Tips for reading x-rays

• Have a systematic approach
• Start proximal and work distal
• Follow all edges

Tips for reading x-rays

• Look for disruption in cortical bone
• Exposed “fuzzy” edges (trabecular bone)
Tips for reading x-rays

- Articular surfaces should be parallel
- Widening or non-uniformity suggests injury

Tips for reading x-rays

- Always evaluate more than one view

Skyline or sunrise view

Tips for reading x-rays

- Look at everything on the film!
Upper Extremity

Shoulder
- Anterior dislocation
  - Subcoracoid (>90%)
  - Subglenoid
  - Subacromial
  - Intrathoracic
- Abducted, externally rotated

Anterior dislocation most common

Shoulder
- Anterior dislocation
  - Bankart lesion
    - Avulsion of anteroinferior glenoid labrum
  - Hill-Sachs deformity
    - Impaction fracture of posterolateral humeral head

Shoulder
- Anterior dislocation
  - Reduction techniques
    - Stimson, scapular manipulation, traction-countertraction, Cunningham

Examine for numbness over deltoid from axillary nerve injury

3 E's: Epilepsy, Ethanol, Electricity

Shoulder
- Posterior dislocation (2-3%)
- Associated with high force mechanisms
- Adducted, internally rotated

Axillary view (other views: Scap-Y, Velpeau)
Shoulder
• Posterior dislocation (2-3%)
• Associated with high force mechanisms
• Adducted, internally rotated

Clavicle
• Direct impact (e.g., fall onto shoulder)
• Distal third (15%)
• Middle third (80%)
• Medial third (5%)

Luxatio erecta is a rare inferior dislocation, arm held over head in full abduction

3 E’s:
- Epilepsy
- Ethanol
- Electricity

Medial clavicle fractures and posterior sternoclavicular dislocations at high risk for intrathoracic, great vessel injury

Scapula
• Fractures occur following significant blunt force

Look for associated injuries!
- Rib fractures
- Pneumothorax
- Hemothorax
- Pulmonary contusions
- Aortic injury

What are some signs of aortic injury on CXR?
• Mediastinum >8 cm supine (>6 cm upright)
• Abnormal aortic contour
• Tracheal deviation
• Loss of aorticopulmonary window
• Widened paraspinal/paratracheal stripes
• Left apical pleural cap
• Left hemothorax

What are some signs of aortic injury on CXR?
• Fall onto outstretched extremity, elderly
• Immobilization with sling and swath

Proximal Humerus
Most treated conservatively with the exception of significantly displaced, 3 and 4 part fractures using the Neer classification
Humeral Shaft
• Fracture typically caused by direct blow, can be pathologic
• Coaptation splint, sling and swath
  Associated with radial nerve injury (20%), causing weak extensors of wrist/digits, numbness of dorsoradial hand

Elbow
• Posterior dislocation
• FOOSH
• Reduction and immobilization with posterior splint
  Terrible triad: posterior dislocation, radial head fracture, and coronoid process fracture
  Associated with injury to the brachial artery

Supracondylar Fracture
• FOOSH, ages 5-10 yo
• Immobilization in posterior splint
  Sail sign and posterior fat pad sign also seen in adult radial head/neck fractures
What’s the diagnosis?

- 2 yo with elbow pain after being swung by the arms
- Elbow held in flexed, pronated position

Nursemaid’s Elbow

- 2 yo with elbow pain after being swung by the arms
- Elbow held in flexed, pronated position
- Radial head subluxation below annular ligament
- Supination/flexion or hyperpronation to reduce

Diagnosis?

Colles Fracture

- FOOSH
- Dinner fork deformity
- Reduction goals
  - Volar tilt
  - Inclination
  - Radius length
- Sugar tong splint

Colles Fracture

- FOOSH
- Dinner fork deformity
- Reduction goals
  - Volar tilt
  - Inclination
  - Radius length
- Sugar tong splint

Diagnosis?
**Smith Fracture**
- FOOSH
- Garden spade deformity
- Reduction goals similar to Colles
- Sugar tong splint

**Barton Fracture**
- FOOSH
- Dorsal radial rim, intraarticular

Volar rim = reverse Barton fracture = type II Smith fracture

*This is actually an image of a reverse Barton fracture

**Galeazzi Fracture**
- Middle/distal third Radius shaft fracture
- Disruption of distal radioulnar joint (DRUJ)

**Monteggia Fracture**
- Proximal Ulnar fracture
- Radial head dislocation

“GR...” = Galeazzi

“UM...” = Monteggia

Comminuted radial head fracture with dislocation of the distal radio-ulnar joint (DRUJ)?

Essex-Lopresti
Buckle Fracture
- Also called torus fracture
- Axial compression in children
- Splint or simple cast

Salter-Harris Classification
I = Slipped epiphysis
II = Fracture above epiphysis
III = Fracture below epiphysis
IV = Fracture through physis
V = Ruined physis

Top 3 most common carpal fractures?
1. Scaphoid
2. Triquetrum
3. Lunate

Scaphoid Fracture
- FOOSH
- Snuff box tenderness
- Retrograde blood supply, proximal injury at higher risk for AVN
Scaphoid Fracture

- AVN can also occur in:
  - Humeral head, hips in sickle cell disease
  - Femoral head following femoral neck fractures or hip dislocations
  - Femoral head in Legg-Calve-Perthes disease (boys 2-12 yo) and SCFE (obese adolescents)
  - Capitate
  - Lunate
  - Talus

Scaphoid Fracture

- Can be occult!
- Thumb spica even if x-rays are normal
- Other "occult" (x-ray neg) fractures...
  - Hip/pelvis
  - Tibial plateau
  - Calcaneous

Suspect occult scaphoid? Look for scapholunate widening on clenched-fist view (aka Terry Thomas sign)

Lunate Dislocation

- Spilled teacup on lateral view
- Piece of pie on AP view
- Teacup is upright but capitate is displaced (usually dorsally)
- Both can cause median nerve injuries

Lunate Dislocation

Both can cause median nerve injuries

Perilunate dislocation

AVN of lunate = Kienbock’s disease

Bennett Fracture

- Intraarticular fracture at base of 1st metacarpal
- Associated subluxation/dislocation

Rolando Fracture

- Essentially a comminuted Bennett fracture

AVN of lunate = Kienbock’s disease
Boxer’s Fracture

- 5th metacarpal neck
- Axial load with clenched fist
- Ulnar gutter splint

Allowable volar angulation post-reduction:

- < 10° - 15°
- < 35°
- < 45°

What are Kanavel’s Signs?

Infectious Flexor Tenosynovitis

Kanavel’s Signs
- Flexed posture of digit
- Fusiform “sausage-digit” swelling
- Tenderness over flexor tendon sheath
- Pain with passive extension
- Immobilize, elevate, IV abx, surgery consult

I like to focus on my arms.

Lower Extremity

Hip Dislocation

- Posterior (80-90%)
  - Adducted and internally rotated
  - Knee vs dashboard

- Anterior
  - Abducted and externally rotated

- Central
  - Impacted through acetabulum
Hip Dislocation
- Posterior (80-90%)
  - Adducted and internally rotated
  - Knee vs dashboard
- Reduction techniques
  - Allis, Bigelow, Under-over, Captain Morgan
- Hip dislocations associated femoral or sciatic nerve injuries
- Prolonged dislocation can lead to AVN of femoral head

Knee vs dashboard differential:
- Posterior acetabular fracture
- Patella fracture
- Knee dislocation
- Tibial plateau fracture

Femoral Neck Fracture
- Common in elderly with minimal or no report of trauma
- Shortened, externally rotated leg
- Be suspicious with new:
  - Inability to bear weight
  - Hip pain on axial loading of leg
  - Inability to straight leg raise

Intertrochanteric Fracture
- 90% occur in elderly due to falls
- Shortened, externally rotated leg
- Referred pain from hip – may present with isolated knee pain, particularly in children and elderly

Femoral Shaft Fracture
- Can occur in elderly from low-energy mechanism
- High-energy MVC in younger patients
- Traction splinting (closed)
- Associated with other life-threatening injuries
- Significant blood loss into thigh can occur

Which artery and nerve may be injured in a posterior knee dislocation?
Which artery and nerve may be injured in a posterior knee dislocation?

- Popliteal artery and peroneal nerve

May present after spontaneous reduction, be suspicious if there is laxity in 3 out of 4 ligaments (ACL, PCL, MCL, LCL)

Tibial Plateau Fracture

- May not be seen well on x-rays
- Axial load, fall from significant height
- Lateral more common, associated with peroneal nerve injury

Fracture pattern described with Schatzker classification

What are the 6 P’s of compartment syndrome?

- Pain out of proportion
- Paresthesias
- Poikilothermia
- Paralysis
- Pallor
- Pulselessness

Most reliable: pain with passive stretch, tender/tight compartment

Definition:
Pressure > 30 mmHg, or within 30 mmHg of DBP

What are the 6 P’s of compartment syndrome?

Other “pain out of proportion” conditions:
- Compartment syndrome
- Mesenteric ischemia
- Necrotizing fasciitis

Which antibiotics are needed?
Which antibiotics are needed?

**Gustilo Classification**
- Type I = wound < 1 cm, clean
- Type II = 1-10 cm, moderate contamination
- Type III = >10 cm, extensive contamination

1st gen cephalosporin (e.g. Ancef), PLUS
Aminoglycoside (e.g. gentamicin) if big and dirty, PLUS
Penicillin for clostridial exposure (think farm)

Ankle Injuries

- Fractures can be uni-, bi-, or trimalleolar
- Weber classification describes location of injury relative to tibiobular syndesmosis

Ankle Injuries

- Generally, small avulsion fractures which do not involve mortise (i.e. stable) can be splinted and discharged
- Posterior short leg splint, at 90° dorsiflexion

Ankle Injuries

- Orthopedics consult indicated for
  - Grossly unstable fractures
  - Bi- or trimalleolar fractures
  - Pilon fractures
  - Talar fractures
  - Open fracture/dislocations

Ankle Injuries

- Maisonneuve fracture (Weber C)
- Medial ankle injury (fracture or ligament tear)
- Proximal fibular fracture

ALWAYS examine the knee!
Ankle Injuries

- No obvious fracture?

- Ankle sprain mimics:
  - Peroneal tendon subluxation
  - Achilles tendon rupture
  - Lateral or posterior talar process fracture
  - Anterior calcaneus process fracture
  - Talar dome fracture

Toddler’s fracture: oblique, non-displaced distal tibial fracture from low-energy torsion, x-rays may be appear normal!

Calcaneous Fracture

- Bohler’s angle < 20° suggests fracture

- Associated with lumbar vertebral compression fractures and forearm fractures

Ottawa Rules

Calcaneous Fracture

- Bohler’s angle < 20° suggests fracture

- Associated with lumbar vertebral compression fractures and forearm fractures

Lisfranc Injury

- Fracture/dislocation from disruption of tarsometatarsal joint

- Can be associated with dorsalis pedis injury

- Weight-bearing films may help reveal subtle injuries

Fleck sign: avulsion fracture at base of 2nd metatarsal on medial side (pathognomonic)

Jones Fracture

- Transverse fracture through base of 5th metatarsal

- Immobilization and NWB

Pseudo-Jones Fracture

- Avulsion of 5th metatarsal styloid

- Also known as dancer’s fracture

- Hard-soled shoe, conservative treatment
Spine and Pelvis

Which of the following cervical fractures is/are unstable?

- A) Odontoid type 1
- B) Clay Shoveler’s fracture
- C) Odontoid type 2/3
- D) Jefferson fracture

Jefferson (C1 Burst) Fracture
- Axial load with vertical compression
- Associated with other cervical fractures

Odontoid Fracture
- Injury due to flexion
  - Type 1: Tip
  - Type 2: Base
  - Type 3: Body

Hangman’s Fracture
- Injury due to hyperextension/distraction
- Anterolisthesis of C2 on C3 with bilateral C2 pedicle fractures
### Match the thoracolumbar fractures

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wedge compression</td>
<td>Loss of anterior height from flexion</td>
</tr>
<tr>
<td>Burst</td>
<td>Horizontal fracture through body from flexion at thoracolumbar junction (lap belts)</td>
</tr>
<tr>
<td>Chance</td>
<td>Loss of anterior and posterior height from vertical compression</td>
</tr>
</tbody>
</table>

**Thoracic spine more rigid and fractures less common, BUT more often associated with spinal cord injury**

### Match the spinal cord syndromes

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior Cord</td>
<td>Ipsilateral paralysis and loss of proprioception/vibration, contralateral loss of pain/temperature</td>
</tr>
<tr>
<td>Central Cord</td>
<td>Paralysis and loss of pain/temperature, preserved proprioception/vibration</td>
</tr>
<tr>
<td>Brown Sequard</td>
<td>Weakness greater in arms than in legs</td>
</tr>
</tbody>
</table>

### Pelvic Fractures

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| Ring Fractures   | • Lateral compression  
|                  | • Anteroposterior compression (aka open book)  
|                  | • Vertical shear                                                           |

1/3 of pelvic fractures do not involve the ring

<table>
<thead>
<tr>
<th>Non-Ring Fractures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Iliac wing</td>
<td></td>
</tr>
<tr>
<td>• Superior pubic ramus</td>
<td></td>
</tr>
<tr>
<td>• Inferior pubic ramus</td>
<td></td>
</tr>
<tr>
<td>• Transverse sacral</td>
<td></td>
</tr>
<tr>
<td>• Coccyx</td>
<td></td>
</tr>
<tr>
<td>• ASIS avulsion</td>
<td></td>
</tr>
<tr>
<td>• Acetabular avulsion</td>
<td></td>
</tr>
<tr>
<td>• Ischial tuberosity avulsion</td>
<td></td>
</tr>
</tbody>
</table>

### Lateral Compression

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC1: PR + sacral compression</td>
<td></td>
</tr>
<tr>
<td>LC2: PR + iliac wing</td>
<td></td>
</tr>
<tr>
<td>LC3: PR + contralateral open book</td>
<td></td>
</tr>
</tbody>
</table>

Young Burgess Classification

Images from Tintinalli
Anteroposterior Compression

APC1: pubic symphysis widening
APC2: pubic symphysis widening + SI joint, anterior SI ligament disruption
APC3: complete hemipelvis separation but no vertical displacement

Young Burgess Classification

Vertical Shear

All pelvic ring fractures associated with hemorrhagic shock

- Signs of urethral injury
  - Blood at meatus
  - Perineal hematoma
  - High riding prostate

Obtain urethrogram before Foley placement

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Who’s ready for the ITE?

Ready?

Ready, bro.

The End