Commonly Missed Fractures

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Objective:
- To recognize the most commonly missed fractures in the ED
- To identify situations that are High Risk for an occult fracture
- To discuss the evidence-based approach to evaluating patients for an occult fracture

“Occult” Fracture?

- Not readily visible on plain radiographs, using standard techniques
- Clinically important
  - Change in management
  - Significant risk of complications if missed

Anatomy of a Lawsuit:

Kachalla, *Annals of EM*, 2007:
- 122 ED malpractice claims, 4 insurers
- Most common “Missed Dx”
  - #1: Fracture, #2: Infection, #3: MI
- Most common Errors:
  - Failure to order right test (58%)
    - Radiologic study (61%): #1: Xray
  - Misinterpretation of test (37%)
    - Radiologic study (66%): #1: Xray

Kachalla, *Annals of EM* (cont.)

- Factors contributing to Missed Dx:
  - Most cases: Cognitive + Contributing factor
  - Cognitive factors:
    - 96%-Judgment, Knowledge, Memory
  - Contributing factors:
    - Signouts (24%), Inadequate supervision (30%), Workload (23%)

The Plan:

- 4 clinical scenarios to illustrate common, occult fractures:
  - Ankle and Foot
  - Hip
  - Elbow
  - Wrist
THE ANKLE AND FOOT

Case 1:
- Young male twisted his ankle “snowboarding”

Ankle sprain?
- R.I.C.E.
- Functional immobilization
- Crutches
  - Weight-bearing as tolerated
- Follow up exam
  - Ligamentous injury
  - Persistent pain / effusion
  - Occult fracture???

When should I consider CT/MRI?
1) Persistent pain/effusion at follow up
2) High clinical suspicion
   - Mechanism, exam
   - Important occult fx of the ankle/foot:
     - Talar dome fracture
     - Tillaux fracture (lateral tibia)
     - Calcaneus, Navicular
     - Lateral process of Talus fx

Haapamaki, *Am J Roentgenol*, 2004:
- Retro, 344 pts with fx on Ankle/foot CT
- Pts with Fx not visualized on plain films:
  - Calcaneus (20)
  - Talus (15)
  - Tillaux (7)
- Calcaneus fracture
  - Male : Female = 5:1
  - Associated injuries
  - L-spine
  - Operative vs Casting

- Bohler’s angle

- Associated injuries
  - L-spine

- Operative vs Casting

- CT scan:
  - Dx occult injury
  - Plan surgery

- Talar dome fracture
  - Osteochondral lesion
  - CT or MRI
  - Non-wt bearing vs Arthroscopy

- Tillaux fracture
  - Lateral tibia
  - Avulsion, ATF lig
  - Adolescents, SH-III
  - Surgical
Our patient:
- Lateral process of the Talus fracture
- “unique” to snowboarding

- Case series, 20 snowboarders
- Lateral process talus fx
- Mechanism: axial load, dorsiflexion, external rotation, eversion
- 2/3 treated surgically
- Good return of function

**High Risk Tips:**
- CT helpful for:
  - High suspicion (mechanism, exam)
  - Poor recovery
- High risk situations:
  - Fall from height—Calcaneus
  - Adolescent—Tillaux
  - Snowboarding—Lateral process of Talus

**Case 2:**
- 75 yo F fell onto her L side
- Pain in L hip with weight bearing
Shenton’s Line

Occult hip fracture
- Common, and clinically important
- Bone Scan (?) vs CT vs MRI
  - MRI is most supported by evidence
  - Older studies of Bone scan vs MRI
  - All three are superior to plain films
  - Local resources may dictate choice

MRI
- Frihagen, *Acta Orthop*, 2005:
  - 100 pts, hip trauma, negative plain films
  - All had MRI
  - 46 femoral neck or intertrochanteric fx
  - 27 other fractures (mostly pelvic)
  - 30 had surgery

MRI vs CT:
- Lubovsky, *Injury*, 2005:
  - 6 pts with suspected fx, negative Xrays
  - All had MR and CT (slice?)
  - 5 of 6 had fx. CT “misdx’d” three.
    - Greater tuberosity fx in 3 who had intertrochanteric fx by MRI

Can CT exclude hip fx?
- Better than plain films
- Rapid advances in technology
- As good as MRI?
- Future studies?
High Risk tip:
- MRI is still more “hip” than plain films, bone scan, or CT
- Question of MRI vs Newer generation CT remains unresolved

Case 3:
- 31 yo M crashed his bicycle
- c/o R elbow pain
- No deformity, slightly swollen
- Decreased ROM

Occult elbow injury:
- Adults
  - Radial head fx
- Children
  - Supracondylar distal humerus fx

Approach to the Adult Elbow:
- 90 degree lateral
  1) Fat pads
     - Bulging anterior
     - Any posterior
Case 4:
- 31 yo M struck by martial arts instructor
- c/o wrist pain
- Snuffbox tenderness

Giovanni Monteggia
- Italian surgeon
- 1762-1815
- Acquired syphilis during an autopsy

High Risk tips:
- Look for fat pads
- Draw the line
- Don’t get syphilis from an autopsy!
Scaphoid fracture

- Most common carpal fracture
  - 10-20% occult
- Distal blood supply
  - Proximal fx worse
- Delayed complications:
  - Non-union
  - Avascular necrosis

Frequent occult fractures

- Bone scan: Traditional, tried and true
- MRI: Better than bone scan in multiple studies
- CT: New technology, as good as MRI?
- U/S: Really?

Bone Scan:

- Murphy, *J Emerg Med*, 1994:
  - 54 pts, snuffbox tenderness, neg xray
  - Thumb spica, re-exam, films in 2 wks:
    - 37 had no pain, negative films
    - 2 had scaphoid fx on films
    - 15 had pain, neg films—Bone scan:
      - 6 positive for scaphoid fx

Frequent complications

= Thumb spica splint and follow-up

AVN, non-union

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Best way to find occult fx?

- Bone scan:
- Traditional, tried and true
- MRI:
  - Better than bone scan in multiple studies
- CT:
  - New technology, as good as MRI?
- U/S:
  - Really?
Bone scan vs CT:

- Cruickshank, Emerg Med Aus, 2007:
  - 47 pts, snuffbox tenderness, neg Xrays
  - CT (64 slice): 7 scaphoid fx, 10 others
  - 30 patients CT negative:
  - Gold std: 2 wk f/u, Xrays, MRI prn (8)
  - MRI found one more fx (capitate)

MRI:

- Brydie, British Journal of Radiology, 2003:
  - 195 pts, snuffbox tenderness, neg films
  - All had MRI w/in 2 wks (most w/in 3d)
  - 37 (19%) had scaphoid fx
  - 37 (19%) had another fx detected
  - Rec early MRI, forget splint if Negative

MRI vs CT:

- Memarsadeghi, Radiology, 2006:
  - 29 pts, neg X-ray, had CT (4) and MRI
  - Gold std: plain films at 6 wks
  - 11 scaphoid fx
  - MR found 100%, CT found 8/11 (73%)
  - CT better at cortical fx
  - MR better at trabecular fx

Newer info on CT:

- Ty et al., Hand, 2008
  - 28 pts with snuffbox tenderness, neg Xray
  - CT (slice?):
    - 4 scaphoid fx, 10 others (radius, carpals)
    - 14 patients CT negative
  - Gold std: neg films at 6 wk f/u
  - 8/14 lost to f/u
  - No missed fx (?)

CT:

- Cruickshank, Emerg Med Aus, 2007:
  - 51 pts with neg X-rays
  - 16 slice CT vs Bone scan at 2 wks
  - CT positive in 14, Bone scan in 23
  - True fractures? Gold standard?

Remaining questions:

- Is newer CT as good as MRI?
- Is it important to find trabecular Fx?
- Do occult fx have same complication rate?
- Should I order MR or CT today instead of splint and follow-up next week?
High Risk tip:

- Don’t ignore the scaphoid:
  - Splint and follow-up, or
  - Advanced imaging (MR vs CT)

Summary:

- Plain film and physical findings that suggest an occult fracture
- Evidence-based approach to evaluating patients for an occult fracture
- 4 common, important clinical scenarios