Orthopedic X-Rays most commonly missed

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COI Disclosure

I am the current Medical Director for Best Doctors Canada.

Presenter: Dr. Vu Kiet Tran
Disclosure

- I missed 80-90% of these cases
I have made many…

MISTAKES

It Could Be that the Purpose of Your Life Is Only to Serve as a Warning to Others.
More mistakes to come

I've learned so much from my mistakes...
I'm thinking of making a few more.
Our work environment
Chaotic
Distraction
Objectives

• Recognize the most frequent Xrays missed by ED health care professionals
• Understands the factors that lead to misinterpretation
• Learn about some radiographic signs that allows one to mitigate the rate of misses
• Apply tools learned to reduce the miss rate
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Do as I say and not as I do!
Let’s start!
Scaphoid fractures

- No longer commonly missed!
Which is the normal?
Lines

- **Anterior Humeral Line**
  - Passes through middle third of capitulum
- **Proximal Radial Line**
  - Bisects through centre of capitulum
Is there a Fracture?
Radial head fractures are often missed
Tip 1

• Know exactly what you are searching for before you look at the film itself
Tips 2

• Always get proper perpendicular views (AP and lateral)
Hurt my wrist swinging a club

- Golf clubs, Baseball bats or Direct Blow to palm
- Pain with Gripping
- Pain at Hypothenar Eminence
Hamate Bone Fracture

- Fractures of the Hamate Body can be seen by X-Ray
  - LESS Common than Fractures of the Hook
Hook of Hamate Fracture

- Fractures of the Hamate Hook require a special X-Ray (or CT)
  - Carpal Tunnel View
  - 20 degree Supinated Lateral View
Hook of Hamate Pull Test

• Examiner pulls on 4th and 5th digits
• Flexor Digitorum Profundus tendons will displace the broken hook and reproduce exact severe pain
• Or you can push on it!
What is the injury?
Scapho-Lunar Dissociation

- Unstable
- Rarely diagnosed
  - Replaces scaphoïd fracture

- **FOOSH**
- Scapho-lunar Pain
Scapho-Lunar Dissociation

Terry Thomas
Scapho-Lunar Dissociation

1. *Terry-Thomas*
2. Shortening of scaphoïd
3. Cortical Ring of the scaphoïd
4. Trapesoidal Semi-lunar
5. Taleisnik V
Scapho-Lunar Dissociation

Closed fist
What is the injury?
Lunate Dislocation

Lateral view
• Disrupt 3 Cs
• “Spilled teacup”
• Capitate rest on radius

PA view
• “Piece of pie”
• Carpal fractures
What is the injury?
Disruption of C’s

Spilled teacup

Capitate rest on Radius
Tip 3, 4, 5, 6

• Be aware of specific occult fracture/dislocation radiographic signs
• Know what a “normal” should look like
• Look for the second injury/fracture
• Avoid being distracted
What is the most commonly missed major joint dislocation?

- Posterior Shoulder Dislocation
- 2% of shoulder dislocations
- 60% missed initially
- Associated with
  - Epilepsy (Seizures)
  - Electricity
  - Blow to anterior shoulder
Which is normal? Which is abnormal?
The Power of the Axillary View!
Male with ankle pain
Female with ankle pain
Medial Dome of Talus

Stage I, II, and III medial lesions can usually be treated nonsurgically with six weeks in a nonweight-bearing cast. Adequate reduction and immobilization are crucial for fracture healing and to avoid avascular necrosis of the fracture fragment.

Patients with stage III lateral lesions, stage IV lesions, and persistent symptoms are generally treated surgically. Treatment options for fragment excision range from arthroscopy with or without subchondral bone drilling to open reduction internal fixation.

Lateral Process Fractures

The lateral talar process is an osseous protuberance that articulates superolaterally with the fibula, helping to stabilize the ankle mortise, and inferomedially with the calcaneus, forming the lateral portion of the subtalar joint (Figures 1 and 2). Lateral process fractures are the second most common talar fractures. From 33 to 41 percent of these fractures are missed on initial presentation.

Traditionally, the causative injuries are falls, motor vehicle crashes, or direct trauma. Some recent reports implicate snowboarding accidents in these fractures.

DIAGNOSIS

The patient usually has a history of a rapid inversion and dorsiflexion injury. Fractures of the lateral process range from avulsion fractures of the capsular ligaments to intra-articular injuries involving the ankle and subtalar joints. Physical examination findings are similar to those in lateral ankle ligamentous injuries. Pain with plantar flexion, dorsiflexion, and

FIGURE 4. Mortise view (left) and anteroposterior view (right) of the ankle showing a traumatic lateral talar dome fracture (arrows).

FIGURE 3. Mortise view of the ankle showing an atraumatic osteochondral lesion (arrow) of the medial talar dome.
Lateral Process of Talus

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Although the normal anatomy of the ankle may be obscured by soft tissue swelling, a helpful diagnostic indicator is point tenderness over the lateral process. The lateral process can be palpated anteriorly and inferiorly to the tip of the lateral malleolus. Fractures can usually be visualized on a standard ankle series. A posterior subtalar effusion seen on the lateral view is highly suggestive of an occult lateral process fracture. A CT scan can clearly show this injury and may be required to confirm a suspected fracture.

TREATMENT

A nonweight-bearing, short leg cast can be used if anatomic position with less than 2 mm displacement can be maintained. A nonweight-bearing cast should be maintained for four to six weeks, followed by two weeks in a walking cast and initiation of rehabilitation exercises. For large and displaced fragments, the treatment of choice is usually surgical reduction and fixation.

Posterior Process Fractures

The posterior process of the talus is composed of two tubercles, the lateral and medial. The lateral tubercle is the larger of the two and serves as the attachment of the posterior talocalcaneal and posterior talofibular ligaments. The medial tubercle serves as the attachment for the posterior third of the deltoid ligament. The under surface of both tubercles forms the posterior fourth of the subtalar joint. An accessory bone known as the os trigonum is relatively common, posterior to the lateral tubercle. The os trigonum can be a source of pathology, and a normal os trigonum may be confused with a fracture of the lateral tubercle. Again, these fractures have been commonly misdiagnosed as ankle sprains. In one case series, 17 of 20 patients with fractures were misdiagnosed with ankle sprains. Posterior process fractures can occur at either or both tubercles. Lateral and medial tubercle fractures are discussed separately.
Posterior Process of Talus

The pain is often exacerbated by activities requiring plantar flexion. Physical examination findings in lateral tubercle fractures of the posterior process are highly consistent for tenderness to deep palpation anterior to the Achilles tendon over the posterior talus. The pain is often reproduced with plantar flexion and occasionally accentuated with dorsiflexion of the great toe. This is caused by compression of the fracture fragment as the flexor hallucis longus tendon passes between the medial and lateral tubercle.

Careful physical examination and correlation with radiographic findings may be necessary to differentiate a fracture of the lateral tubercle, a fracture of a fused os trigonum, a tear in the fibrous attachment of the os trigonum to the lateral tubercle, or a normal os trigonum.

A lateral radiograph of the foot usually best visualizes the lateral tubercle and, if present, the os trigonum. When evaluating the fracture line, a rough, irregular cortical surface suggests the presence of an acute fracture. In acute injuries, this rough irregular surface may help distinguish a fracture from a normal os trigonum, which generally has a smooth, rounded cortical surface. In chronic cases, these differences may be less distinct, making the distinction between a fracture and a normal os trigonum difficult.

When the diagnosis is unclear and clinical suspicion is present, an MRI or CT will clearly demonstrate this fracture.

Treatment. No undisplaced or minimally displaced fractures can be treated with a non-weight-bearing, short leg cast for four to six weeks. After this period of immobilization, weight bearing is allowed as tolerated. If symptoms persist, an additional four to six weeks of immobilization would be recommended. If the fracture site continues to be symptomatic after six months, fragment excision is usually curative.

Larger and more displaced fractures may require open reduction internal fixation.

FRACTURES OF THE POSTERIOR PROCESS: MEDIAL TUBERCLE

Medial tubercle fractures are relatively rare. They were first described by Cedell, who presented four cases of medial tubercle fractures that had originally been treated as ankle sprains.

Diagnosis. Generally, medial tubercle fractures are secondary to dorsiflexion, pronation-type injuries, because the medial tubercle is avulsed by the deltoid ligament. On clinical assessment, there may be only slight pain with ambulation and range-of-motion.
Ankle sprain mimics

- Talar dome
  - Medial dome
  - Lateral dome
  - Anterior process
  - Posterior process
  - Lateral process

- Anterior process of the Calcaneum
Use of the Ottawa ankle rule

Inability to bear weight after the injury of during the examination
Tip 7-8-9-10

• Your history and physical exam trumps any radiographic finding (or lack thereof)
• For the ankle, apply the Ottawa Ankle Rule
• For any lower extremity injury, always observe the gait and watch the patient walk
• Keep in mind some of the most common misses by ED doctors
Other missed injuries

- Supracondylar fractures
- DRUJ injuries
- Triquetum fractures
- Volar plate fractures (Phalanges)
- Hip fractures
- Patella injuries
- Tibial plateau fractures
- Calcaneal compression fractures
## Diagnostic errors in the ED

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of errors</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractures</td>
<td>760</td>
<td>79.7</td>
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<tr>
<td>Dislocations</td>
<td>19</td>
<td>2</td>
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<tr>
<td>Tendon injuries</td>
<td>21</td>
<td>2.2</td>
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<tr>
<td>Nerve injuries</td>
<td>5</td>
<td>0.5</td>
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<tr>
<td>Ligament injuries</td>
<td>15</td>
<td>1.6</td>
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<tr>
<td>Foreign bodies</td>
<td>19</td>
<td>2.0</td>
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<tr>
<td>Other trauma</td>
<td>51</td>
<td>5.4</td>
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<tr>
<td>Non-trauma (MI, abdo pain)</td>
<td>36</td>
<td>3.8</td>
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<tr>
<td>Incidental findings</td>
<td>27</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>953</td>
<td></td>
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Why do I talk about this?
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<th>Areas</th>
<th>Specific injury</th>
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<tbody>
<tr>
<td>Shoulder</td>
<td>Clavicle</td>
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<tr>
<td>Elbow</td>
<td>Radial Head, Supracondylar</td>
</tr>
<tr>
<td>Wrist</td>
<td>Distal radius, Greenstick radius, Scaphoid, Triquetrum</td>
</tr>
<tr>
<td>Hand</td>
<td>Base of 5&lt;sup&gt;th&lt;/sup&gt; metacarpal, Thumb, Proximal phalange of fingers, Volar plate fracture</td>
</tr>
<tr>
<td>Hip</td>
<td>Neck of femur, One or more pubic rami</td>
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<tr>
<td>Knee</td>
<td>Tibial plateau</td>
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<tr>
<td>Ankle</td>
<td>Lateral malleolus, Calcaneum, Avulsion fractures</td>
</tr>
<tr>
<td>Foot</td>
<td>Base of 5&lt;sup&gt;th&lt;/sup&gt; metatarsal</td>
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<tr>
<td>Spine</td>
<td>Odontoid, Jefferson fracture</td>
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## Misread rate by ED docs

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Accuracy</th>
<th>Clinically significant</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Fleischer et al.</td>
<td>1983</td>
<td>91.1%</td>
<td>1.2%</td>
<td>Pediatric ED</td>
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<tr>
<td>Mucci et al.</td>
<td>1983</td>
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<tr>
<td>Overton et al</td>
<td>1987</td>
<td>0.59%</td>
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<tr>
<td>Graton et al.</td>
<td>1990</td>
<td>2.8%</td>
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<td>ED residents</td>
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<tr>
<td>Walsh-Kelly et al.</td>
<td>1995</td>
<td>86%</td>
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<tr>
<td>Brunswick et al.</td>
<td>1996</td>
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<tr>
<td>Preston et al.</td>
<td>1998</td>
<td>0.7%</td>
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<tr>
<td>Berman et al.</td>
<td>2000</td>
<td>99%</td>
<td>0.8%</td>
<td>Adult trauma</td>
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<tr>
<td>Benger et al.</td>
<td>2003</td>
<td>98.5%</td>
<td>0.3%</td>
<td>Adult ED</td>
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<tr>
<td>Petinaux et al.</td>
<td>2008</td>
<td>96.5%</td>
<td>0.056%</td>
<td>Adult ED</td>
</tr>
</tbody>
</table>

Misread rates vary from 0.4-16.4%

Significant misread rates vary from 0.06-3%
Summary
How to avoid misinterpretation of an Xray
Examine the patient first
The clinical findings trump everything

Note to self:
She is ALWAYS right.
Examine the joint above and below the fracture
Avoid being distracted
Know what you are looking for
Obtain multiple views of the same area of interest
Be familiar with specific radiographic signs
Look for the second...or third fracture
Look for the ring disruption
Pay more attention to the common misses

An error doesn’t become a mistake until you refuse to correct it.
Thank you

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"If we really did learn from our mistakes
you would be as smart as Einstein by now!"