flatfoot
- Treatment in older children: osteotomies of the calcaneus and midfoot
Pes Cavus
PES CAVUS

- Elevated longitudinal arch due to plantar flexion of the forefoot &/or dorsiflexion of the calcaneus.
- Secondary contracture of plantar fascia.
- Claw toes - often the first deformity seen.
Cavus Foot - Aetiology

> 50% Neuromuscular

- Hereditary Motor Sensory Neuropathy (CMT)
- Poliomyelitis
- Friedreich’s ataxia
- Cerebral Palsy
- Spina bifida
- Spinal cord tumour
- Syringomyelia
Cavus Foot - Aetiology

- Non neurological causes include:
  - Idiopathic
  - CTEV, Arthrogryposis
  - Traumatic
    - Compartment Syndrome
Cavovarus

- Plantarflexion of first ray
- Pronation of forefoot
- Adduction of forefoot
- Hindfoot varus
- Toes clawed
Cavus foot symptoms

- Clawtoes - calluses with shoes
- Metatarsalgia
- High arch
- Anterior ankle pain
- Recurrent ankle sprains
Cavus Treatment

- Full neurologic work-up especially if unilateral
  - Spinal X-Rays
  - MRI
  - NCS
- Referral to neurologist
Cavovarus foot - treatment

- Non-operative orthotics
- Surgery: Plantar release, dorsal cuneiform osteotomy
  - Tendon transfers
  - Calcaneal osteotomy
  - Ilizarov for multiply operated case
CONGENITAL VERTICAL TALUS
Congenital Vertical Talus

- Irreducible dorsal dislocation of navicular on talus with a fixed talocalcaneal complex. Dislocation can be limited to talonavicular joint or can also involve calcaneocuboid joint.
- Common cause of rigid flatfoot
- 50% bilateral
Congenital Vertical Talus

- Teratologic - most CVT
  - Chromosomal abnormalities
  - Arthrogryposis
  - Myelomeningocele

- Neurogenic

- Iatrogenic - overcorrection CTEV

- Idiopathic - rare
NORMAL             OBLIQUE TALUS           VERTICAL TALUS
CVT TREATMENT

- Non-operative initially
  - stretching
  - serial casting
Surgery is aimed at correcting hindfoot equinus and forefoot dorsiflexion and abduction.

Correction of hindfoot is the primary step in correction of the foot.
OBLIQUE TALUS

- Talonavicular subluxation that reduces with plantar flexion of the foot.

- Treatment
  - Observation
  - Orthotics
  - Surgery: Pinning reduced talonavicular joint & tendoachilles lengthening
TARSAL COALITION

- Disorder of mesenchymal segmentation leading to fusion of 2 or more tarsal bones
- Autosomal dominant with variable penetrance
- 3% of population
- 50% bilateral
- 90% calcaneonavicular or talocalcaneal
TARSAL COALITION

- May be bony, cartilaginous or fibrous
- Multiple coalitions may exist in same foot
- Leading cause of peroneal spastic flatfoot
TARSAL COALITION

- Become symptomatic when coalition ossifies:
  - TALONAVICULAR 3-5yo
  - CALCANEONAVICULAR 8-12yo
  - TALOCALCANEAL 12-16yo

- Hindfoot pain aggravated by activity.
- Ankle sprains
- Stiff subtalar joint
- Medial or lateral tenderness
- Peroneal spastic flatfoot
Normal oblique foot xray
CALCANEO-NAVICULAR BAR

ANTEATER’S NOSE
TALONAVICULAR COALITION
TARSAL COALITION

- Asymptomatic - observation
- Symptomatic: NON-OPERATIVE
  - activity modification
  - Orthotics
  - Short leg walking cast
TARSAL COALITION

- OPERATIVE TREATMENT
  - Calcaneonavicular - excision & EDB interposition
  - Talocalcaneal
    - adolescent with <50% of facet involved - resection
    - subtalar OA or > 50% of facet involved - subtalar fusion
    - midfoot OA - triple arthrodesis
Juvenile Hallux Valgus
Bunion
JUVENILE BUNION

- Bilateral, familial, more common in females
- Aetiology: Imbalance of forces
- Predisposing factors:
  - Metatarsus primus varus
  - Long 1st MT
  - Ligamentous laxity
  - Neurologic disorders
  - Shoewear with narrow toe box
JUVENILE BUNION

- Most asymptomatic & require no treatment
- Non-operative treatment: wide shoes and arch support
- Surgical treatment - progression of deformity or failed non-op tx

SOFT TISSUE CORRECTION
OSTEOTOMY - metatarsal
- phalangeal
- cuneiform

ARTHRODESIS
JUVENILE BUNION

- Complications

* OVERCORRECTION/HALLUX VARUS
* RECURRENCE 20% (soft tissue only >50%)
  - inversely related to age
  - REOPERATE AFTER SKELETAL MAT
* PHYSEAL INJURY - rare
* AVN - rare
* STIFFNESS
* DEFUNCTIONING 1ST RAY
BUNIONETTE

- Lateral prominence of 5th MT head
- Usually unilateral
- Irritated by shoewear

Treatment:
- Non-operative
  - shoewear modification
- Operative
  - Exostectomy
  - osteotomy
Flexible Flatfoot

- Flattening of the medial longitudinal arch on standing
- Heel valgus, forefoot pronation and abduction.
- Prominent talar head medially.

- 7%-22% prevalence
- Bilateral and familial
- Associated with ligamentous laxity and limb alignment problems
Flexible Flatfoot

- Symptoms: midfoot ache, pretibial pain, excessive shoe wear. Pain and callosity over talar head.
- Longitudinal arch develops spontaneously during first decade and most flatfooted adults are asymptomatic.
Flexible Flatfoot

- No treatment if asymptomatic

- If symptomatic
  - Arch orthosis/UCBL inserts
  - Achilles tendon stretches if tight

- If refractory
  - wedge or sliding calcaneal osteotomy
  - +/- Achilles tendon lengthening
KOHLER’S DISEASE
KOHLER’S DISEASE

- AVN of navicular due to repetitive compressive forces
- Males (5:1)
- 4 - 5 yo
- Bilateral in 1/3
- Self limiting
- X-Ray - flattening, sclerosis, irregularity of navicular
KOHLER’S DISEASE

- May be asymptomatic
- Present with pain over navicular, antalgic gait, weight bearing on lateral aspect of foot
- Treat with decreased activity, orthotics with arch support +/- immobilisation
- Prognosis excellent
FREIBERG’S INFRACTION

- AVN usually of 2nd MT head (other MTs may be affected) due to vascular insufficiency $2^0$ to chronic stress
- Adolescents
- Female 75%
- Occasionally bilateral
- X-Ray: MT head flat & irregular
FREIBERG’S INFRACTION

- Metatarsalgia, mild swelling and stiffness

- Treatment:
  - non-operative
    - Walking cast
    - Metatarsal pad
  - Operative
    - curettage & bone graft
    - Shortening MT osteotomy
    - extension osteotomy
SEVER’S DISEASE

- Traction apophysitis at insertion of Achilles tendon
- Heel pain & tenderness, aggravated by activity & relieved by rest
- Decreased ankle dorsiflexion
- Normal X-Rays - sclerosis and fragmentation of calcaneal apophysis normal variant
- Treatment: Activity modification, rest, heel cushion, stretches, NSAIDS, cast
SEVER’S DISEASE OR NORMAL?
ACCESSORY NAVICULAR

- Normal variant seen in 4-21%
- Often incidental discovery
- Associated with flatfeet
- Medial arch pain with overuse centred over navicular.
- External oblique X-Ray view demonstrates
ACCESSORY NAVICULAR

- Treated with restriction of activities +/- immobilisation in short leg cast, then shoe modification/padding

- Excision relieves pain but does not correct flatfoot
Curly Toe

- “Underlapping toe”. Flexion deformity of PIP joint with external rotation and varus of the toe.
- Usually occurs in lateral 3 toes
- Familial, bilateral, symmetrical, rarely symptomatic
- Due to muscle imbalance
CURLY TOE

- 25% resolve spontaneously. Remainder don’t worsen with growth but may develop symptoms and become stiff.

- Treatment if symptomatic or if severe - flexor tenotomy (FDL +/- FDB)

- Late treatment - resection or arthrodesis of PIP joint may be necessary for correction
OVERLAPPING FIFTH TOE

- Familial, bilateral & asymptomatic
- Fifth toe adducted, extended & externally rotated at MTP jt & overlaps fourth toe
- May cause footwear problems

- Non-operative tx: stretching & buddy taping
- Operative - tenotomy, dorsal capsulotomy & V-Y advancement

Foot Disorders
OLIGODACTYLY

- Congenital absence of toe(s)
- Requires no treatment
- Associated with fibular hemimelia and tarsal coalition
TOE POLYDACTYLY

- Extra digits - preaxial, central or postaxial
- Incidence 2:1000
- Usually involves lateral ray (80%)
- May be inherited (30%) (AD)
- 25% bilateral
- Associated with finger polydactyly & metatarsal anomalies
TOE POLYDACTYLY

- Rudimentary digits treated by ligation in nursery and allowing “autoamputation”
- Surgical excision of digit at 9-12 months before starts wearing shoes
TOE SYNDACTYLY

- Fusion of adjacent toes (2nd-3rd)
- Familial & asymptomatic
- Simple or Complex
- Complete or partial
- Simple does not require treatment
- Complex separated at 18mths - 5yrs.
HAMMER

CLAW

MALLET
HAMMER TOE

- Flexion deformity at PIP jt with hyperextension at DIP jt +/- secondary hyperextension at MTP jt.
- Due to flexor tightness
- Bilateral, symmetrical, commonly 2nd toe.
- Asymptomatic early - later painful corn, stiffness
- Treatment flexor tenotomy in early childhood
- Fixed deformity - arthrodesis PIPJ + MTPJ dorsal capsular release
CLAW TOE

- Flexion deformity at PIP and DIP joints with hyperextension at MTP joint
- Usually all 4 lesser toes involved
- Usually associated with pes cavus but can be idiopathic
- Result of imbalance between intrinsics and extrinsics muscles
- Often asymptomatic.
- Symptoms - metatarsalgia, painful corns over PIP joints
CLAW TOE

- **Treatment:**
  - **Non-operative**
    - shoewear modification (deep toe box, soft shoes)
    - Orthotics - metatarsal bar
  - **Operative**
    - Capsule release
    - Tenotony
    - Tendon transfer
    - Arthrodesis PIPJ
MALLET TOE

- Flexion deformity at DIP jt
- Aetiology: FDL shortening
- Commonly 2nd toe
- Assoc with long 2nd MT
- Symptoms from dorsal corn or toenail irritation
- Treatment:
  - young child - FDL tenotomy
  - fixed deformity - excision arthroplasty or arthrodesis
Thank you