What to Order When: (WOW) Bony Pelvis

Bony Pelvis Trauma

WOW conference: 10/8/11

**Topics**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

### Bony Pelvis = 3 Bones

Innominate Bone = 3 Bones

**Skeletally Mature**

- Sacrum
- Innominate

**Innominate Bone = 3 Bones**

- Skeletally Immature
- Ilium (top)
- Ischium (back)
- Pubis (front)

**Innominate Bone = 3 Bones**

- Skeletally Immature

**Innominate Bone = 3 Bones**

- Skeletally Mature

**Bony Pelvis: Landmarks**

- Iliac Crest “Hips”
- “Hands on Hips”
- Greater Sciatic Notch
- Sciatric nerve passes
- Ischial Tuberosity
- Part we sit on

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What to Order When: (WOW) Bony Pelvis

Bony Pelvis: Attachments

- Hamstrings:
  - Semimembranosus
  - Semitendinosus
  - Biceps femoris

- Sartorius origin
- Rectus femoris origin

Apophysis Avulsions

- Iliac Crest
- ASIS
- AIIS

Apophysis ≈ Epiphysis
- Unused end of the skeletally immature bone
- Muscle attachment to apophysis is stronger than the apophysis attachment to the rest of the bone

Pelvis Radiographs

- Lying on x-ray table
  - Not weight-bearing
  - Unlike knees & feet which should be done standing
- Cassette slides into “Bucky Grid”
  - Minimize x-ray scatter
  - Dr. Gustav Bucky (9/3/1880-2/19/1963)
  - 1913: Moving grid (Berlin)
**What to Order When:**

(WOW) Bony Pelvis

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**Bony Pelvis Trauma**

**Anatomy**

**Radiographs**

CT Protocols

Pelvic Ring Fx

AP Force

Lateral

Vertical

Acetabular Fx

Walls

Columns

Leotumel

Judet View

WOW

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**What to Order When (WOW)**

Always start with radiographs

- Trauma to bony pelvis (car collision)
- Chronic hip pain (arthritis)
- Additional hip view (frog leg lateral)
- Acute hip fracture (femoral neck fracture)
- Single SI view (modified Ferguson view)

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**AP Pelvis**

**AP Pelvis shows more than AP Hip**

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**Frog Leg Lateral**

**Working up Hip Pain**

Should order:

1) AP pelvis (both hips)
2) Frog leg view of painful hip (or both hips)
   - UW: “PELVIS w 1 HIP” = 2 charges = $283
   - UW: “PELVIS w BOTH HIPS” = 1 charge = $179

Should NOT order:

- AP view of just one hip without an AP pelvis
- Often helpful to compare with asymptomatic side

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**Bony Pelvis Trauma**

**CT Protocols**

Pelvic Ring Fx

AP Force

Lateral

Vertical

Acetabular Fx

Walls

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Leotumel

Judet View

WOW

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**Radiographs**

WOW conference: 10/8/11

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**What to Order When:**

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**Do we always need a 2nd view?**

Basic concept in radiology: “One view equals no views”

Frog leg view typically shows femoral head osteophytes earlier than AP view

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**Value of the Frog Leg View**

- Dx: Mild OA
- Relatively normal hip joint width
- Small Osteophyte

**WOW: Hip Pain**

- Chronic Pain (arthritis)
  1) AP Pelvis (to include BOTH hips)
  2) Frog leg view of painful hip (or both hips)
    - Consider L-spine radiographs (AP & Lateral)
- Acute Pain (hip fracture)
  1) AP Pelvis (to include BOTH hips)
    - Don’t want a frog leg view
      - Don’t want patient to abduct thigh and risk dislocating the fracture
  2) Instead: “Cross-Table Lateral View”

**Cross-Table Lateral Hip**

**Views of the Hip**
What to Order When: (WOW) Bony Pelvis

Femoral Neck Fractures

These are surgical emergencies
Should be repaired within hours
Otherwise femoral head will die (AVN)
Best outcome if NON-DISPLACEDE

- Non-displaced femoral neck fractures:
  Repaired with “Percutaneous Pinning”

- Displaced femoral neck fractures:
  Repaired with Hip Prosthesis

- Don’t want to miss non-displaced fractures…
  But non-displaced fractures hard to see…
  Particularly osteoporotic, post-menopausal

MRI Does Not Miss Fractures!

Coronal T1 (Fat is bright)
Normal fatty yellow marrow

Coronal STIR (Fluid is bright)
Black line
Neck FX!

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What to Order When: (WOW) Bony Pelvis

**WOW: Hip Pain**

- **Acute Pain (hip fracture)**
  1. AP Pelvis (to include BOTH hips)
  2. Don't want frog leg view
  3. Don't want patient to abduct thigh and risk dislocating the fracture

- Instead: “Cross-Table Lateral View”

- If radiographs are negative and there is still a concern for a hip fracture:
  1. Get MRI Bony Pelvis (attn: symptomatic hip)
  2. TODAY! (Send patient to ER if necessary)

**WOW: Pelvic Joint Pain**

- **Chronic Pain (arthritis)**
  1. AP Pelvis (to include BOTH hips)
  2. Frog leg view of painful hip (or both hips)

- **Acute Pain (hip fracture)**
  1. AP Pelvis (to include BOTH hips)
  2. Cross-Table lateral view of painful hip

- Consider MRI Bony Pelvis for occult fracture

**Sacraliiac Joints**

- Single SI view (Modified Ferguson view)

- To see the SI joints in their entirety, need to either: rotate pelvis, or x-ray beam… or both.

**SI Joint View (Modified Ferguson)**

- Can see cortical margins of SI joints REALLY well!
To see the SI joints in more detail, need to use cross-sectional imaging:
- MRI (pre & post intravenous contrast)
- Good for seeing inflammation/synovitis
- CT (without contrast)
  - Good for seeing cortex/erosions
What to Order When: (WOW) Bony Pelvis

Pelvic Ring: Model

When a ring breaks... it breaks in at least 2 places

Pelvic Ring Repformatting

Reformat Techniques
- Depend upon body part
- Depend upon injury
- For pelvic ring fractures: Reformat in 3 planes (Relative to anatomy)
- For acetabular fractures: Add simulated Judet views
- For sacral fx, SI joints: Oblique coronal & axial (Relative to sacrum)

Pelvic Ring

Structurally, solid ring...

...but with discontinuities

at both SI joints

at pubic symphysis

Pelvic Fractures = Serious Trauma

Pelvic ring is a strong structure. Pelvic ring fractures means patient has experienced SERIOUS trauma.
- High speed car crash
- Concern for life threatening injuries.
- Aorta, major artery rupture
- Can hemorrhage large volume of blood internally within the pelvis.

ER: First 2 Trauma Radiographs

Chest

Pelvis

This patient did not survive long enough to go to CT

Bony Pelvis Trauma

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Pelvic Fractures

Pelvic Fractures = Serious Trauma

Pelvis

Chest

This patient did not survive long enough to go to CT

Pelvic Ring

Structurally, solid ring...

...but with discontinuities

at both SI joints

at pubic symphysis

Pelvic Ring Fracture Patterns

AP Compressive Force

When a ring breaks... it breaks in at least 2 places
What to Order When: (WOW) Bony Pelvis

**Bony Pelvis Trauma**

**AP Compressive Force**

- **Anatomy**
- **Radiographs**
- **CT Protocols**
- Pelvic Ring Fx
- AP Force
- Lateral Vertical Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

- **SI Joints**
- Book Open Anteriorly
- SI Joints
- Fracture
- SI diastasis
- Urinary Bladder

**Diastasis Pubic Symphysis**

- **Posteriorly**
- **Anteriorly**

**CT Protocols**

- **Radiographs**
- **Anatomy**

**Pelvic Ring Fx**

- **Excreted Contrast**

**T-bone collision**

- **SI “Book open” Posteriorly**
- **Sacral Impaction Fractures**

**Pubic Compression Fractures**

These lateral force compression fractures are harder to see on radiographs than the distracted fractures from AP pelvic forces.
What to Order When: (WOW) Bony Pelvis

Lateral Compressive Force

- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

Vertical Shear Force

- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

Acetabulum

- Skeletally Mature
- Ilium (top)
- Ischium (back)
- Acetabulum Pubis (front)

Acetabulum: Cup

- Latin acētābulum, vinegar cup
- From acētum, vinegar

In ancient dining, an acetabulum was a vinegar cup, which, from the fondness of the Greeks and Romans for vinegar, was always placed on the table at meals to dip the food in before eating it. The vessel was wide and open above.
What to Order When: (WOW) Bony Pelvis

**Acetabulum: Walls**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Posterior Wall Fracture**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Hip Dislocations**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Anterior Wall Fracture**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Acetabulum: Walls**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Posterior Wall Fracture**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Hip Dislocations**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
- Acetabular Fx
- Walls
- Columns
- Letournel
- Judet View

**Anterior Wall Fracture**
- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fx
- AP Force
- Lateral
- Vertical
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What to Order When: (WOW) Bony Pelvis

Acetabulum: Columns

Anterior Column (Ilium + Pubis)

Posterior Column (Ischium up to the Greater Sciatic Notch)

Column Fractures

Posterior Column Fracture

Anterior Column Fracture

Both Column Fracture

Letournel Classification

Elementary Fractures

Combined Fractures

3 of these > 70% Acetabular Fractures

emedicine.medscape.com

Figures from HSS J. 2006 Sept; 2(2): 161-171
What to Order When: (WOW) Bony Pelvis

Wall vs Column Fractures

- Posterior Column Fracture
- BOTH Column Fracture
- Anterior Column Fracture

All Column Fractures Involve Obturator Ring

Judet Views

- Anatomy
- Radiographs
- CT Protocols
- Pelvic Ring Fracture
  AP Force
- Lateral
- Vertical
- Acetabular Fracture
- Walls
- Columns
- Letournel
- Judet View

The Journal of Bone and Joint Surgery

Fractures of the Acetabulum: Classification and Surgical Approaches for Open Reduction

The Journal of Bone and Joint Surgery

Judet Views

Radiographic Positioning

What to call these views?

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What to Order When: (WOW) Bony Pelvis

**Should we get Judet in ER?**

- **Smiley face:** Surgeons like them
  - Want them to compare with future outpatient Judet views

- **Frown face:** Difficult to get in the ER
  - May not want to roll patients with Fxs
  - Portables never come out very well

- **Neutral face:** All these patients go to CT
  - Reformat CT data into simulated Judet
  - Directly at the CT scanner

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**CT Judet Views: Examples**

- **G,D 66 yo M**
  - Obturator oblique view, L hip
  - Iliac oblique view, R hip
  - Iliac oblique view, L hip
  - Obturator oblique view, R hip

- **How to make CT Judet (GE)**
  1. Move reference to femoral head on Oblique viewport
  2. Adjust Slice Thickness (middle mouse button) ~ 60mm
  3. Change “MIP” to “Average” (right mouse button)
  4. Set Window=1500, Level=300
  5. Hide Annotations (right mouse button)
  6. Click “Rotate/Translate” button, set to 45 degrees
  7. Click 4 to “Rotate to Left”
  8. Save image (right mouse button)
  9. Click 3 to “Rotate to Left”, then to right
  10. Save this image as well

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**How to make CT Judet (GE)**

- **Standard Reformat:**
  - Axials (off coronal)
  - Coronal (off axial)
  - 3mm thick

- **CT-Judet Reformat:**
  - Work off “oblique” viewport

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What to Order When: (WOW) Bony Pelvis Trauma

**How to make CT Judet (GE)**

- 4) Window=1500
- 5) Level=300
- 6) Hide Annotations (right mouse button)
- 7) Click “Rotate/Translate” button
- 8) Save image (right mouse button)

**What to Order When: Pelvis ER: Acute pelvic trauma (MVC)**
- Radiographs: Chest & pelvis (to start…)
- CT: Evaluate extent of pelvic fractures
  - Surgeons like: Reformats (2D, 3D, CT Judet)
- Followup radiographs: Access healing
  - Acetabular fractures: AP pelvis, Judet views
  - Pelvic ring: AP pelvis, inlet/outlet views

**Coccyx Fractures?**
- Radiographs are notoriously insensitive…
  - Physical exam… MRI if really necessary

**What to Order When: Hip**

**Chronic hip pain (arthritis)**
- 1) AP Pelvis (to include BOTH hips)
  - 2) Frog leg view of painful hip (or both hips)

**Acute hip pain (femoral neck fracture)**
- 1) AP Pelvis (to include BOTH hips)
  - 2) Cross-Table lateral view of painful hip

**Sacroiliac joint pain**
- Single SI view (Modified Ferguson view)

**Occult Hip Fracture**

- 1) AP pelvis
  - 2) Cross-Table lateral view of painful hip
  - 3) Consider MRI Bony Pelvis for occult fracture

**29 yo Male**
- Bike hit curb
- Fell on right hip
- Right hip pain
- r/o fracture…
- Radiographs negative
- Still concerned for fracture…

**MRI!**
- Today
- ASAP!