5-year-old boy presents to ED for foot injury

N yokabi Kamau OMS IV, Lake Erie College of Osteopathic Medicine
Allegheny Health Network Department of Radiology:
Dr. Danielle Yin, MD
Dr. Jason Long, MD
Dr. William Peterson II, MD
Patient Presentation

5 year–old boy presents to the emergency department with acute left foot pain and swelling after jumping off the toilet. There is tenderness on the dorsal medial side of the foot, worsened with direct pressure, walking and relieved with rest.

PMHx: ADHD, developmental delay, heart murmur, sensory deficit

ROS: no decreased range of motion, no neurologic deficits, no joint tenderness
What Imaging Should We Order?
ACR Appropriateness Criteria

**Variant 2:**
Adult or child older than 5 years of age. Acute trauma to the foot. Ottawa rules can be evaluated without exclusionary criteria. Ottawa rules are positive. Initial imaging.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Appropriateness Category</th>
<th>Relative Radiation Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiography foot</td>
<td>Usually Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>Radiography foot with weightbearing</td>
<td>Usually Appropriate</td>
<td>0</td>
</tr>
<tr>
<td>CT foot with IV contrast</td>
<td>Usually Not Appropriate</td>
<td>☠️</td>
</tr>
<tr>
<td>CT foot without and with IV contrast</td>
<td>Usually Not Appropriate</td>
<td>☠️</td>
</tr>
<tr>
<td>CT foot without IV contrast</td>
<td>Usually Not Appropriate</td>
<td>☠️</td>
</tr>
<tr>
<td>MRI foot without and with IV contrast</td>
<td>Usually Not Appropriate</td>
<td>☠️</td>
</tr>
<tr>
<td>MRI foot without IV contrast</td>
<td>Usually Not Appropriate</td>
<td>☠️</td>
</tr>
<tr>
<td>US foot</td>
<td>Usually Not Appropriate</td>
<td>☠️</td>
</tr>
</tbody>
</table>

This imaging modality was ordered by the ER physician.
Findings (unlabeled)
Findings: (labeled)
Final Dx:

Kohler’s Disease
Case Discussion

Kohler’s Disease

• Avascular necrosis of the navicular bone

• Epidemiology:
  • Mostly affects boys between 4-7 years of age but can occur as early as 2 years of age. Girls with this condition are often younger, possibly due to earlier ossification. Bone ossification begins at 18-24 months of age for girls and 24-30 months of age for boys.

• Presentation:
  • Often occurs unilateral with medial sided foot pain, swelling, with or without limping.

Pathology:

• The navicular bone is the last tarsal bone to ossify. Typically, at 18-24 months of age for girls and 30-36 months of age for boys. It is susceptible to compression between the ossified Talus and cuneiforms. This compression often occurs as the child ages due to added weight.
Case Discussion

• Pathology:
  • The navicular bone possesses a dual blood supply. Dorsal blood supply comes from a branch of the dorsalis pedis artery, while the plantar blood supply arises from the medial plantar branch of the posterior tibial artery. These branches also supply the medial and lateral portions of the bone. However, the central zone is left with poor blood supply.
  • It is theorized that compression of these small vascular branches could result in ischemia and put the navicular bone at risk for avascular necrosis.
  • Mechanical stress from the ossified talus and cuneiform bones compresses the blood vessels in the periosteum of the navicular bone, which causes osteonecrosis.
Navicular Blood Supply

Figure 1

Figure 2
Case Discussion

- Bone biopsy not required
- Imaging findings:
  - Patchy areas with sclerosis and loss of normal trabecular patterns. Sometimes it appears collapsed or normal in shape with uniformed increased density. The navicular will have standard characteristics of avascular necrosis, including sclerosis, fragmentation, and flattening.
- Differential Diagnosis:
  - Often misdiagnosed as osteomyelitis in kids. Normal labs can help differentiate from osteomyelitis (WBC, ESR, CRP).
- Prognosis:
  - Self limiting with complete recovery
Comparison AP view

Normal

Patient

Navicular

Sclerosis, increased density
Comparison lateral view

Normal

Navicular

Patient

Navicular

Fragmentation and flattening
Case Discussion

• Treatment management:
  • Follow up with pediatric orthopedic surgeon. Treatment management includes pain control, soft arch supports, or medial heel wedges. For severe symptoms, patients may receive a short leg cast for 4-6 weeks.
  • X-rays improve 6-48 months from onset of symptoms. Patients without a cast can still recover in 6 – 9 months. Patients with arch support have decreased pain on average of 7 months. However, treatment method does not alter rate of improved radiographs.

Patient treatment:
In ED patient received posterior splint, followed by short leg cast post Orthopedic follow up.
References:

1. ACR Criteria of Appropriateness : Acute Trauma to the Foot. https://acsearch.acr.org/docs/70546/Narrative/


5. Image sources:
   Figure 1 : https://musculoskeletalkey.com/midfoot-fractures/
   Figure 2 : https://radsourse.us/articular-osteocondroeses/
   Normal lateral view radiograph : https://www.pedrad.org/Portals/5/Events/2012/Laor-Foot.pdf