Evaluation of Pediatric Foot Pain

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Our Patient…

AP is a 10 year old boy with chronic R foot pain
Anatomy of the Foot

Manusov EG, et al. (1996), Part II
DDX of Pediatric Foot Pain

- **Forefoot/ Midfoot**
  - Structural Abnormality
    - Overlapping/ Curly Toes
    - Accessory Navicular
  - Infectious
    - Osteomyelitis
  - Repetitive/ Acute Trauma
    - Onychocryptosis (Ingrown Nail)
    - Hallux Valgus
    - Turf Toe
    - Sesamoiditis
    - Sesamoid Stress Fx
    - Frieberg's Disease (AVN of second metatarsal epiphysis)
    - Stress Fracture
    - Fracture
    - Kohler's Disease (Ischemic Necrosis of Navicular)
  - Tumor/ Growth
    - Bone Cysts
    - Ewing’s Sarcoma
    - Osteoid Osteoma
    - Synovial Sarcoma
DDX of Pediatric Foot Pain

**Structural Abnormality**
- Pes Planus (Flatfoot)
  - Flexible
  - Rigid (Tarsal Coalition)
- Os Trigonum Syndrome

**Infectious**
- Osteomyelitis

**Repetitive/Acute Trauma**
- Plantar Fasciitis
- Calcaneal Apophysitis (Sever’s Disease)
- Calcaneal Stress Fx
- Retrocalcaneal Bursitis (Haghund’s Disease)
- Lisfranc Joint Sprain
- Ankle Sprain
- Osteochondritis dessicans
- Fracture

**Tumor/Growth**
- Bone Cysts
- Ewing’s Sarcoma
- Osteoid Osteoma
- Synovial Sarcoma

Manusov EG, et al. (1996), Parts I & II
Anatomy of the Calcaneus

http://education.yahoo.com/reference/gray/subjects/subject?id=63
Anatomy of the Talus-1

Lateral View

Medial View

Fibular Facet

Navicular Facet

Tibial Facet

http://www.maitrise-orthop.com/corpusmaitri/orthopaedic/mo80_laude/laude_us.shtml#1
Anatomy of the Talus-2

Inferior Aspect

- Navicular Facet
- Middle Articular Facet (for sustentaculum tali)
- Posterior Articular Facet

http://www.maitrise-orthop.com/corpusmaitri/orthopaedic/mo80_laude/laude_us.shtml#1
Standard Views of the Foot

• Lateral

• Oblique

• Anteroposterior

One Special View: Harris Beath View
Obtaining a Lateral View

Normal Lateral Radiograph of Foot

http://www.rad.washington.edu/RadAnat/FootLateral.html
Normal Lateral Radiograph of Foot

http://www.rad.washington.edu/RadAnat/FootLateralLabelled.html
Oblique Radiograph of Foot

Normal Oblique Radiograph of Foot

http://www.rad.washington.edu/RadAnat/FootOblique.html

http://www.rad.washington.edu/RadAnat/FootObliqueLabelled.html
AP View of the Foot

Normal AP Radiograph of the Foot

http://www.rad.washington.edu/RadAnat/FootAP.html

http://www.rad.washington.edu/RadAnat/FootAPLabelled.html
Obtaining the Harris Beath View

Our Patient’s Initial Radiographs
Our Patient’s Lateral Views

- Loss of Middle Facet Space
- Narrowed Joint Space
- Loss of Foot Arch
- Narrowed Joint Space

Children’s Hospital Boston
Our Patient’s Oblique Views

Normal Appearance
Patient’s Harris Beath Views

Loss of Talocalcaneal Joint Space

Loss of Talocalcaneal Joint Space
Patient’s Coronal CT

Bilateral Bony Fusion
Diagnosis:

Talocalcaneal coalition
Discussion of Coalition

• Results from abnormal differentiation and segmentation of primitive mesenchyme with resultant lack of joint formation
• Postulated autosomal dominant inheritance with variable penetrance
• 50%-60% are Bilateral
• Prevalence 1-2%
• Can occur between any tarsal bone; talocalcaneal and calcaneonavicular coalitions are most common

Types of Coalition

- Osseous
- Fibrous
- Cartilaginous
Pathogenesis of Coalition

Limitation of Normal Subtalar & Midfoot Motion

Inflammation of Involved Joints

Irritation of Peroneal Tendon Crossing Subtalar Joint

Peroneal Tendon Spasm

“Peroneal Spastic” Rigid Flatfoot

Manusov EG, et al. (1996), Part II
Talocalcaneal Coalition-1

- Coalition between the talus $\rightarrow$ calcaneus
  - Most commonly between middle facet of talus and sustentaculum tali of calcaneus
- Represents 48% of all Tarsal Coalitions
- Typically become symptomatic in 8-12 y.o. children
- Imaging Modalities:
  - Difficult to see on standard views
  - May be suggested by loss of foot arch
  - Harris Beath View to demonstrate subtalar joint
  - May need fine-cut CT
  - May also be seen on MRI
  - If a bone scan is done, will show as area of increased uptake

Talocalcaneal Coalition-2

- **Secondary Plain Film Signs:**
  - Talar beak
  - Narrowing of the subtalar joint
  - Rounding of the lateral talar process
  - Lack of depiction of middle facets on lateral
  - C-sign

- **Secondary Signs on CT:**
  - Talar beak
  - Joint Narrowing
  - Broadening and down-sloping of sustentaculum tali

Middle Facet on Lateral

- Short solid arrow: middle facet
- Long solid arrow: posterior facet
- Open arrow: lateral process of talus (anterior extent of posterior facet)
- Normal = Open space


Companion Normal Case
Absence of Middle Facet

- Curved arrow: talar beak
- Long arrow: loss of middle facet space
- Short arrows: C-sign present
- Loss of posterior facet space

Companion Coalition Patient Case

Talar Beak

- Secondary to impaired subtalar joint motion
- Represents navicular overriding the talus
- Periosteal elevation occurs at site of talonavicular ligament
- Osseous repair results in talar beak

C-Sign

- Results from bone bridging between talar dome and sustentaculum tali
- Seen in osseous and non-osseous coalition
- Varies based on sustentaculum size and orientation

Companion Coalition Patient Case

Another Patient with Coalition

9 year old girl with Chronic R foot pain
Our Patient 2 Bone Scan

Focal Areas of Increased Tracer Uptake

Children’s Hospital Boston
Patient 2 Sagittal CT

- Bony Fusion
- Preserved Joint Space
Calcaneonavicular Coalition

- Coalition between calcaneus → navicular
- Represents 43% of all Tarsal Coalitions
- Typically become symptomatic in 12-16 yo children
- **Best Imaging Modality:**
  - Plain Film, 45 degree internal oblique
  - May also be seen on CT, MRI, bone scan
- **Ragiographic Signs:**
  - Bony Bar (seen with osseous coalition)
  - Bones in close proximity, irregular surfaces, anteromedial calcaneus is widened/ flattened (seen with fibrous or cartilaginous coalition)
  - Hypoplasia of the talus
  - Anteater sign

“Anteater” Sign

Companion Coalition Patient Case

How did they come up with that anteater sign?
“Anteater” Sign

Companion Coalition Patient Case

“Anteater” Sign


www.porpoiserecords.com
Performance of Secondary Signs

• The next slide shows the individual performance of secondary signs evaluated in a retrospective blinded study.

• Table shows that individual stand alone signs have a low sensitivity, but high specificity.
## Performance of Secondary Signs

### Table 1: Accuracy of Unenhanced Radiographic Signs of Tarsal Coalition Assessed on Routine Anteroposterior and Lateral Radiographs

<table>
<thead>
<tr>
<th>Sign</th>
<th>Coalitions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Sensitivity (%)</td>
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<tr>
<td></td>
<td>Specificity (%)</td>
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<td></td>
<td>Sensitivity (%)</td>
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<tr>
<td></td>
<td>Sensitivity (%)</td>
</tr>
<tr>
<td></td>
<td>Specificity (%)</td>
</tr>
<tr>
<td>C sign</td>
<td>NA</td>
</tr>
<tr>
<td>Dysmorphic sustentaculum tali</td>
<td>NA</td>
</tr>
<tr>
<td>Middle facet not visible</td>
<td>NA</td>
</tr>
<tr>
<td>Talar beak</td>
<td>49</td>
</tr>
<tr>
<td>Short talar neck</td>
<td>38</td>
</tr>
<tr>
<td>Visible CN bar</td>
<td>NA</td>
</tr>
<tr>
<td>&quot;Anteater&quot; sign</td>
<td>NA</td>
</tr>
<tr>
<td>Navicular</td>
<td>NA</td>
</tr>
<tr>
<td>Broad</td>
<td>NA</td>
</tr>
<tr>
<td>Laterally tapered</td>
<td>NA</td>
</tr>
</tbody>
</table>

Crim & Kjeldsberg (2004)
Combination of all Secondary Signs

• Evaluated both retrospectively and prospectively by attending and resident radiologists

• Results:
  – Calcaneonavicular Coalition
    • Attending (100% sens, 97% spec)
    • Resident (80% sens, 98% spec)
  – Talocalcaneal Coalition
    • Sensitivity 100%
    • Specificity 88%
Treatment

• Initially managed conservatively with steroid injections, orthotics
• Surgery may be undertaken to separate fused tarsal bones
Conclusions

• Coalition is a frequent cause of pediatric foot pain that may present in late childhood or early adulthood
• There are many secondary signs of coalition that can be seen on plain film radiographs
• The combination of multiple secondary signs is a sensitive and specific way to screen for coalition
• CT & MRI may be needed to confirm existence of coalition
References


6. Websites:
   - http://www.maitrise-orthop.com/corpusmaitri/orthopaedic/mo80_laude/laude_us.shtml#1
   - www.porpoiserecords.com
   - www.peeperandfriends.com
Acknowledgements

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