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/metal 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 (*This depends on body habitus*)
- Get other bones out of scanning FOV (*This does not*)

CT: AP Scout

**Suggestions**

- **Shrug UP ipsilateral**
- **Scooch patient over**
- **Shrug DOWN contralateral**

**“Schreibman Shrug”**

**Schreibman Shrug**

- Gets contralateral shoulder out of scan FOV, minimizing streak artifacts from that side
Optimizing Bone CT: Shoulder

1) Optimize Patient Positioning

✓ Try to center the bone \( \rightarrow \text{This depends on body habitus} \)
✓ Get other bones out of scanning FOV \( \rightarrow \text{This does not} \)
✓ GET METAL OUT OF SCANNING FOV!

CT: AP Scout

CT: AP Scout

“Schreibman Shrug”

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Shoulder Imaging

Bones: S, C, H
Radiographs:
AP & Obl
Ax & WP
Y & ACJ
AC Injury
GH Dislocate

Anterior
Posterior

CT

Final Case

Conclusion
## Optimizing Bone CT: General

2) Optimize Scanning Technique

(This is what my physicist tells me..)

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)
  - Set the Max mA value to be less than the maximum allowed mA for the small focal spot
Shoulder Imaging

### GE CT Scanner mA Limits

<table>
<thead>
<tr>
<th>Scanner Name</th>
<th>Scan FOV</th>
<th>140 kV</th>
<th>120 kV</th>
<th>100 kV</th>
<th>80 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery CT750HD</td>
<td>Normal mode: Large Focal Spot</td>
<td>715</td>
<td>835</td>
<td>800</td>
<td>700</td>
</tr>
<tr>
<td>Discovery CT750HD</td>
<td>Hi Res mode: Large Focal Spot</td>
<td>540</td>
<td>625</td>
<td>750</td>
<td>700</td>
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<tr>
<td>Discovery CT750HD</td>
<td>Normal mode: Small Focal Spot</td>
<td>10 - 490</td>
<td>10 - 570</td>
<td>10 - 680</td>
<td>10 - 620</td>
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<tr>
<td>Discovery CT750HD</td>
<td>Hi Res mode: Small Focal Spot</td>
<td>10 - 360</td>
<td>10 - 420</td>
<td>10 - 500</td>
<td>10 - 620</td>
</tr>
<tr>
<td>LightSpeed VCT 64, LightSpeed 16 Pro, &amp; Optima CT 580</td>
<td>Large Focal Spot</td>
<td>715</td>
<td>800</td>
<td>770</td>
<td>675</td>
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<tr>
<td>LightSpeed VCT 64, LightSpeed 16 Pro, &amp; Optima CT 580</td>
<td>Small Focal Spot</td>
<td>10 - 335</td>
<td>10 - 335</td>
<td>10 - 310</td>
<td>10 - 300</td>
</tr>
<tr>
<td>Revolution Evo &amp; Optima CT660</td>
<td>Large Focal Spot</td>
<td>515</td>
<td>560</td>
<td>480</td>
<td>400</td>
</tr>
<tr>
<td>Revolution Evo &amp; Optima CT660</td>
<td>Small Focal Spot</td>
<td>10 - 170</td>
<td>10 - 200</td>
<td>10 - 240</td>
<td>10 - 300</td>
</tr>
<tr>
<td>LightSpeed 16, &amp; LightSpeed 8</td>
<td>Large Focal Spot</td>
<td>380</td>
<td>440</td>
<td>420</td>
<td>400</td>
</tr>
<tr>
<td>LightSpeed 16, &amp; LightSpeed 8</td>
<td>Small Focal Spot</td>
<td>10 - 170</td>
<td>10 - 200</td>
<td>10 - 240</td>
<td>10 - 300</td>
</tr>
</tbody>
</table>

### What kV to use?
- **Adults:**
  - At least 120
  - Use 140

- **Large Adults:**
  - Use 140

- **Small child:**
  - Use 100

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Courtesy of Frank Ranallo, PhD, DABR
Physicist- UW Radiology Department
2) Optimize Scanning Technique
   (This is what my physicist tells me..)

b) Thin slices with 50% overlap
   - Shoulder: Thin but not too thin (1-1.5mm)
     - <1mm slices may be too noisy (We use 1.25mm)
   - 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: General

2) Optimize Scanning Technique

(This is what my physicist tells me..)

c) Use smallest possible display FOV to maximize resolution

- Display FOV always = 512 pixels
- Display FOV → smaller pixel size
- Smaller pixel size → higher resolution

Just a little math...

- 50 cm display FOV / 512 pixels → pixel size ≈ 1 mm
- 25 cm display FOV / 512 pixels → pixel size ≈ ½ mm
Shoulder Imaging

Optimizing Bone CT: Shoulder

2) Optimize Scanning Technique
   (This is what my physicist tells me..)

d) Use “Ultra High Resolution” (UHR)...
   …if available on your CT scanner

- On any CT scanner, resolution degrades dramatically as you move away from center
  - This will always be an issue with shoulders
- Hi Res uses fluctuating focal spot position
  - Minimizes off-center sharpness degradation
  - Particularly useful for shoulders

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Optimizing Bone CT: Shoulder

3) Optimize Reformats

- Angle slices relative to ANATOMY *Not relative to table*
  - Overly aggressive shrugs: Angle axial reformats
  - Coronal slices angled perpendicular to GHJ
  - Sagittal slices angled parallel to GHJ
  - Slices should not be coronal to the table
  - Also, all these annotations should be turned off

CT: AP Scout
CT: Axial image through GHJ
CT: Axial image through GHJ

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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

Optimizing Bone CT:

Shoulder

Radiographs
AP & Obl
Ax & WP
Y & ACJ

AC Injury

GH Dislocate

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Shoulder Imaging

Case CT: 2D Reformats

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

CT: Axial slice through GHJ

CT: Coronal Reformat (Perpendicular to GHJ)

CT: Sagittal Reformat (Parallel to GHJ)

CT: CT scout

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Shoulder Imaging

CT: 3D Reformats

Bones
Radiographs
AP & Obl
Ax & WP
Y & ACJ
AC Injury
GH Dislocate
Anterior
Posterior
CT

Scapula only
Coracoid Fx
Bankart Fx

Humerus only

Sagittal Reformat
(Parallel to GHJ)

Coronal Reformat
(Perpendicular to GHJ)

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

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