### Upper Extremity Trauma: Shoulder

#### Bones & Radiographs

**AP & Obl**
- Ax & WP
- Y & ACJ
- AC Injury
- GH Dislocate
- Anterior
- Posterior
- CT
- Final Case
- Conclusion

#### Radiographic Views

**AP & Obl**
- Ax & WP
- Y & ACJ
- Anterior
- Posterior
- CT
- Final Case
- Conclusion

#### CT Optimization

**Anterior**
- Posterior
- CT
- Final Case
- Conclusion

#### Imaging Techniques

**Glenohumeral Joint**
- Radiographic Views
- CT Optimization

#### Imaging

**Shoulder Trauma**
- How not to miss a posterior dislocation

---

### Scapula: Anterior View

**Goal**

Better 3-D Understanding of The Shoulder

**Objectives**

- Illustrate Anatomy
- 3-D Scapula
- Glenohumeral Joint
- Radiographic Views
- CT Optimization
- Shoulder Trauma
- How not to miss a posterior dislocation

#### Parts:

- **Body**
  - Razor
  - Thin
  - "Shoulder Blade"
  - No articular surfaces
  - Origin of all 4 Rotator Cuff (RC) Muscles

---

### Scapula: Medial View

**Goal**

Better 3-D Understanding of The Shoulder

**Objectives**

- Illustrate Anatomy
- 3-D Scapula
- Glenohumeral Joint
- Radiographic Views
- CT Optimization
- Shoulder Trauma
- How not to miss a posterior dislocation

#### Parts:

- **Body**
  - **ANTERIOR**
  - **POSTERIOR**
  - **3D**
  - **Spine**

---

### Scapula: Anterior Medial View

**Goal**

Better 3-D Understanding of The Shoulder

**Objectives**

- Illustrate Anatomy
- 3-D Scapula
- Glenohumeral Joint
- Radiographic Views
- CT Optimization
- Shoulder Trauma
- How not to miss a posterior dislocation

#### Parts:

- **Body**
  - **Triangular**
  - **3 Margins**
  - **2 Angles**

---

### Scapula has complex 3-D anatomy

**Helps to look at it from multiple views**
Upper Extremity Trauma: Shoulder

Scapula: Posterior Medial View

Parts:
- **Body**
- **Spine**
- **Posterior**
- **Structure**
- **Off back of Body**
- **Defines RC muscles**
  - **Supraspinatus**
  - **Infraspinatus**

Scapula: Posterior View

Scapula: Lateral View

“Y-view”

3 Limbs:
- **Body**
- **Spine**
- **Coracoid**

Scapula: Anterior Lateral View

Coracoid is in Elbow

Clavicle: 2 Joints

"Long Bone", but not a straight bone

Clavicle: [U] "collarbear", "key"

Clavicle: [U] "collarbear", "key"
Upper Extremity Trauma:  
Shoulder

**Radiographs: Technical Points**

- Both AP & Oblique:  
  1) Shot Standing  
  2) Shield Genitals  
  3) Boomerang Filter  
  Allows good exposure of GHJ without overexposure of ACJ

**Boomerang Filter**

- Sometimes we can see the filter on radiographs
- Usually we see only the internal radiopaque tracer chain

**Radiographs: Need Orthogonal Views**

- The 3 Orthogonal views to the GHJ are:
  - Oblique
  - "Grashey"
  - Axillary (supine)
  - West Point (prone)

**Radiographs: Axillary view (supine)**

- Profiles glenohumeral joint
  - Width
  - Arthritis
  - Alignment
  - Dislocations

**Radiographs: West Point view (prone)**

- Profiles glenohumeral joint
  - Width
  - Arthritis
  - Alignment
  - Dislocations
Upper Extremity Trauma: Shoulder

**Radiographs: West Point vs Axillary**

- AP view (upright)
- Axillary view (supine)

Both well show GHJ width/alignment
- Ax: Anterior glenoid overlaps clavicle
- WP: Well shows anterior glenoid

**Radiographs: UW 3-view series**

- Standard (trauma, pain)
  1) AP
  2) Oblique
  3) Axillary

**Instability (3-views Glenohumeral Joint)**

- 1) Oblique
- 2) Axillary
- 3) West Point

If need orthogonal views Scapula, ACJ

**Radiographs: AC Joints (Bilateral)**

**Radiographs: Scapular Y view (PA)**

**Radiographs: AC Joints (Bilateral)**

**Shoulder: 3 Bones & 2 Joints**

2 Ligaments attach clavicle to scapula:
- AC Lig
- CC Lig

AC injury types based on:
- Which ligaments are torn
- Degree/direction of A-C displacement

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**Upper Extremity Trauma: Shoulder**

### Acromioclavicular Injury: Type 1

**Bones & CT**
- AC Lig: Sprain (intact)
- CC Lig: Intact
- ACJ: Aligned
- Radiographs: Normal

**Shoulder Clavicle Dislocation**
- AC Injury
- GH Dislocation
- Anterior
- Posterior
- CT

**Final Case**
- Conclusion

**Rockwood & Green's Fractures in Adults 8th Ed. ©2015 [Kindle Edition]**

**Fig 41-2**
- AC injuries most commonly occur in males <30 related to contact sports

Galen (120-199AD) diagnosed his own AC dislocation received from wrestling.
He treated himself with tight bandages to hold clavicle down, keeping arm elevated.
He abandoned the treatment after only a few days as it was uncomfortable.

**Low compliance rate of shoulder bracing**

### Acromioclavicular Injury: Type 2

**Bones & CT**
- AC Lig: Torn
- CC Lig: Intact
- ACJ: Subluxated

**Shoulder Clavicle Dislocation**
- AC Injury
- GH Dislocation
- Anterior
- Posterior
- CT

**Final Case**
- Conclusion

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**Fig 41-2**
- D,V 21yoM

### Acromioclavicular Injury: Type 3

**Bones & CT**
- AC Lig: Torn
- CC Lig: Torn
- ACJ: Dislocated

**Symptomatic Clavicle Dislocation**
- AC Injury
- GH Dislocation
- Anterior
- Posterior
- CT

**Final Case**
- Conclusion

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**Fig 41-14**
- L,L 42yoM

### Acromioclavicular Injury: Type 4

**Bones & CT**
- AC Lig: Torn
- CC Lig: Torn
- Clavicle Posterior to Acromion

**Symptomatic Clavicle Dislocation**
- AC Injury
- GH Dislocation
- Anterior
- Posterior
- CT

**Final Case**
- Conclusion

**AC injury is so rare I've never seen one**

### Acromioclavicular Injury: Type 5

**Bones & CT**
- AC Lig: Torn
- CC Lig: Torn
- ACJ: Very Dislocated

**Symptomatic Clavicle Dislocation**
- AC Injury
- GH Dislocation
- Anterior
- Posterior
- CT

**Final Case**
- Conclusion

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**Fig 41-14**
- L,L 42yoM

### Acromioclavicular Injury: Type 6

**Bones & CT**
- AC Lig: Torn
- CC Lig: Torn
- Clavicle Posterior to Acromion

**Symptomatic Clavicle Dislocation**
- AC Injury
- GH Dislocation
- Anterior
- Posterior
- CT

**Final Case**
- Conclusion

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**Fig 41-14**
- L,L 42yoM

This type is very rare

**Subtle overlap of Acromion on Clavicle**

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**Fig 41-14**
- L,L 42yoM

This type is so rare I've never seen one
**Upper Extremity Trauma: Shoulder**

**Upper Extremity Trauma**

**GH Dislocations: Anterior**

Humerus Anterior-Inferior to Glenoid

- Easy to see on all radiographic views
- ½ Anterior Dislocations are subglenoid

**Mechanism**

Anterior humerus dislocates, postero-superior head impacts into anterior-inferior glenoid (creating Hill-Sachs fracture)

**GH Dislocations: Hill-Sachs**

- Posterior Humeral Head impacted on Anterior Glenoid
- Creating wedged fracture in the posterior-supero-lateral humeral head
- Hill-Sachs Defect

**GH Dislocations: Bankhart Fx**

- ± fracture antero-inferior glenoid
- Bankart fracture
- “Bony Bankart”
- The defect Bankart described was not of the bone, but of the cartilaginous labrum

**GH Dislocations: Subglenoid**

Humerus Anterior-Inferior to Glenoid

- Easy to see on all radiographic views
- Subglenoid

**GH Dislocations: Anterior**

- 2 Very rare types (I’ve never seen either…)
- Subclavicular
- Intrathoracic

**Conclusion**

Final Case

CT

GH Dislocate

AC Injury

Radiographs

Bones

AP & Obi

Ax & WP

Y & ACJ

Conclusion

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Upper Extremity Trauma: Shoulder

**Shoulder**

**Bankart:** Often best seen on WP

- AP & Y
- ACJ
- GH Dislocate
- Anterior
- Posterior
- CT
- Final Case
- Conclusion

**Dislocations: Anterior v Posterior**

- Anterior Dislocations (97%)
  - Goes Anterior & Inferior
  - **Easy to see**
  - Indirect trauma
    - Rarely from direct blow
    - 48% fall at home, 35% during sports
- Posterior Dislocations (3%)
  - Goes Straight Posterior
  - **Harder to see**
  - 67% Trauma (Falls > MVA > Sports)
  - 31% Seizure
  - 2% Electrocution

**Posterior Dislocation Clues: 1**

- Humerus Stuck in Internal Rotation
- Lack of Parallelism on Oblique View

**Posterior Dislocation Clues: 2**

- Look at the Axillary/WP View!

**Posterior Dislocation Clues: Bonus**

- Trough Line Sign (Reverse Hill-Sachs)

**Posterior Dislocation Clues:**

- **Trough Line Sign** (Reverse Hill-Sachs)

- Anterior Dislocation:
  - Anterior Glenoid
  - Impacts Info
  - Anterior Humerus
  - "Hill-Sachs"
- Posterior Dislocation:
  - Posterior Glenoid
  - Impacts Info
  - Posterior Humerus
  - Trough Line Sign

**West Point: Well shows anterior glenoid**

**Axillary view:**

- Clavicle overlaps anterior glenoid

**Posterior Dislocation Clues:**

- **Trough Line Sign** (Reverse Hill-Sachs)

- Anterior Dislocation:
  - Anterior Glenoid
  - Impacts Info
  - Anterior Humerus
  - "Hill-Sachs"
- Posterior Dislocation:
  - Posterior Glenoid
  - Impacts Info
  - Posterior Humerus
  - Trough Line Sign

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**Axillary view:**

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- **Trough Line Sign** (Reverse Hill-Sachs)

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  - Anterior Glenoid
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  - Anterior Humerus
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  - Impacts Info
  - Posterior Humerus
  - Trough Line Sign

**West Point: Well shows anterior glenoid**

**Axillary view:**

- Clavicle overlaps anterior glenoid

**Posterior Dislocation Clues:**

- **Trough Line Sign** (Reverse Hill-Sachs)

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  - Anterior Glenoid
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  - Anterior Humerus
  - "Hill-Sachs"
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  - Impacts Info
  - Posterior Humerus
  - Trough Line Sign

**West Point: Well shows anterior glenoid**

**Axillary view:**

- Clavicle overlaps anterior glenoid
Upper Extremity Trauma: Shoulder

**Optimizing Bone CT: General**

There are always 3 things technologists can do to optimize Bone CT:

1) **Optimize Patient Positioning**
   - Try to center the bone
   - Get other bones out of scanning FOV

2) **Optimize Scanning Technique**
   - Thin slices, 50% overlap
   - Use small focal spot, small display FOV

3) **Optimize Reformats**
   - 2D: Angle slices relative to ANATOMY
   - 3D: Rotate & Segment

**Optimizing Bone CT: Shoulder**

1) **Optimize Patient Positioning**
   - Try to center the bone
   - Get other bones out of scanning FOV
   - This depends on body habitus

2) **Optimize Scanning Technique**
   - Cannot manually select small focal spot
   - Small focal spot comes on automatically if the mA-particular value, based upon the KV
   - Ask your Application person for your CT scanner
   - Can use Automatic Exposure Control (AEC)

   a) **Use Small Focal Spot**
      - Cannot manually select small focal spot
      - Small focal spot comes on automatically if the mA-particular value, based upon the KV
      - Ask your Application person for your CT scanner
      - Can use Automatic Exposure Control (AEC)

   b) **Reduce the mA**
      - Set the mA value to be less than the maximum allowed mA for the small focal spot

---

**Shoulder Exams at UW DOR**

<table>
<thead>
<tr>
<th>Body Region</th>
<th>Shoulder: Sorted by Modality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiographs</td>
<td>Record total number of exams each month</td>
</tr>
<tr>
<td>Oblique</td>
<td>CT exams</td>
</tr>
<tr>
<td>AP</td>
<td>Calculated number of radiographic exams (RG)</td>
</tr>
<tr>
<td>Y &amp; ACJ</td>
<td>Doesn’t include fluoroscopic injections (not listed by joint)</td>
</tr>
<tr>
<td>AC Injury</td>
<td>We do daily shoulder injections for pain (steroids), MR-Arthro (Gol)</td>
</tr>
<tr>
<td>GH Dislocate</td>
<td>Train all UW Residents</td>
</tr>
<tr>
<td>CT</td>
<td>Doesn’t include Ultrasound (not listed by joint)</td>
</tr>
<tr>
<td>CT</td>
<td>UW MSK US Clinic</td>
</tr>
<tr>
<td>CT</td>
<td>DT: Rotator Cuff</td>
</tr>
<tr>
<td>CT</td>
<td>Rx: Steroids. Lavage Ca** Tendonitis</td>
</tr>
</tbody>
</table>

**Radiographs**

- Obstetrics
- Ax & WP
- Y & ACJ
- AC Injury
- GH Dislocate
- Anterior
- Posterior
- CT

**Conclusion**

CT: Mostly for surgical planning

CT: Mostly for surgical planning

**Shoulder: What to Order When**

- **Radiographs**
  - Obstetrics
  - Ax & WP
  - Y & ACJ
  - AC Injury
  - GH Dislocate
  - Anterior
  - Posterior
  - CT

**Conclusion**

CT: Mostly for surgical planning

CT: Mostly for surgical planning

---

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Upper Extremity Trauma: Shoulder

Optimizing Bone CT: General

2) Optimize Scanning Technique (This is what my physicist tells me...)
   a) Larger pixel size
   b) Thin slices with 50% overlap
      - Shoulder: Thinner but not too thin (1-1.5mm)
      - <1mm slices may be too noisy (We use 1.25mm)
   c) 50% overlap yields better reformats
   d) Use "Ultra High Resolution" (UHR)... if available on your CT scanner
      - This will always be an issue with shoulders
   e) Hi Res uses fluctuating focal spot position
      - Minimizes off-center sharpness degradation
      - Particularly useful for shoulders

Optimizing Bone CT: Shoulder

2) Optimize Scanning Technique (This is what my physicist tells me...)
   b) Thin slices with 50% overlap
      - Shoulder: Thinner but not too thin (1-1.5mm)
      - <1mm slices may be too noisy (We use 1.25mm)
   c) 50% overlap yields better reformats
      - Adds information to the stack of axial images
      - Pitch close to 0.5
      - Reduces helical artifacts
      - Uses less mA, hence use small focal spot

Optimizing Bone CT: Shoulder

3) Optimize Reformats
   - Angle slices relative to ANATOMY Not relative to table
     - Coronal slices angled perpendicular to GHJ
     - Sagittal slices angled parallel to GHJ
     - "All these reformats should be turned off"

Optimizing Bone CT: Shoulder

3b) Optimize 3-D Reformats
   - Series of 36 rotating images, 10° intervals
   - Rotate around both vertical and horizontal axes
   - Disarticulate humerus/scapula
Upper Extremity Trauma: Shoulder

One final case...

R,D 58yoM: Cleaning gutters, fell from 6ft ladder. Fell on elbow, shoulder pain.

Indirect trauma was to shoulder.

Direct trauma was to elbow. Surgical Neck Fracture

2-Part Fracture (at least)

Anterior Dislocation

Subcoracoid GT Fx

Triceps Spur

CT: Sagittal Reformat (Parallel to GHJ)

Post ORIF

Can download this and all of my lectures in various formats.

Questions?