Other Congenital and Developmental Diseases of the Foot

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- Flatfoot
- Congenital Vertical Talus
- Tarsal Coalition
- Cavus Feet

Hallux Valgus
- Hallux Valgus Interphalangeus

Foot Pain
- Osteochondrosis
- Syndesmosis Disruption

Toe Walking
Introduction

Foot
1) forefoot : metatarsals and phalanges
2) midfoot : cuboid, navicular, and cuneiforms
3) hindfoot : talus and calcaneus

Description of deformity : location, plane of the abnormal rotation, translation
Introduction

Hindfoot
1) coronal rotation: varus (medial) / valgus (lateral)
2) axial rotation: varus (internal) / valgus (external) rotation at the subtalar joint
3) sagittal rotation: equinus / calcaneus at the ankle joint

Midfoot and Forefoot
1) coronal rotation: adduction (medial deviation) / abduction (lateral deviation)
2) axial rotation: pronation / supination
Foot Deformities
# Contents

## Introduction

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## Foot Pain
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## Toe Walking
Metatarsus Adductus

- the most common foot deformity
- 1 per 1,000 live births
- medial deviation of the forefoot with neutral or slight valgus hindfoot
Metatarsus Adductus

The most accepted theory: tight intrauterine packing

Etiology:
- Predisposing Factors: twin births, oligohydramnios
- Farsetti: anomaly of medial cuneiform-MT joint
- Kite: muscle imbalance
Metatarsus Adductus

Intrauterine Packing Abnormalities

Careful hip & neck evaluation is essential !!!

Congenital Muscular Torticollis

Hip Dysplasia

Metatarsus Adductus
Metatarsus Adductus

Diagnosis

- heel bisector line

- photocopies of the sole
Metatarsus Adductus

Classification by Bleck(1983)

: heel bisector line

NORMAL    VALGUS    MILD  Figure 1   MODERATE    SEVERE
Metatarsus Adductus

Classification by Crawford (1987): according to passive and active mobility

- **Type I**: flexible, **correct** to overcorrected position passively and actively
- **Type II**: **correct** to neutral passively but does not correct actively
- **Type III**: rigid, does **not correct** to neutral passively and actively
# Metatarsus Adductus

*D/Dx*: metatarsus varus, clubfoot (common), skewfoot (rare), abducted great toe

<table>
<thead>
<tr>
<th>Type</th>
<th>Etiology</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Metatarsus adductus</td>
<td>late intrauterine, positional deformity</td>
<td>common form, flexible 90% resolve spontaneously</td>
</tr>
<tr>
<td>Metatarsus varus</td>
<td>early onset, intrauterine position?</td>
<td>often rigid cast correction necessary</td>
</tr>
<tr>
<td>Skewfoot</td>
<td>familial generalized joint laxity</td>
<td>hindfoot valgus abduction midfoot adduction forefoot treatment difficult</td>
</tr>
<tr>
<td>Abducted great toe</td>
<td>unknown</td>
<td>dynamic deformity resolves spontaneously</td>
</tr>
</tbody>
</table>
Metatarsus Adductus

Management

Natural History Studies
♠ Rushforth GF(1978) : only 4% had a severe deformity
♠ Ponseti IV & Becker JR(1966) : 5% had a significant residual deformity of the casting group

Mild flexible foot : documentation and observation

Moderately flexible foot : home stretching
Metatarsus Adductus

Management

- Severe foot (Metatarsus varus)
  - ♠ serial casting: every 1 to 2 weeks - most effective
    before 8 months of age
  - ♠ long-leg bracing: in the toddler
  - ♠ operative correction after 4 years of age:
    1) multiple metatarsal (not to damage the 1st metatarsal’s
       growth plate)
    2) medial lengthening & lateral shortening osteotomies rather
       than 3) capsulotomy (high rate of recurrence)
Metatarsus Adductus

Management

- Severe foot (Metatarsus varus)
  - ♠ in the older child: best to accept the deformity
    1) not cause disability
    2) correction is not simple and complications are common
Forefoot adductus (infant)

Screening

Examination

Flexible

Metatarsus adductus

Document, reassure, follow-up

Metatarsus varus

Rigid

Infant

Cast or brace

Young child

Long-leg cast series

Older child

Accept deformity

Osteotomy
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Toe Walking
Skewfoot

- Z-foot, serpentine foot
- a spectrum of complex deformity
- forefoot adduction
  - *midfoot abduction*
  - *hindfoot valgus plantarflexion*
Skewfoot

Etiology
- primarily: neuromuscular dis. / sometimes familial
- idiopathic: usually isolated deformities
- iatrogenic: overcorrected MA and clubfoot

Symptoms
- pain and difficulty wearing shoes
- a tight heel-cord: usually present in symptomatic cases
- idiopathic skewfoot: persist and cause disability in adolescence and adult life
Skewfoot

X-ray findings

- zig-zag deformity
- medial deviation of forefoot
- lateral deviation of navicula on talus

- plantar flexed talus
Skewfoot

Management

- **op. indication**: failure of conservative care with the inability to accommodate a shoes

- **young children**
  - ♠ initial documentation and observe to determine the effect of growth on the deformity
  - ♠ early soft tissue procedures: effective

- **late childhood**: heel-cord lengthening
  + calcaneal osteotomy
  + med. lengthening & lateral shortening osteotomies

- **mature patients**: fusion
Flat Feet (Pes Planus, Planovalgus)

- arch increases in height with maturity as the fatty tissue along the sole decreases
- a valgus heel and reduction in height of longitudinal arch
- hindfoot valgus + compensatory midfoot supination & abduction

Central issues: foot flexibility and pain !!!
Flat Feet (Pes Planus, Planovalgus)

**Classification:** physiologic or pathologic

<table>
<thead>
<tr>
<th>Flexible (Physiologic) flatfoot</th>
<th>Developmental flatfoot</th>
<th>flexible, benign common variation of normal</th>
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<tbody>
<tr>
<td>hypermobile flatfoot</td>
<td>hypermobile FF &amp; tight tendo–Achilles coaliton skewfoot vertical talus neurogenic flatfoot</td>
<td>some degree of stiffness disability require treatment</td>
</tr>
<tr>
<td>Pathologic flatfoot</td>
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</tbody>
</table>
Flexible Flatfoot

Incidence
- present in nearly all infants, many children, about 15-23% of adults
- often familial
- most common: wear shoes, obese, generalized joint laxity

2 Basic forms
- Developmental: in infants and children / as a normal stage of development
- Hypermobile: persist as a normal variant
Flexible Flatfoot

Screening exam. : generalized joint laxity
Flexible Flatfoot

- the most useful test: great toe extension test (Jack test)
- the simplest test: stand on tip-toe test
Flexible Flatfoot

Management

- **Reassurance**: required with a flexible, painless flatfoot in the absence of tight Achilles tendon
- **Require no treatment**
- **Custom-made orthotics**: ineffective, expensive, need to be replaced
- **Well-formed arch support**: in the adolescent-adult who have midfoot pain after prolonged walking
Calcaneovalgus

due to intrauterine packing abnormality
associated with developmental hip dysplasia
D/DX: congenital vertical talus
tibia; sometimes posteromedial bowing
– take several years to resolve
resolve spontaneously over several weeks - require no treatment
stretching
unilateral involvement + LLD(1-5cm)
: limb equalization procedure
**Hypermobile Flatfoot with Tight Tendo-Achilles**

- the first line Tx: Achilles tendon lengthening
- serial casting & botulinum toxin injection: useful
- persistent ankle equinus: surgical lengthening
Hypermobile Flatfoot with Tight Tendo-Achilles

Procedures that correct hindfoot valgus

1. medial displacement calcaneal osteotomy
2. lateral column lengthening of the calcaneus
3. arthrorisis: staple across the subtalar joint without a fusion
4. subtalar arthrodesis: poor long-term results

3 & 4: restrict hindfoot motion and not restore the arch
Congenital Vertical Talus

the most severe and serious pathologic flatfoot

congenital deformity: not only flattening but an actual convexity of the sole (stiff “rocker bottom” foot)

dorsal D/L of the navicula onto the talar head

equinus hindfoot & dorsiflexed abducted midfoot

Etiology

1. idiopathic

2. CVT with other condition: more common / arthrogryposis
   multiplex congenita, myelomeningocele, congenital myopathy, intraspinal lesions
Congenital Vertical Talus

- stiff foot with contractures of both dorsiflexors and plantarflexors
- lateral radiograph: **vertical orientation** of the talus
- Sx. & Signs: pain / callus / can’t stand
Congenital Vertical Talus

- **Flexible oblique talus**: plantar flexion lateral radiograph - reduction
- **CVT**: talus and calcaneus are fixed in plantarflexion in both views
Congenital Vertical Talus

Management

- **Nonambulators**: accommodation shoes

- **Without Tx in sensate ambulators**: progressive pain / plantar callus / Charcot joint

- **Late in the 1st year**: lengthen the heel-cord and anterior structures
  - + posterolateral release
  - + reestablish the talonavicular joint
  - + consider transfer of the tibialis anterior to the talus

- **Older child**: naviculectomy or subtalar fusion

- **Best results**: undergo op. intervention before 2 years of age
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Toe Walking
Tarsal Coalition

a failure of segmentation: fusions between tarsal bones

greatly reduced subtalar motion of inversion & eversion:
  a history of frequent ankle sprain, fractures

subtalar joint: typically in valgus

fibrous(syndesmosis) / cartilaginous(synchondrosis) / osseous(synostosis)
Tarsal Coalition

2 common forms: Talocalcaneal (TC) / Calcaneonavicular (CNC)

Often familial / unilateral or bilateral / equal in both sexes

Be aware that coalition may involve more than one joint.

Early adolescence: degenerative arthritis, pain, peroneal spasm
Tarsal Coalition

Calcaneonavicular C.

- most common
- pain: in the sinus tarsi
- oblique X-ray: best
  lateral X-ray: “anteater nose” sign
- Tx of symptomatic cases
  1) initial: short leg walking cast
     for 4 weeks
  2) recur or fail: resection of the coalition with fat,
     muscle (extensor hallucis brevis) or tendon interposition
Tarsal Coalition

Talocalcaneal C.

- usually involve the middle facet
- pain: in the medial hindfoot by the sustentaculum tali
- Harris view or special calcaneal view
  lateral X-ray: “C sign”

CT scan: best
1) to identify multiple coalition
2) to assess the coalition location
3) to assess the percentage of joint involvement
Tarsal Coalition

Talocalcaneal C.

Treatment of symptomatic coalition

- initial: short leg walking cast for 4 weeks
- recur or fail: resection of the coalition with fat, muscle (extensor hallucis brevis) or tendon interposition
- resection: is likely to fail if coalition exceed 50% of the joint
  - heel valgus may be increased by resection → calcaneal lengthening
- extensive or multiple: arthrodesis
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Toe Walking
Cavus Feet

- normal stable tripod: 1st and 5th metatarsal head and calcaneal tuberosity
- increased height of the longitudinal arch: the opposite deformity of a planovalgus
- high arch and heel varus: caused by plantar flexion (depression) of the 1st metatarsal
- forefoot: pronation
- foot ridigidity: contracture of plantar fascia, tibialis anterior and posterior, and osseous adaptation
Cavus Feet

Classification

- physiologic form
  1) most often
  2) often familial
  3) usually bilateral / onset in infancy
  4) clawing of the toes: absent

- pathologic form
  1) usually secondary to
     a neuromuscular disorders causing muscle imbalance
  2) clawing of the toes due to intrinsic muscle weakness: present
Cavus Feet

Evaluation

- neuromuscular disorders causing cavus: often familial!
  1) family history
  2) careful neurologic examination

- standing radiographs
  1) calcaneal pitch
  2) 1st & 5th metatarsal alignment
Cavus Feet

Evaluation

- mobility of the hindfoot (Coleman block test)
Cavus Feet

Types

- **Pes cavus**: increase in calcaneal pitch with valgus or neutral position of the heel

- **Pes cavovarus**: most common form / mild increased calcaneal pitch with heel varus / plantar flexion of the 1\textsuperscript{st} ray / clawing of the toes

- **Pes calcaneovarus**: result from weakness of the triceps / increase in calcaneal pitch and cavus
Cavus Feet

**Managements**

- **Mild deformity**
  - shock absorbing footwear / soft molded shoe insert

- **Moderate or severe**
  - **Flexible def.**
    - plantar medial release & appropriate tendon transfer

  - **Fixed def.**
    - correction in two stages

    - soft tissue release

    - Calcaneocavus – calcaneal osteotomy
    - Cavovarus – plantar flexion cuneiform osteotomy
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Toe Walking
Hallux Valgus (Bunion)

Etiology

- **developmental deformity**
  - due to metatarsus primus varus
  - increased intermetatarsal angle

- **secondary deformity**
  - due to the effect of wearing shoes
  - increased hallux valgus angle

- combination of primary & secondary deformities
Hallux Valgus (Bunion)

**Etiology:**

**Intrinsic Factors**
- familial
- neuromuscular
- joint laxity
- hindfoot valgus

**Extrinsic Factors**
- pointed shoes

**Other Factors**
Hallux Valgus (Bunion)

AP & lateral standing radiographs

- intermetatarsal angle > 10°
- distal metatarsal articular angle > 9°
- hallux valgus angle > 15°
Hallux Valgus ( Bunion )

Management

- attempt to delay operative correction until the end of growth to reduce the risk of recurrence
- avoid pointed shoes and high heels: aggravate deformity and discomfort
- hindfoot valgus & Achilles tendon contracture (a cause of recurrence) must be treated
- splint: night-time use
  : may be effective
Hallux Valgus (Bunion)

- Metatarsal osteotomy
- Cuneiform osteotomy
- Proximal phalangeal osteotomy
- Simple excision of the bunion prominence
- Capsular plication + osteotomies
Hallux Valgus (Bunion)
Hallux Valgus (Bunion)

Complications

- recurrence
- MP joint subluxation
- elevation or depression of MT head
- overcorrection
- ray shortening
Hallux Valgus Interphalangeus

- valgus at the IP joint of big toe
- associated with a congenital anomaly of the distal phalanx
- X-ray: wedge-shaped epiphysis
Hallux Valgus Interphalangeus

Management

- osteotomy of the proximal phalanx
- fusion of the IP joint after growth has finished
Hallux Valgus Interphalangeus
Foot Pain
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Toe Walking
Köhler disease

- tarsal navicular
- most common in boys between 3 and 5 years of age
- spontaneous healing without residual deformity
  - short leg walking cast for 8 weeks

- X-ray: collapse and increased density
  - patchy deossification
  - reconstituted
**Freiberg disease**

- metatarsal head
- most common in adolescent girls or running athletes / second metatarsal
- irregular articular surface → sclerosis
  → fragmentation
  → reconstitution
**Freiberg disease**

- residual overgrowth & articular irregularity
  - degenerative change & persistent pain

**Management**

**Conservative**:
- nonweight-bearing orthosis
- metatarsal pads
- short leg walking cast

**Operation**
- ♠ persistent pain: joint debridement / resection arthroplasty
- / interposition arthroplasty
- ♠ severely involved: metatarsal resection or arthrodesis
Sever disease

calcaneal apophysis:
etiologically similar to Osgood-Schlatter’s disease

fragmentation and sclerosis of the calcaneal apophysis:
: show commonly in asymptomatic children

Management:
: rest / NSAIDs / heel pads
: Achilles tendon stretching
: resolves over weeks to months
**Syndesmosis Disruption**

- accessory ossicles: common and usually asymptomatic

- disruption between primary ossicle and accessory ossicle

- a common cause of pain: children and teenagers

- the equivalent of a stress injury

- recurrence: common
Accessory Navicular

- accessory ossification center on the medial side of the navicular: 10-12% of the population
- remain as a separate ossification center in about 2%
- one of the causes of a painful planovalgus
Accessory Navicular

3 morphologic types
- type I: a small oval to round ossicles within the TPT
- type II: a larger lateral projection with a clear separation / cause pain
- type III: a connected, “horn shaped” prominence
Accessory Navicular

disruption are common during late childhood and adolescence: probably due to repetitive trauma

pain: cause inhibition of the function of the tibialis posterior tendon with secondary lowering of the longitudinal arch

Management

short leg cast for 4 weeks → a custom orthosis

persistent pain: simple excision with or without plication of the posterior tibialis tendon
Accessory Navicular
Malleolar Ossicles

- ossification centers: below the malleoli
- persisting ossicle under lateral malleolus: painful
- cast immobilization
- rarely, excision or stabilization by internal fixation
Toe Walking

- Developmental milestones of walking:
  - start walking: 10-17 months
  - adult gait pattern: 7 years

- Toe walking (equinus gait):
  - until 3 years of age: can be a normal
  - after 3 years of age: considered abnormal

- Classification:
  - acute painful toe walking: recent trauma / foreign body
  - acute painless toe walking: PMD / spinal cord lesion
  - chronic toe walking: LLD / CP
  - idiopathic (habitual) toe walking
# Toe Walking

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<td>Gastrocnemius contracture</td>
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<tr>
<td></td>
<td>Accessory soleus muscle</td>
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<tr>
<td></td>
<td>General triceps contracture</td>
</tr>
<tr>
<td>Neurogenic</td>
<td>Cerebral palsy</td>
</tr>
<tr>
<td></td>
<td>Poliomyelitis</td>
</tr>
<tr>
<td>Myogenic</td>
<td>Muscular dystrophy</td>
</tr>
<tr>
<td>Functional</td>
<td>Hysterical toe walking</td>
</tr>
</tbody>
</table>
Idiopathic Toe Walking

3 distinct clinical categories

Gastrocnemius contracture
- the most common
- often familial
- lengthening of G. aponeurosis

Accessory soleus
- rare
- congenital
- lengthening

General triceps contracture
- rare
- heel cord lengthening
Idiopathic Toe Walking

Initial
Gastrocnemius-soleus complex stretching

Fail
cast / Botulinum toxin injections / both

Treatment

Persistent contracture
surgical lengthening of the Achilles tendon
Thank You !!!