Commonly Missed Fractures in the Emergency Department

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MS IV - UMASS

Images courtesy of Jim Wu, MD, Sanjay Shetty, MD and Mary Hochman, MD
Diagnostic Errors in the ED

- Due to time and bed constraints in Emergency Departments, diagnostic error is more likely than in less urgent settings
- Missed fractures can comprise a large fraction of total diagnostic errors
- The most common reason for missed fracture is misreading of radiographs
- Peak error rate from 8pm-2am, so read carefully at night!

*BMC Emerg Med. 2006 Feb 16;6:4*
CASE

ED evaluation for: 57F S/P FALL.
Patient tripped, fell, sustained small avulsion-type laceration to the left lateral hand, a 2cm superficial laceration to the left forehead/eyebrow.
Patient complains of left elbow pain and has left lateral elbow point tenderness.
No evidence of any other trauma.
Can you find the fracture?

Images Courtesy of: Jim Wu, MD
A Systematic Approach to Musculoskeletal Radiographs

ABC’S:

- Adequate Exposure
- Alignment
- Bones
  - contour
  - margins
  - density
  - trabecular pattern
- Cartilage (cartilaginous spaces are dark)
- Soft Tissue

For more detail, see: BMJ 1994;308:401-405 (5 February)

Images Courtesy of Jim Wu, MD
Most Commonly Missed Fractures

- Scaphoid
- Elbow (Radial Head)
- Calcaneus

(fractures missed disproportionately often)


Image: www.innerbody.com
Scaphoid Fracture: Epidemiology

- Annual incidence is 4.3/10,000
- Predominantly young males
- Primarily due to fall (classically on an outstretched hand) or post-trauma
- 10% associated with other wrist fracture

Scaphoid Fracture: Signs/Symptoms

- Classically associated with anatomic “snuff box” tenderness
- Also associated with tubercle tenderness: landmark is the first bony prominence distal to the radial head
- “Chen” test: axial compression of thumb along longitudinal axis should produce pain
- Watson Test for ligamentous damage. See: Wheeless'

Radiographic Exam:
- Wrist PA and Oblique
- Request dedicated scaphoid views if suspicion is high


Image: www.aaos.org
What to Look For: Thin cortical breaks in the distal head and waist.
What to Look For: Step-Off break in waist or proximal scaphoid angulation

Fracture Location:
20% Distal
70% Waist
10% Proximal

Images Courtesy of: Jim Wu, MD
Scaphoid Fracture: Keep In Mind

- Get dedicated scaphoid views if clinical suspicion is high. Re-image if necessary
- Even with proper imaging, not all scaphoid fractures will be visible on plain film. Obtain further imaging and orthopedic consult if occult fracture is suspected. Complications can be severe without proper treatment:
  - Osteonecrosis: More common with proximal rather than distal fractures due to tenuous blood supply
  - Non-union
  - SLAC: ScaphoLunar Advanced Collapse: migration of the capitate through the scapholunar ligament causing subsequent osteoarthritis, pain and loss of motion
Elbow Fracture: Epidemiology

- Fracture and dislocation account for 2-3% of Emergency Room visits
- Radial Head Fracture is the most common (30%) and most difficult to identify on radiograph
- Supracondylar fractures seen more commonly in pediatric patients
- Transcondylar fractures associated with osteoporosis in elderly

Elbow Fracture: Signs/Symptoms

- Unable to fully extend elbow and pain with pronation/supination
- Check for point tenderness, ecchymosis and edema, neurovascular compromise
- Full and equal ROM is a good predictor of absence of fracture*

Radiographic Exams:
- AP
- Lateral with 90º flexion
- Oblique Extended

Radiographic Signs of Radial Head Fracture on Lateral Elbow Exam

Anterior Fat Pad Displacement

Fracture Line

Contour Deformity

Anterior Fat Pad Displacement

Posterior Fat Pad

Fracture Line

Images Courtesy of Jim Wu, BIDMC
Can you find the fracture now?

- Elbow AP
- Elbow Oblique
- Elbow Lateral

Images Courtesy of Jim Wu, MD
Elbow Fracture: Keep in Mind

- Ask for 3 Views: AP, oblique, lateral
- Look for sail sign and posterior fat pad
- If these signs are present but no fracture is identified, radial head fracture is likely
- Additionally, look for a fracture line, and contour deformity
Calcaneal Fracture: Epidemiology

- Most frequently injured bone in the foot
- 75% are intra-articular
- Frequently there are associated injuries
- Most patients with calcaneal fracture are men in their working years, majority are industrial workers
- Fall from a height, motor vehicle accident is the most common mechanism
- Less common but frequently missed radiologically – anterior process avulsion / calcaneal stress fracture

**Signs/Symptoms: Calcaneal Fracture**

- Most commonly: heel pain, gait disturbance, but can be difficult to distinguish from ankle or other foot injury
- Avulsion fracture of the anterior process may present as ankle pain from an inversion injury and confused with lateral ankle strain
- Stress fracture presents as chronic heel pain, typically in osteoporotic patients

**Radiographic Exam:**
- Hindfoot AP and Lateral
Böhler’s Angle on Lateral Exam

Normally: 20-40º

If angle < 20º, consider intra-articular compression fracture
If angle >40º, consider displaced fracture

Images Courtesy of Sanjay Shetty, MD
Reduced Böhler’s Angle Fracture

Related fracture lines

Fracture can be severe

Images Courtesy of Sanjay Shetty, MD
Vertical Sclerosis in Calcaneal Stress Fracture

Ankle Lateral

Images Courtesy of Sanjay Shetty, MD
Vertical Sclerosis in Calcaneal Stress Fracture

Very faint on plain film, stress fracture is distinctly visible on MRI

Images Courtesy of Jim Wu, MD
Anterior Process Avulsion

Ankle Lateral

Images Courtesy of Mary Hochman, MD
Anterior Process Avulsion

Very faint on plain film, avulsion is distinctly visible on MRI

Images Courtesy of Sanjay Shetty, MD
Calcaneal Fracture: Keep In Mind

- Böhler’s Angle 20°- 40°
- Look for fracture: follow all lucent lines carefully
- Consider associated injury (and think about the other foot!)
- Stress Fracture: Heel pain and vertical sclerosis
- Check for Anterior Process Avulsion in patients with chronic ankle/foot pain and inversion injury – CT or MRI may be required to make the diagnosis
Summary

<table>
<thead>
<tr>
<th>Bone</th>
<th>Frequency of Fracture</th>
<th>Frequency Missed on Radiograph</th>
<th>Online Resources</th>
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<tbody>
<tr>
<td>Scaphoid</td>
<td>53/4907*</td>
<td>10-15%*</td>
<td>AAOS</td>
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<tr>
<td></td>
<td>Most commonly injured carpal bone</td>
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<td>eMedicine</td>
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<td></td>
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<td>Wheeless'</td>
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<tr>
<td>Elbow</td>
<td>176/4907*</td>
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<tr>
<td></td>
<td>2-3% of Emergency Department Visits</td>
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<td>Wheeless' (Radial Head)</td>
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<tr>
<td>Calcaneus</td>
<td>50/4907*</td>
<td>10%*</td>
<td>eMedicine</td>
</tr>
<tr>
<td></td>
<td>2% of all fractures, most commonly injured tarsal</td>
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<td>Wheeless'</td>
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## Acknowledgements

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