Which X-Ray Is Best?

Foot Trauma

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Donna I. Meltzer, MD
At the end of this presentation, participants should be able to:

- Select the best imaging study for patients who present with foot or ankle pain
- Identify the best imaging modality for patients who present with possible foreign body
Ottawa Rules

- Midfoot pain
- Point tenderness of navicular
- Point tenderness of base of 5th metatarsal
- Inability to bear weight
Ottawa Foot and Ankle Rules

- Bone tenderness
  - Distal 6cm of posterior tibia
  - Distal 6cm of posterior fibula
  - Base of 5th metatarsal
  - Navicular bone
- Inability to bear weight/4 steps
Caution with Ottawa Rules

* Penetrating trauma
* Pregnancy
* Skin wounds
* >10 days after trauma
* Continued traumatic foot pain
* Altered sensorium
* Neurologic abnormality
A 32 yo male presents to an Urgent Care facility with complaint of twisting his foot/ankle. He had trouble walking more than 2 steps immediately after the injury.

On exam, he has point tenderness in the base of the 5th metatarsal.
* The most appropriate imaging study is

- X ray of foot
- CT foot without contrast
- CT foot with contrast
- MRI without contrast
- Ultrasound of foot
Variant 1: Adult or child >5 years old. Acute injury to the foot; positive Ottawa Rules, suspicious for fracture. First study.

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
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<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
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Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level
The twin brother of patient in Case 1 is your next patient in the Urgent Care Center. He also has an acute injury to his foot, but was able to walk immediately after the accident.

On exam, there is no point tenderness in 5th metatarsal or navicular area.

Neurologically intact
The next best step in your management is to
- Order x-ray of foot
- Order CT foot without contrast
- Order MRI of foot with and without contrast
- Order ultrasound of foot
- Order no x-ray
**Variant 2:** Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; no focal tenderness in the foot or palpable abnormality of the foot on physical examination; able to walk; neurologically intact (including no peripheral neuropathy). First study.

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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
A 62 year overweight female who has insulin requiring type 2 diabetes presents to the office after twisting her foot while doing housework. She was able to walk after the injury.

On exam, pleasant female in NAD. BMI 32.

No point tenderness in foot.

No ulcers

Decreased peripheral sensation
What is the next best management step?
- Order an x-ray of the foot
- Order CT without contrast
- Order MRI without contrast
- Order an Ultrasound of foot
- Perform no imaging
ACR Appropriateness Criteria
Variant 3

**Variant 3:** Adult or child > 5 years old. Acute injury to the foot; does not meet the Ottawa Rules; patient is not neurologically intact and/or has a peripheral neuropathy that involves the feet. First study.

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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level
Variant 4: Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; patient has polytrauma. First study.

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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level
How many views should be ordered?
- Two views?...AP, Lateral
- Three views?...AP, Lateral, Oblique
A 29 yo female was horseback riding when her horse was spooked and she fell to the ground. There was no loss of consciousness and her only complaint is midfoot pain. She can barely walk 4 steps.

You should order which of the following?
- X-ray of foot
- X-ray of foot with weight bearing
- CT foot without contrast
- MRI foot without contrast
### Variant 5

Adult or child >5 years old. Acute injury to the foot; does not meet the Ottawa Rules; physical examination is concerning for a Lisfranc injury. First study.

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<tr>
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<td>9</td>
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<tr>
<td>X-ray foot with weight bearing</td>
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<td>🍀</td>
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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
The boyfriend of the last patient was also thrown from his horse after the other horse bucked. He also has midfoot pain. On exam, he has midfoot ecchymosis on the plantar surface.

He was unable to weight bear
Lisfranc Injury
General Jacques Lisfranc
You review the non weight bearing x-ray from the Urgent Care Center where the patient first presented and agree there is no fracture. His midfoot pain has persisted and you are concerned about a Lisfranc injury.

The next best management plan is to
- Order x-ray of foot with weight bearing
- Order MRI foot without contrast
- Order CT foot with contrast
- Order CT foot with and without contrast
- Ultrasound of foot
**ACR Appropriateness Criteria**

**Variant 6: rule out Lisfranc injury**

**Variant 6:** Adult or child >5 years old. Acute injury to the foot; physical examination is concerning for a Lisfranc injury. Radiographs are normal and patient is not able to tolerate a weight-bearing radiographic view. Next imaging study.

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*Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate*  

*Relative Radiation Level*
Normal alignment

Loss of alignment of cuboid and 4th metatarsal
A 22 year old college student was walking barefoot at a fraternity party when some beer bottles were broken. He doesn’t recall anything else other than drinking a lot. After his hangover had worn off, he presents to the ER with sensation of something in his foot and pain when he weight bears.

On exam, you don’t see much, but the patient has tenderness with palpation on one small area of his sole.
Foreign Bodies
The best imaging study in this case of suspected foreign body in soft tissue is:

- X-ray of foot
- CT foot without contrast
- CT foot with contrast
- MRI without contrast
- Ultrasound of foot
Variant 9: Adult or child ≥5 years old. Acute injury to the foot; physical examination is concerning for penetrating trauma with a foreign body in the soft tissues. First study.

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*R: Relative Radiation Level
If the x-ray of the foot is negative. The next best study is:

A. CT foot with contrast
B. CT foot without contrast
C. MRI with contrast
D. MRI without contrast
E. Ultrasound of foot
**Variant 10:**

Adult or child >5 years old. Acute injury to the foot; physical examination is concerning for penetrating trauma with a foreign body in the soft tissues. Radiographs of the foot are negative. Next best study.

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<td>The RRL for the adult procedure is ☐ .</td>
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*Relative Radiation Level*
**Puncture Wounds & Retained Foreign Bodies**

- 8.2 million ER visits for open wounds in US
  - Retained foreign bodies less common
- Occupation
- Warmer climates and seasons
- Types of foreign bodies
  - Metallic
  - Splinters (wood, thorns, etc)
  - Glass
Imaging Modalities for localizing various Types of Foreign Bodies in Skin and Subcutaneous Tissue

Radiography
- Bone
- Fish spines (some)
- Glass
- Gravel/stone
- Metal/aluminum
- Pencil graphite
- Plastic (some)
- Teeth
- Wood (e.g., splinters, cactus spines, thorns)

Ultrasonography
- Glass
- Metal
- Pencil graphite
- Plastic (some)
- Stone
- Wood

Computed tomography
- Reserve for failed exploration or infection

Source: AFP Sept 1, 2007
Ultrasound Guided Foreign Body Extraction

Source: Clinical Radiology 67 (2012) 531-535
## Comparison of Diagnostic Tests for Detection of Foreign Bodies

<table>
<thead>
<tr>
<th>Material</th>
<th>Plain radiographs</th>
<th>High-resolution ultrasound scans</th>
<th>CT scans</th>
<th>MRI</th>
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</thead>
<tbody>
<tr>
<td>Wood</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td>Metal</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
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<tr>
<td>Glass</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td>Organic (thorns, spines)</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
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<tr>
<td>Plastic</td>
<td>Moderate</td>
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<td>Good</td>
<td>Good</td>
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<tr>
<td>Palm thorn</td>
<td>Poor</td>
<td>Moderate</td>
<td>Good</td>
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In summary

* Acute foot trauma and **meets** Ottawa Rules:
  * 3 view x-ray of foot
* Acute foot trauma and **doesn’t meet** Ottawa Rules:
  * 3 view x-ray of foot
* Midfoot injury (suspicious for Lisfranc)
  * 3 view x-ray, ~ weight bearing
  * then advanced imaging (CT, MRI)
* Possible foreign body
  * X-ray if radiopaque
  * US if non-radiopaque
References
