Orthopedic Trauma

Pelvic Ring Injuries

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- **Topic: Pelvic Ring Injuries**
  - Epidemiology
  - Anatomy/Imaging
  - Classification
  - Initial evaluation
  - Operative vs Non-op
  - Treatments
    - Binder
    - Ex-fix
    - ORIF

Epidemiology

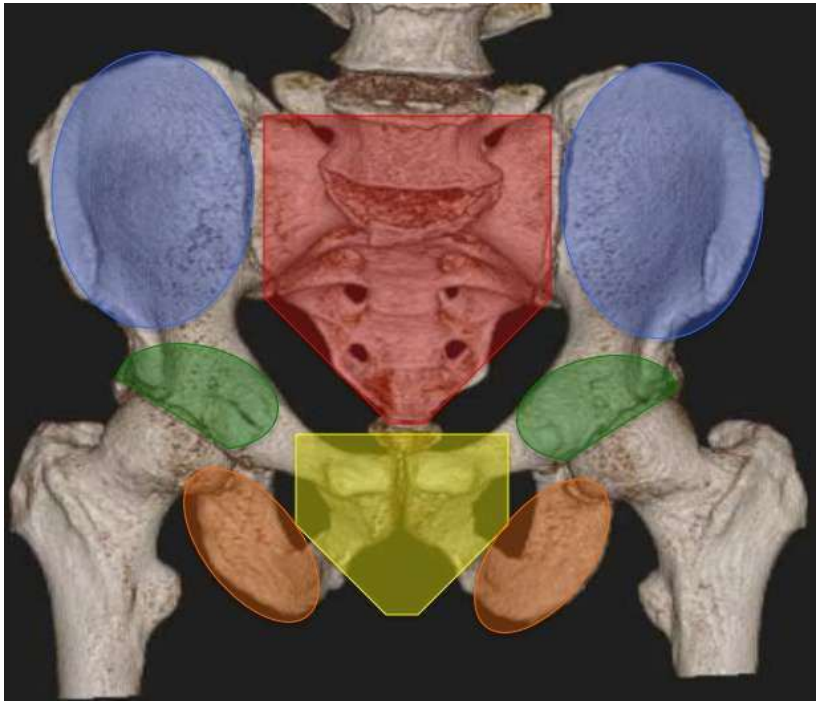
- Most result from low energy falls
- Bimodal distribution
  - Elderly - Low-energy falls, generally LC injuries
  - Young – High energy, unstable fracture patterns, may be life threatening
- Mortality rate 1-15% for closed fractures, 50% for open fractures

- **Intro**
  - Management of severe pelvic fx should follow ATLS protocols
    - ABCDE's
    - Initial reduction can prevent blood loss
    - Open fractures involving perineum or bowl benefit from colostomy

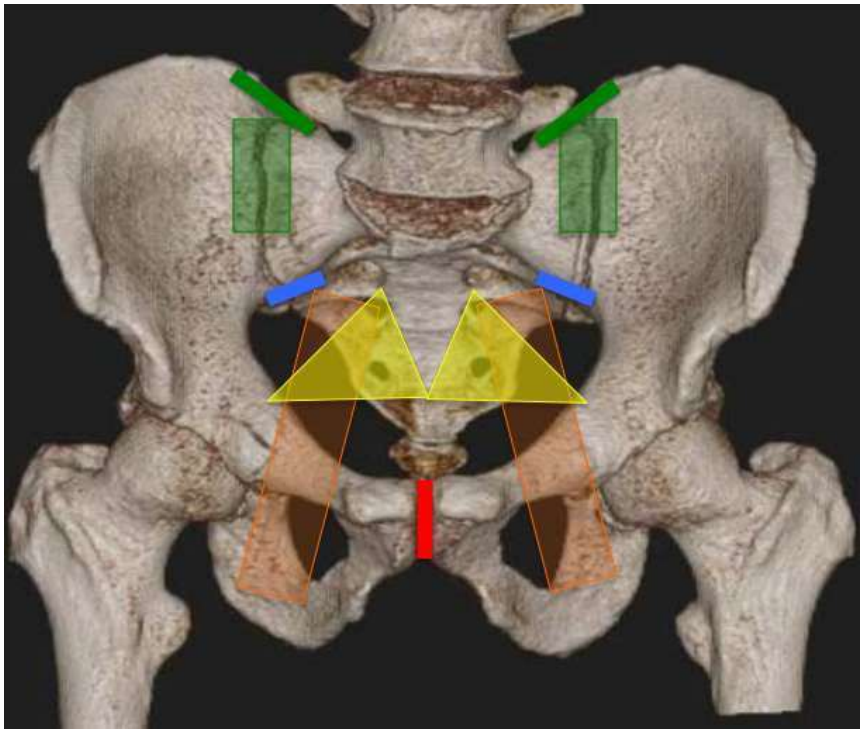
- **Associated injuries:**
  - Degloving injury (Morel- Lavalle lesion)
  - Urethral Injury
  - Bladder disruption
  - Vascular injury
  - Neurologic injury

- **Poor prognosis associated with:**
  - SI joint incongruity of > 1 cm
  - high degree initial displacement
  - malunion or residual displacement
  - leg length discrepancy > 2 cm
  - nonunion
  - neurologic injury
  - urethral injury

- **Osteology**
  - Sacrum
  - Iliac Wing
  - Acetabulum
  - Pubis
  - Ischium

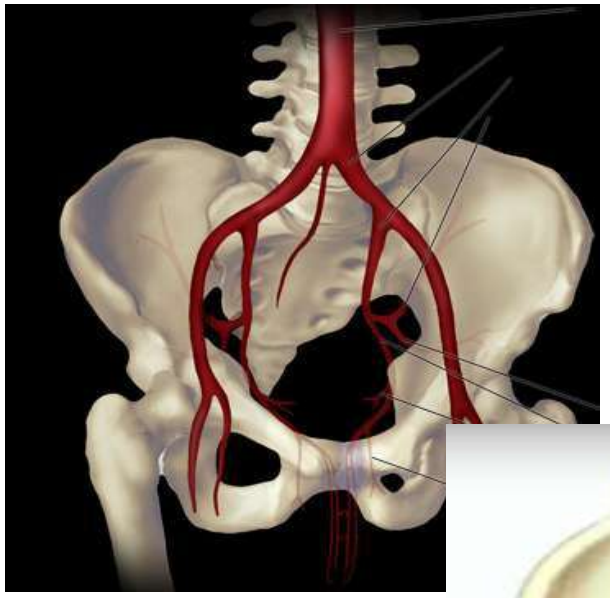


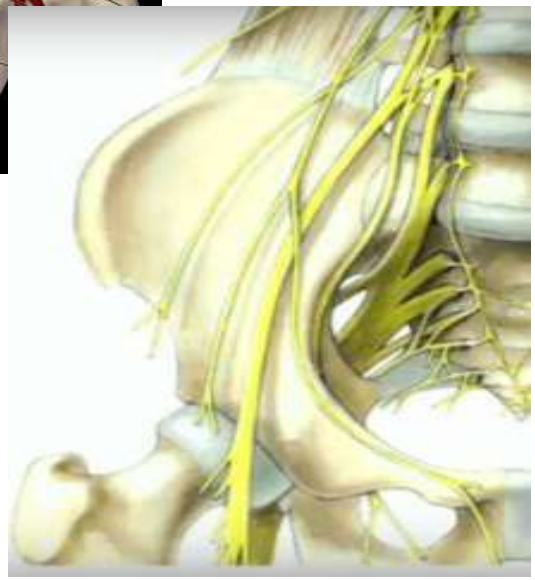
- Ligaments
  - Posterior SI ligaments
  - Anterior SI ligaments
  - Sacrospinous ligaments
  - Sacrotuberus ligaments
  - Pubic Symphysis



Vascular/Neuro

- Vascular
  - Superior gluteal art
  - Venous Plexus (90% of bleeding in pelvis fx)
- Nerves
  - L4/5 Nerve roots over anterior sacrum
  - Sciatic Nerve at the notch



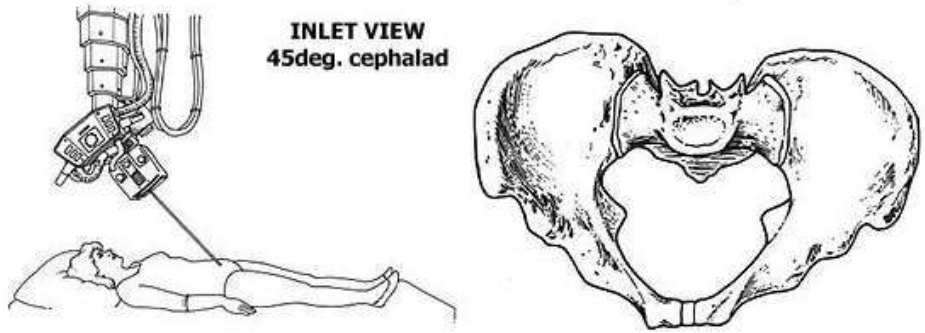


- Imaging
  - X-rays
  - CT-scan
  - Dynamic Imaging

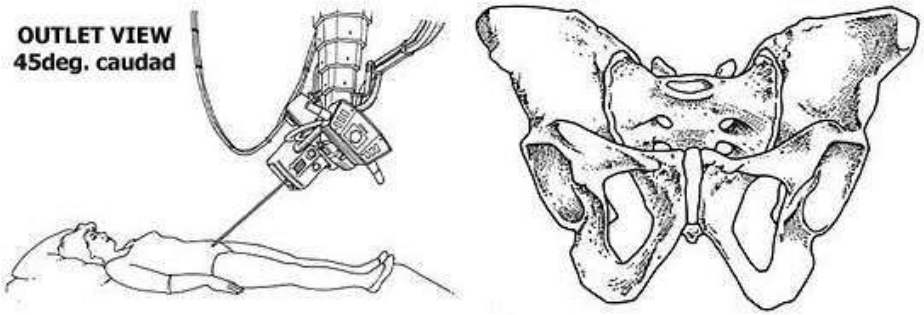
- **Imaging**
  - **X-rays**
    - **AP Pelvis in Trauma Bay**
      - **May show obvious deformity or subtle fractures**
      - **Useful for determining if immediate interventions are needed (binder/sheet, CT angio)**

- **Imaging**
  - **X-rays**
    - AP Pelvis in Trauma Bay
    - **Pelvis Inlet/Outlet**

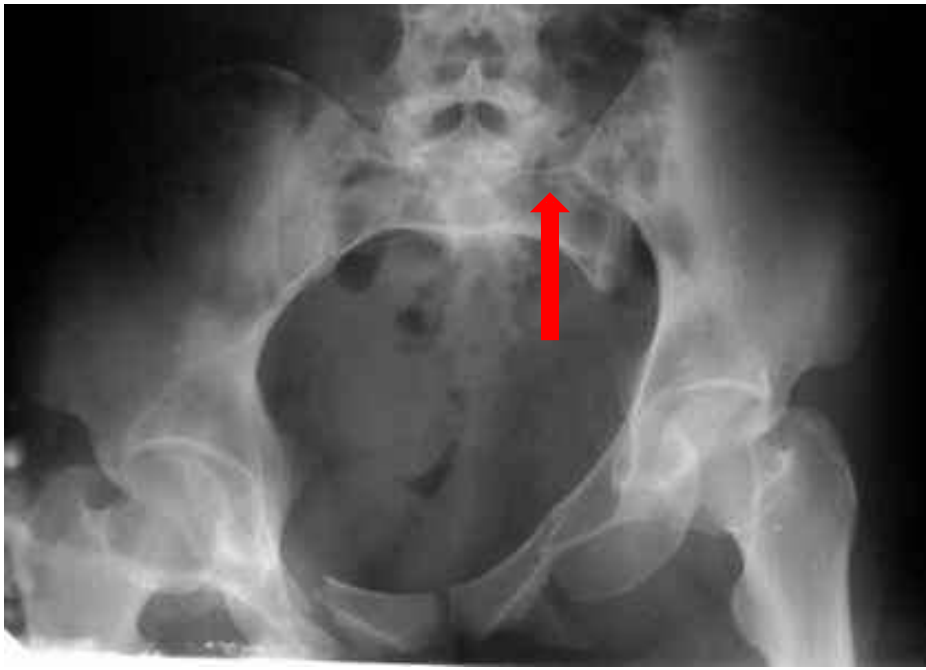
Inlet view:



Outlet View:

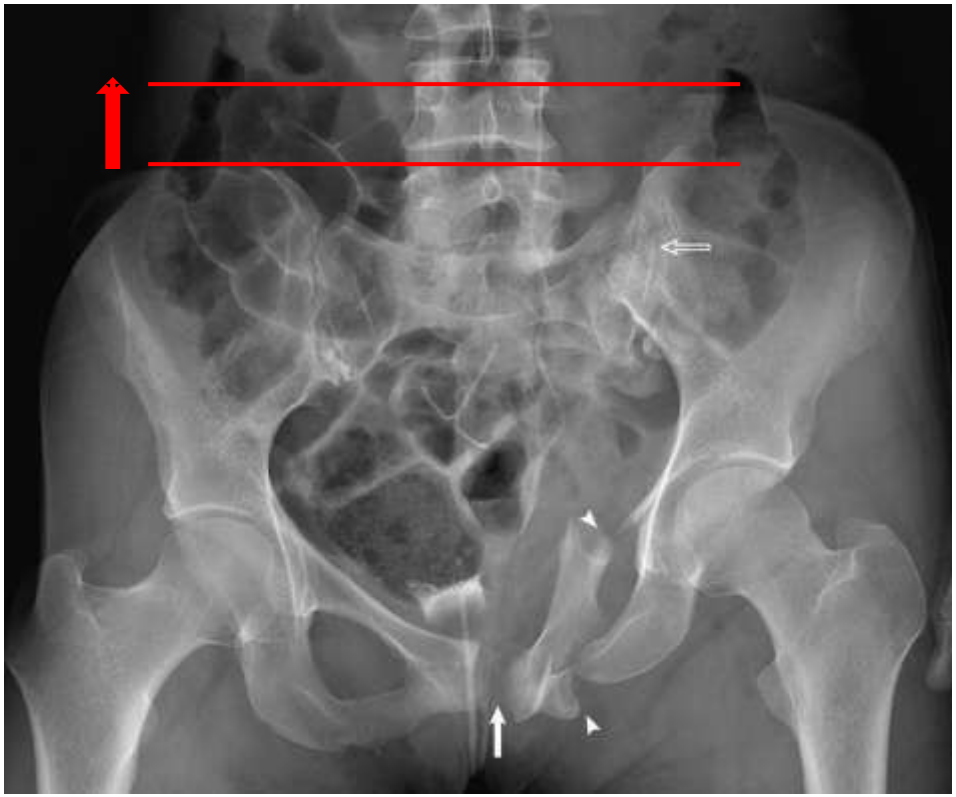


- **Imaging**
  - **X-rays**
    - AP Pelvis in Trauma Bay
    - **Pelvis Inlet/Outlet**
      - **Inlet View**
        - **Anterior to Posterior displacement**
        - Internal/External Rotation



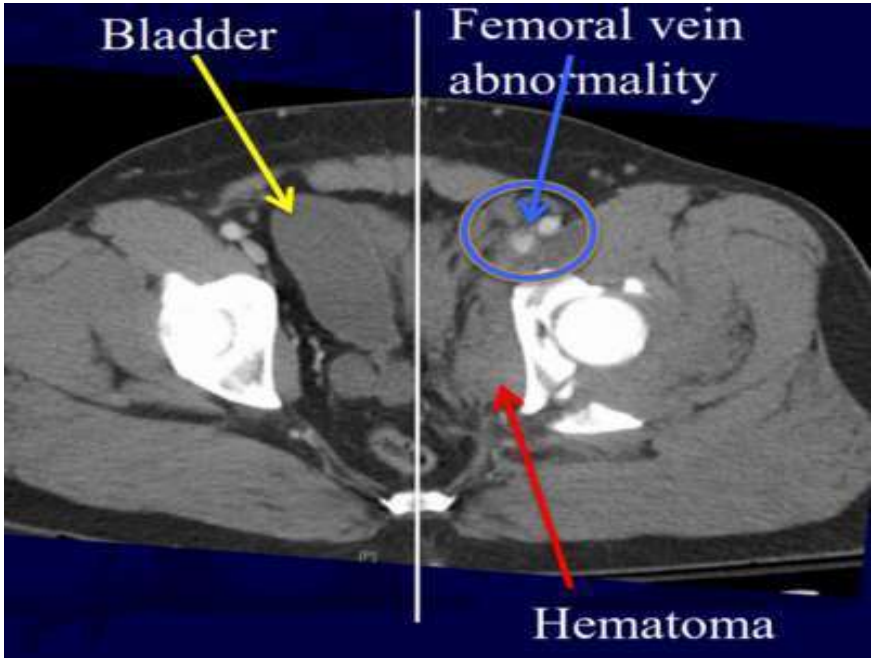
- **Imaging**
  - **X-rays**
    - AP Pelvis in Trauma Bay
    - **Pelvis Inlet/Outlet**
      - **Inlet View**
        - Anterior to Posterior displacement
        - **Internal/External Rotation**

- **Imaging**
  - **X-rays**
    - AP Pelvis in Trauma Bay
    - **Pelvis Inlet/Outlet**
      - **Outlet View**
        - **Vertical Displacement**



Imaging

- CT-scan
  - Assess soft Tissue windows:
    - Air – Open Fracture
    - Hernias – may affect surgical approach
    - Evulsion injuries – indicate stability
    - Hematoma



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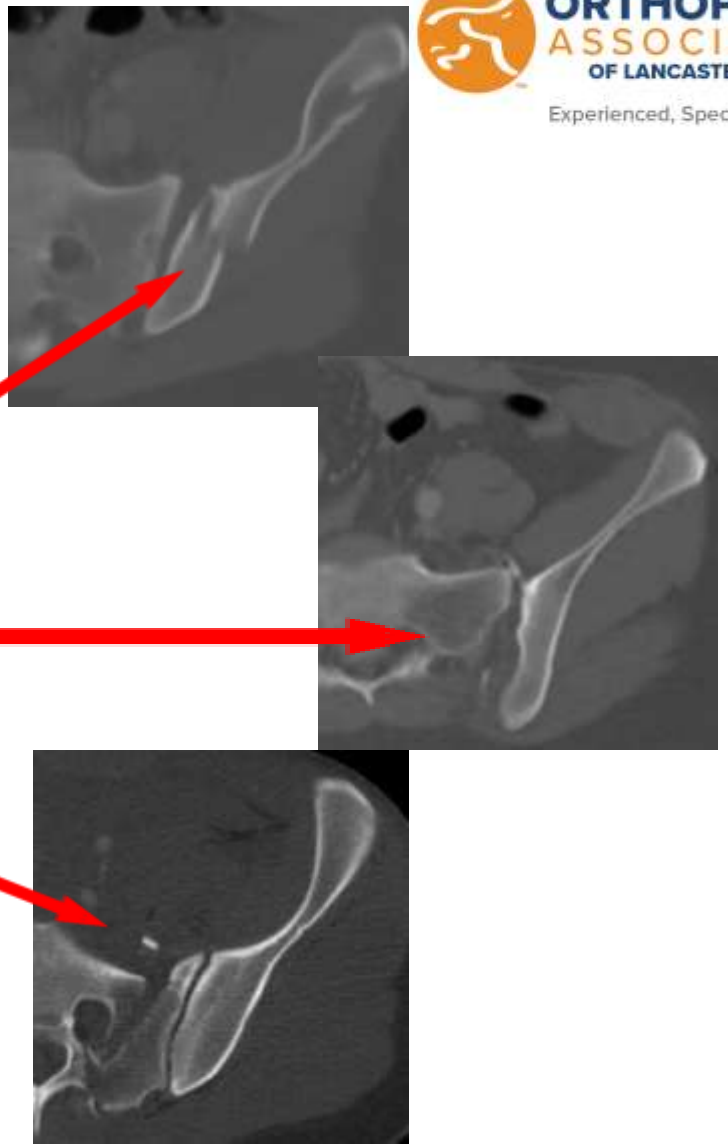
Imaging

- CT-scan
  - Posterior Ring Injuries
    - Iliac Wing Fractures
    - SI joint Disruptions
    - Sacral Fractures



Multiple classification systems

- Young Burgess Classification
- Tile
- OTA

Young Burgess Classification

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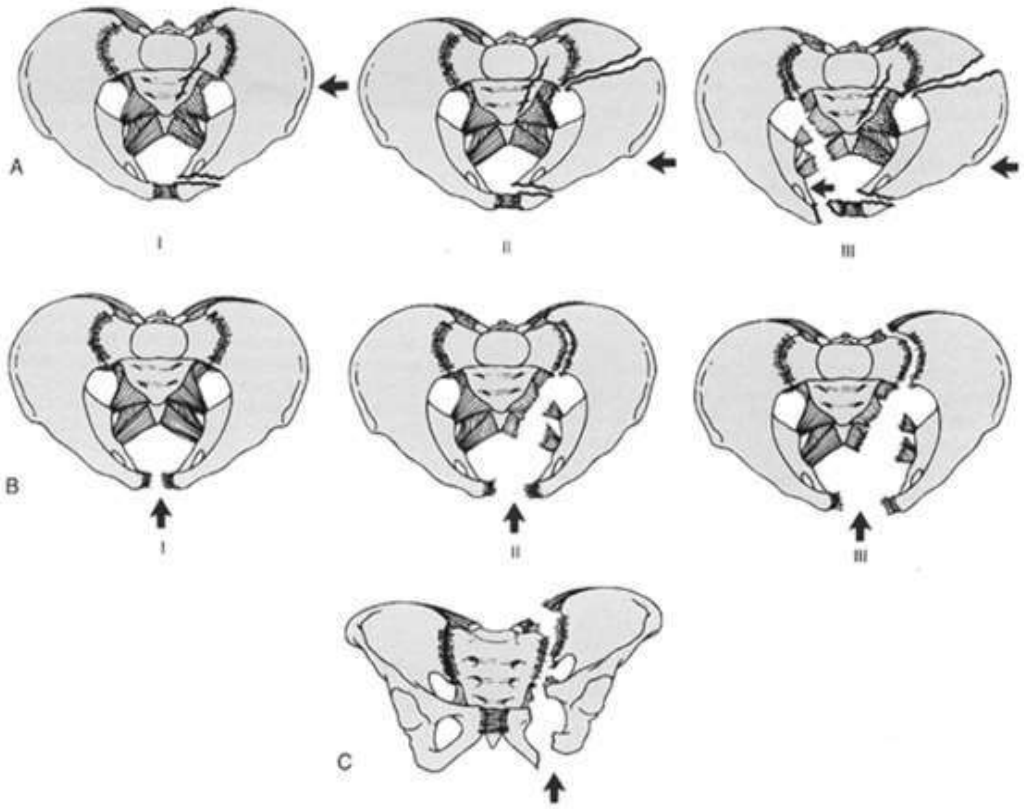
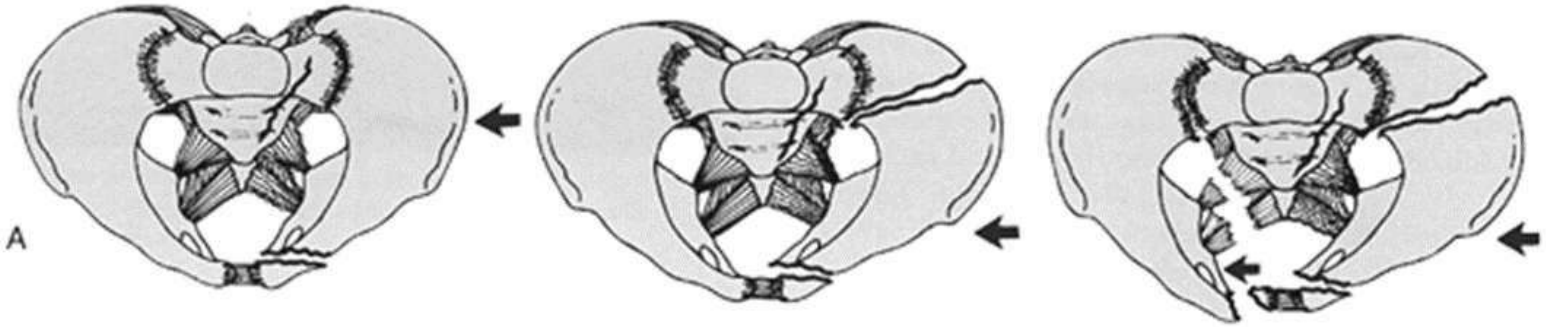
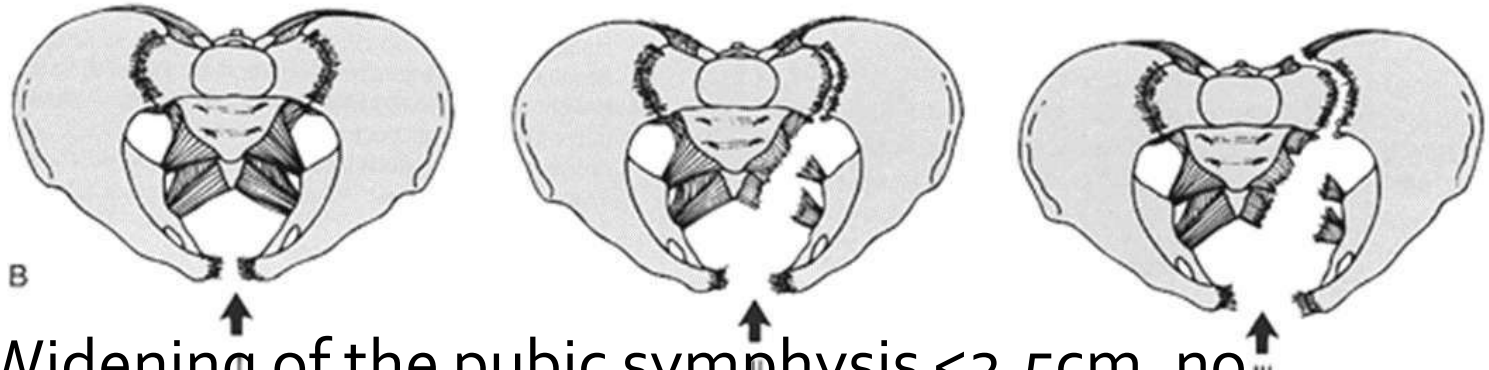
- Lateral Compression
- Anteroposterior Compression
- Vertical Shear





- LC1 – Pubic rami fracture and sacral ala buckle fracture
- LC2 – Further internal rotation, near complete posterior injury (may have ilium fracture with "crescent"
- LC3 – Windswept pelvis, continued internal rotation results in external rotation of the contralateral side

LC2-3's less stable



- APC1 – Widening of the pubic symphysis <2.5cm, no significant posterior injury
- APC2 – Widening >2.5cm, complete disruption of pelvic floor ligaments and anterior SI joint
- APC3 – Complete disruption of the posterior SI joint

APC2-3's less stable, high rate of blood loss

- **Assessing Pelvis Stability**
  - Radiographic instability
    - Young Burgess APC/LC2-3's, all vertical shear
    - Dynamic stress?
  - Biomechanical Stability
    - Able to with stand normal physiologic forces without abnormal deformation
  - Hemodynamic Instability

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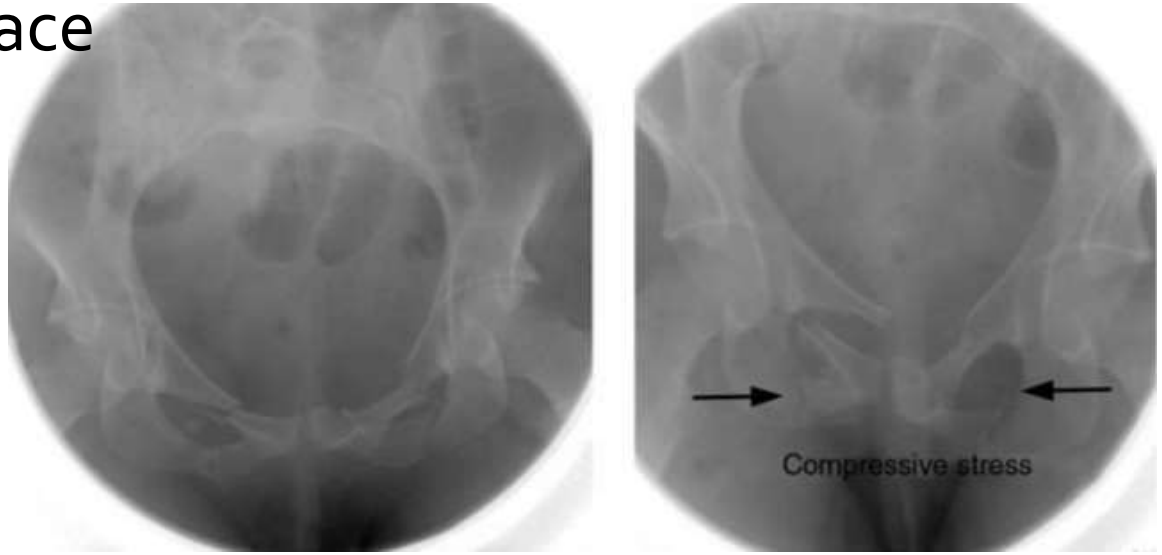
Dynamic Stress

- Difficult to differentiate APC1 and 2's because x-rays are static
  - External rotation stress can show symphyseal widening
- Most LC1 fractures are stable, but high energy fractures can displace
  - Compressive stress



Radiographic Signs of Instability

- Sacroiliac displacement of 5 mm in any plane
- Posterior fracture gap (rather than impaction)
- Avulsion of fifth lumbar transverse process, lateral border of sacrum (sacrotuberous ligament), or ischial spine (sacrospinous ligament)

Primary survey:

Airway maintenance with cervical spine protection

Breathing and ventilation

Circulation with hemorrhage control

Disability: Neurologic status

Exposure/environment control: undress patient but prevent hypothemia

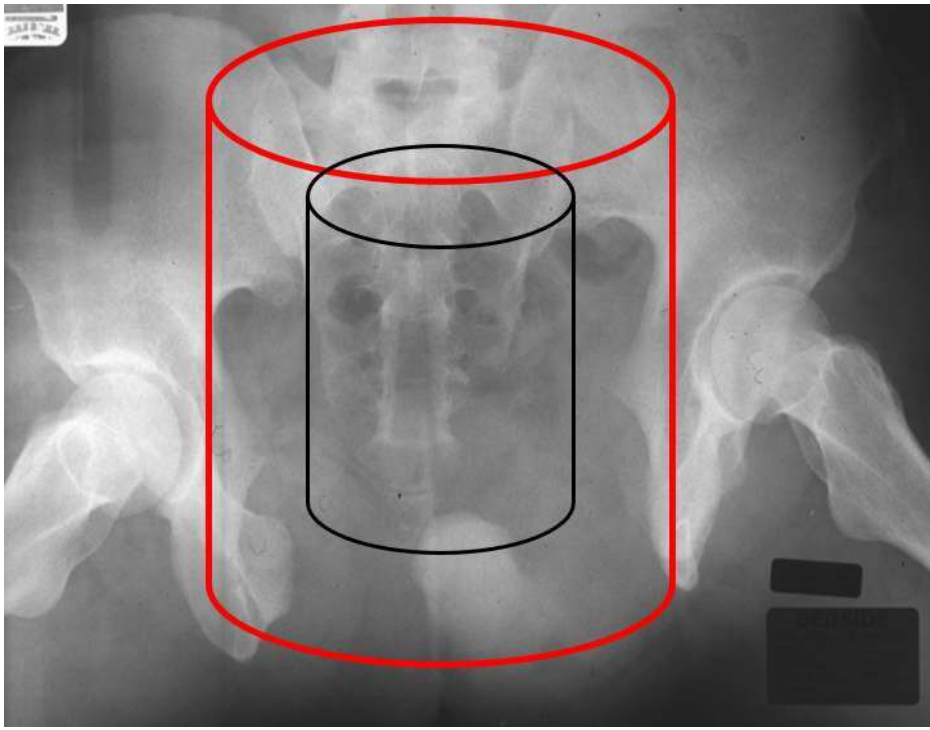
Physical Exam

- Degloving injuries
- Limb shortening
- Limb rotation
- Open wounds
- Swelling & hematoma

- **Hemodynamic instability with pelvic fractures**
  - May have life threatening bleeding (venous or arterial)
  - APC2/3 and VS highest risk of bleeding (tensile to NV structures and increase volume)

Dalal et al, JT, 1989
Burgess et al, JT, 1990
Whitbeck et al, JOT, 1997
Switzer et al, JOT, 2000
Eastridge et al, JT, 2002

- **Hemodynamic instability with pelvic fractures**
  - Increased pelvic volume can allow for massive bleeding
  - Pelvis is a semi-elliptical sphere with a volume of **$4/3\pi r^3$**
  - **Closing volume can tamponade bleeding**

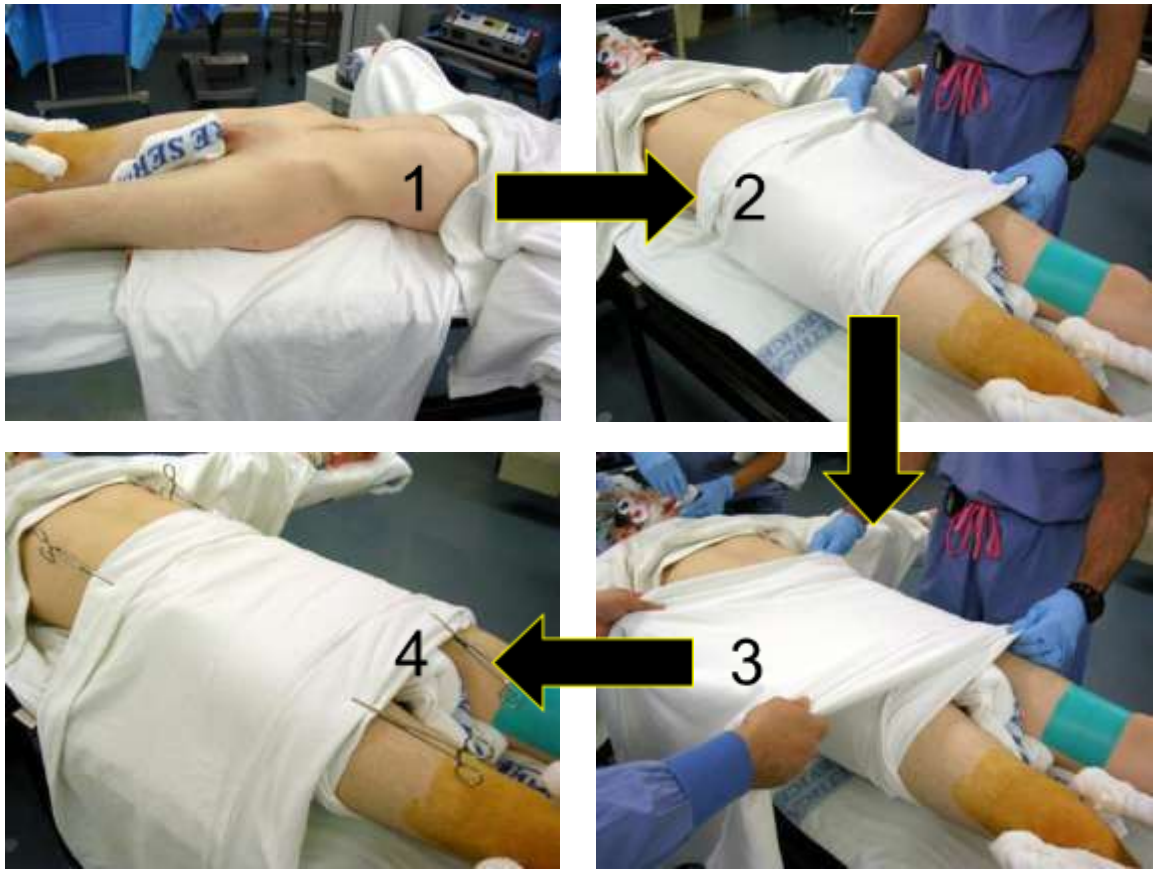


- **Hemodynamic instability with pelvic fractures**
  - Pelvic volume decreased with binder, sheet application, or external fixation
  - If continued instability
    - IR for selective embolization of arterial bleeding (blush on CT angio), about 10-15% of patients
    - Pelvic packing for venous bleeding or bony sources

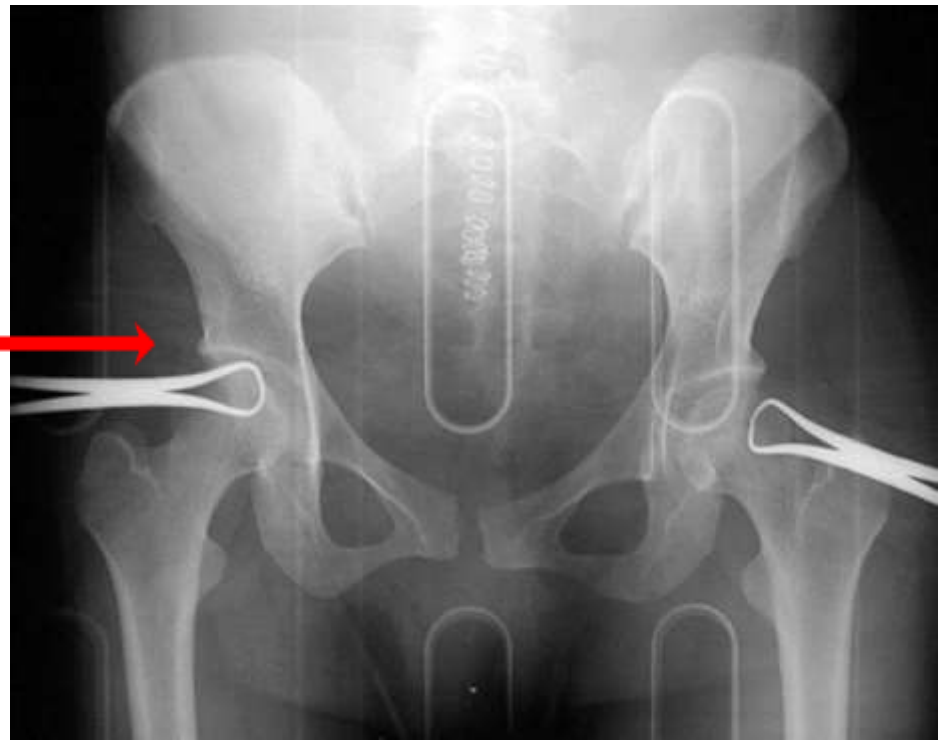
- **Pelvic Containment: Sheet or Binder**
  - Decreases pelvic volume, allows for stabilization of clots from bony and venous sources
  - **Must be at the level of the trochanters!**
  - Temporary only, prolonged use may lead to skin necrosis
  - Access to groin for angiography or laparotomy can be made by cutting sheet or binder
  - Indicated for APC and VS type injuries

Circumferential Sheeting

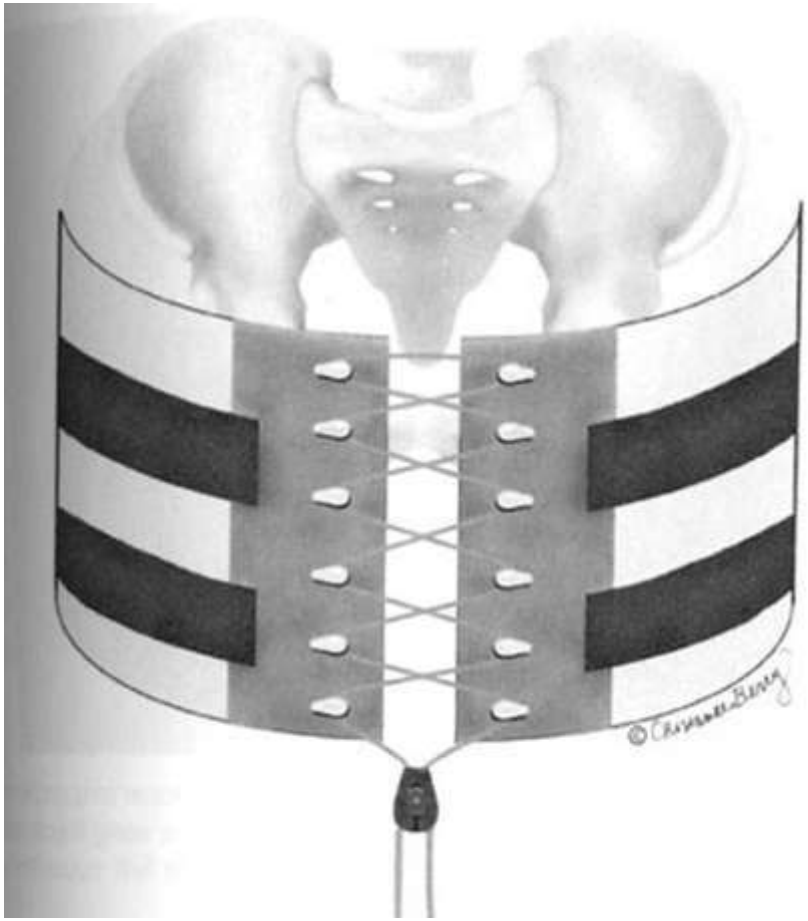
- Supine
- 2 "Wrappers"
- Placement
- Apply
- "Clamper"
- 30 Seconds



- Sheet Application



- Pelvic Binders

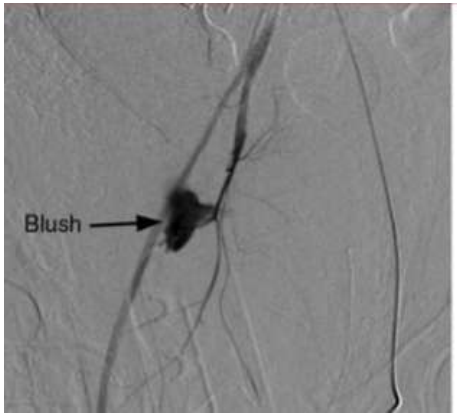


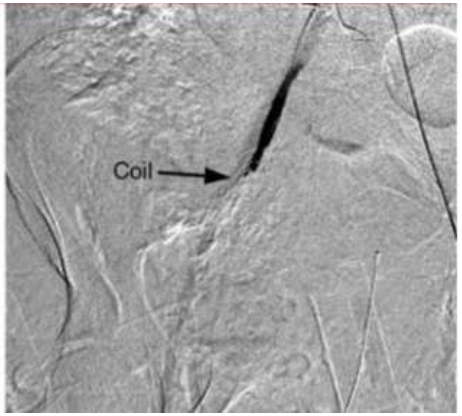
Commercially available. Placed over the TROCHANTERS and not over the abdomen.

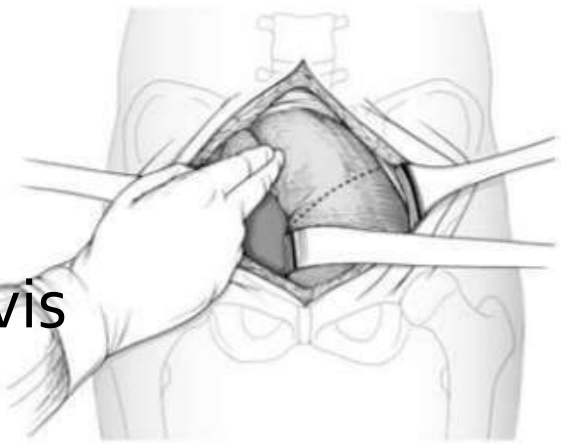
Continued Instability….

After Pelvic containment

- IR for selective embolization of arterial bleeding (blush on CT angio)
- Pelvic packing for venous bleeding
- Both benefit from pelvis stabilization







Open Pelvic Injuries

- Open wounds extending to the colon, rectum, or perineum: **strongly consider early diverting colostomy**
- Soft-tissue wounds should be aggressively debrided
- Early repair of vaginal lacerations to minimize subsequent pelvic abscess

Urologic Injuries

- 15% incidence
- Blood at meatus or high riding prostate
- Eventual swelling of scrotum and labia (occasional arterial bleeder requiring surgery)***
- Retrograde urethrogram indicated in pelvic injured patients

Urologic Injuries

- Bladder Injuries – APC/LC2-3's
  - Intraperitoneal & extraperitoneal bladder ruptures are may be repaired
  - A Foley catheter is preferred
  - If a supra-pubic catheter it used, it should be tunneled to prevent anterior wound contamination
- Urethral injuries are usually repaired on a delayed basis

Definitive Treatment

- Patient should first be stabilized (eg pelvic binder) and resuscitated
- Non-operative treatment:
  - APC1
  - Low energy/stabile LC1
  - Patients may be WBAT
  - Follow radiographically for evidence of displacement

- **Operative Indications**
  - APC2/3 injuries
  - Unstable LC1, LC2/3
  - All Vertical Shears

  - Depending on the injury pattern, may require anterior and posterior fixation

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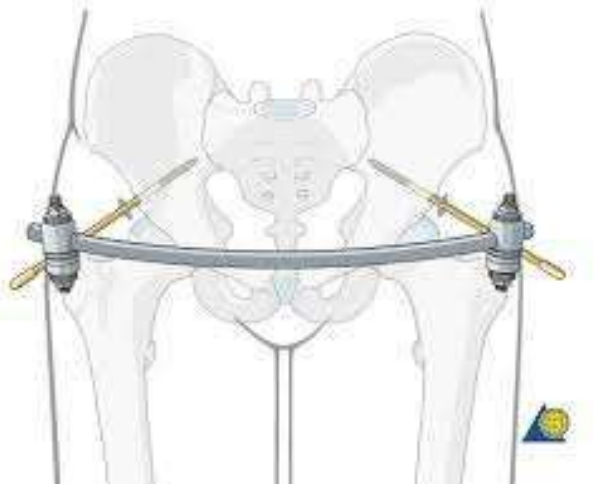
Types of fixation

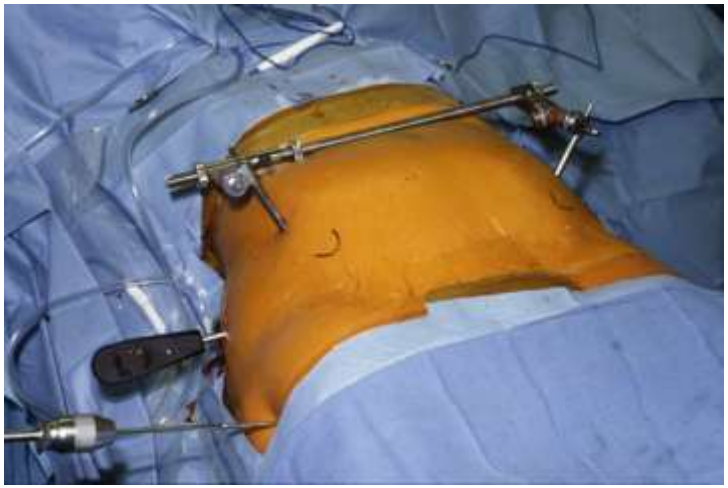
- Anterior Fixation
  - External Fixator
  - Pelvic In-Fix
  - ORIF Symphysis/Rami
  - Percutaneous Rami screws
- Posterior Fixation
  - Percutaneous ilioscarcal screws
  - ORIF iliac wing
  - Tension band of sacrum

- **External Fixation**
  - May be temporary or part of definitive treatment
  - 2 Types of Frames
    - ASIS (Iliac Wing pins)
    - AIIS (Low frame)



ASIS Frames

- Technically easier to apply
- Can be done without fluoro
- Not as stable
- 3 to 5 cm posterior to the ASIS (gluteal pilar)
- Aim: 30 to 45 degrees (from lateral to medial) toward the hip joint



Outlet Oblique Image

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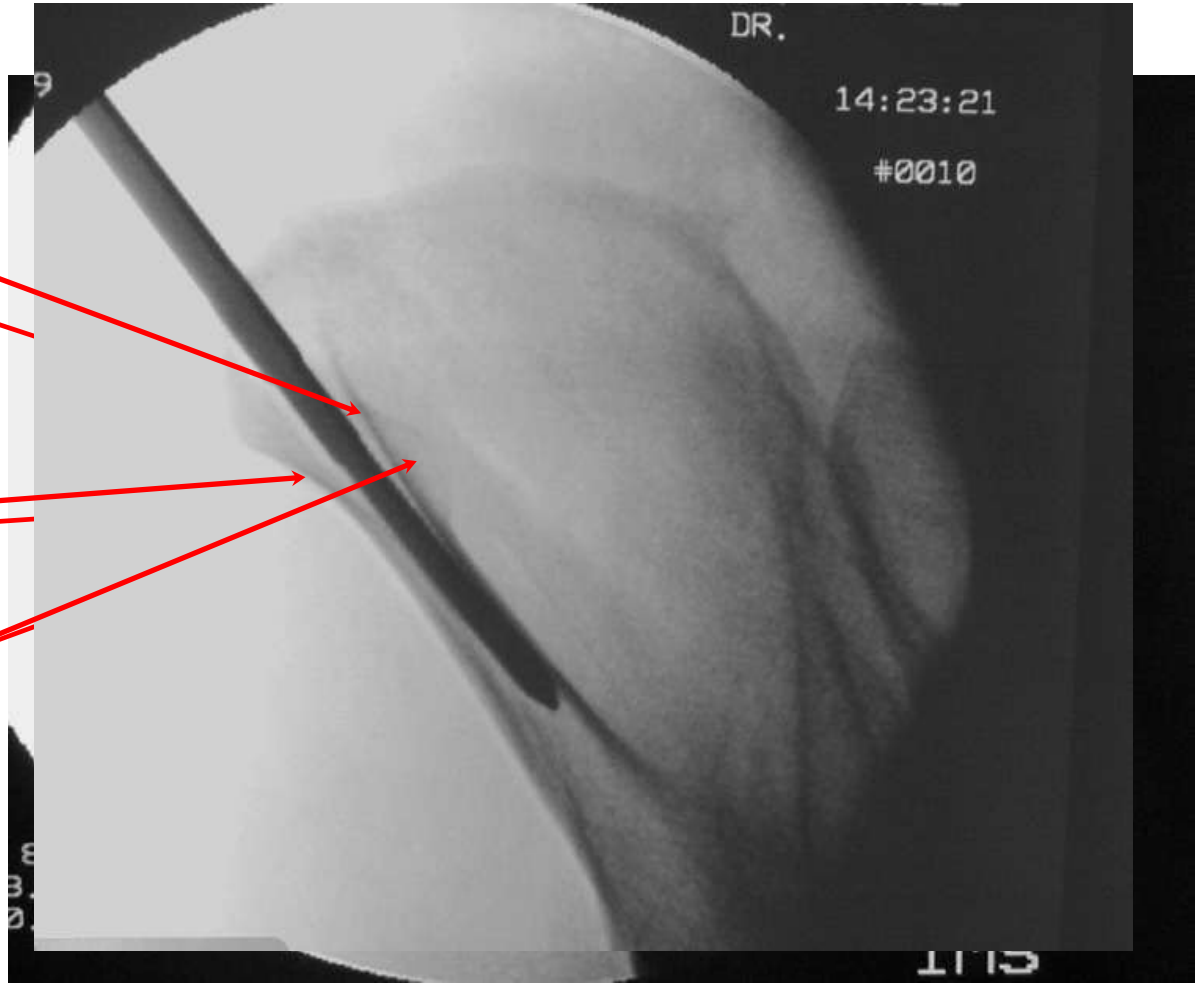
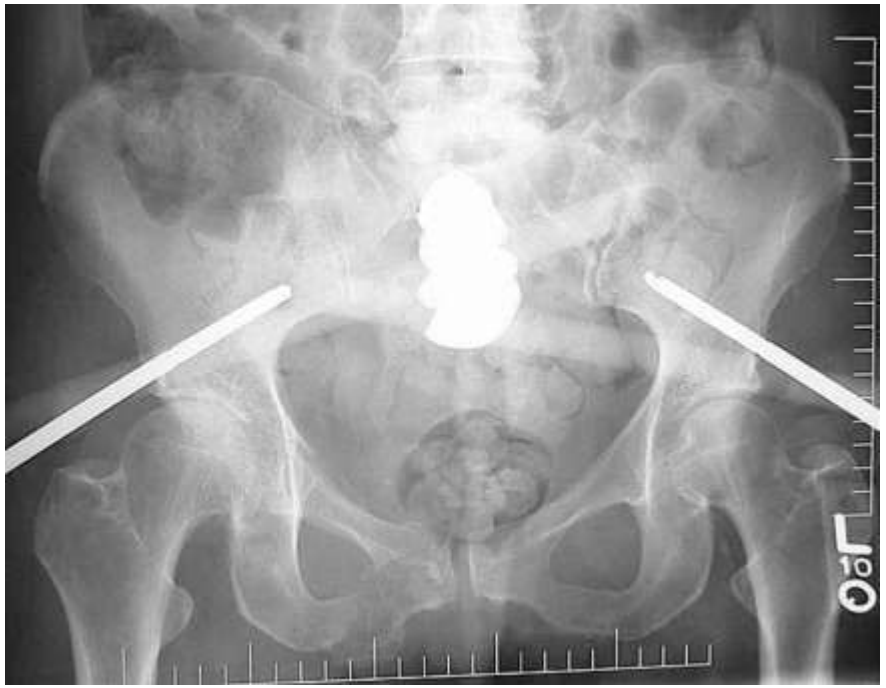
- Inner Table
- Outer Table
- ASIS



- **AIIS Frames**
  - More demanding
  - Requires Fluoro
  - More stable, better control
  - ***good x-ray tech helps!**



AIIS Frames

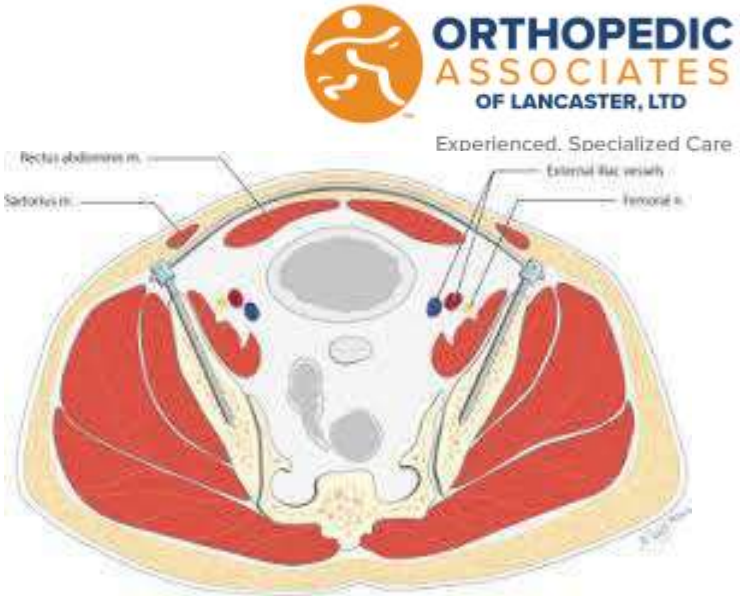
- Start at AIIS directed toward the posterior ilium
- **Obturator Oblique Outlet view**

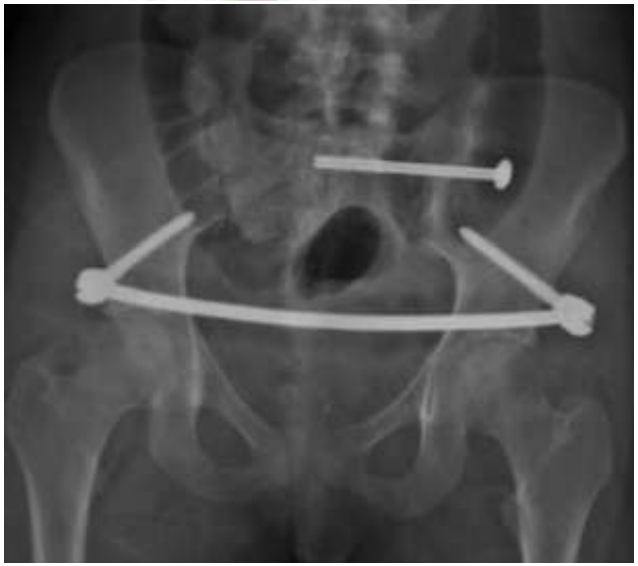
- **AIIS Frames**
  - Advance the pin posteriorly staying above the hip joint and sciatic notch
  - **Iliac Oblique Inlet**

- **AIIS Frames**
  - **Obturator Oblique Inlet** demonstrates the interosseous path and pin depth

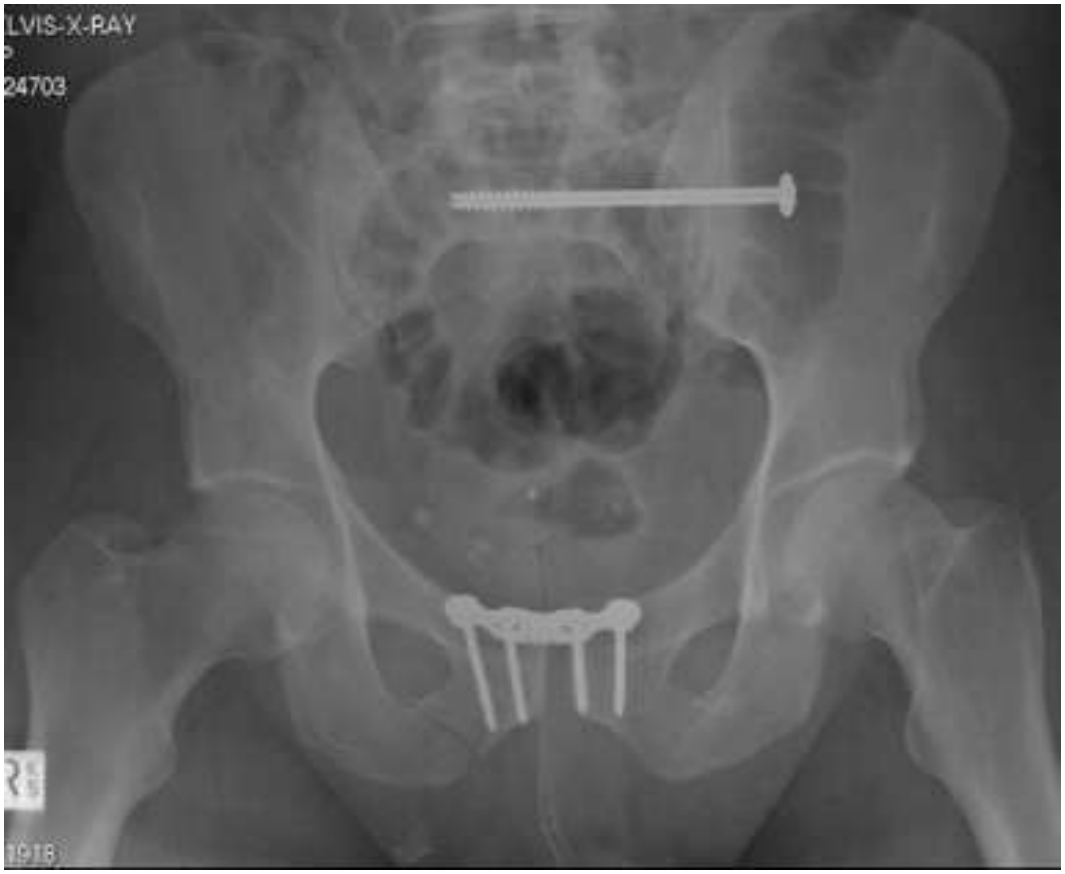
Pelvic Infix

- Essentially an "internal" ex-fix
- Perc incisions for screws, bar passed subcutaneously
- Uses large pedicle screws from spine sets
- Eliminates risk of pin tract infections, better mechanical advantage
- Good for multiple ramus fractures
- Risk of compression NV structures and LFCN



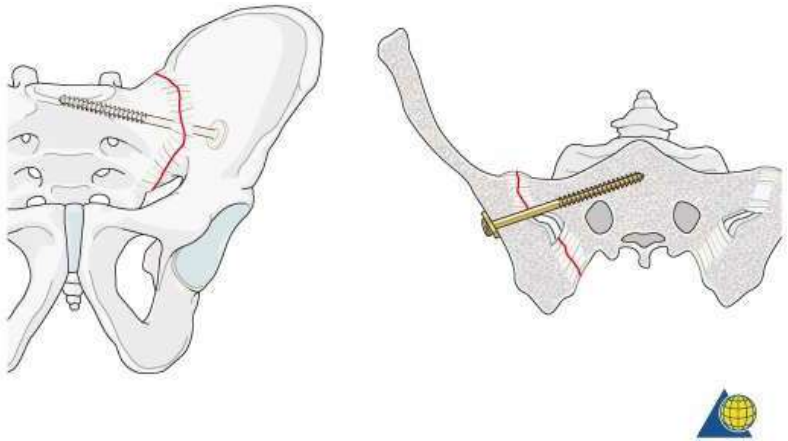


- **ORIF**
  - Pfannenstiel type incision
  - Plate symphysis in APC type injuries
  - Span rami fractures in LC/VS



- **Percutaneous Rami screws**
  - Antegrade
  - Retrograde

- **Percutaneous iliosacral screws**
  - Reduces SI joint disruptions and mild sacral fractures
  - Requires precise fluoro images
  - Risk of injury to L5 nerve root and the iliac vessels



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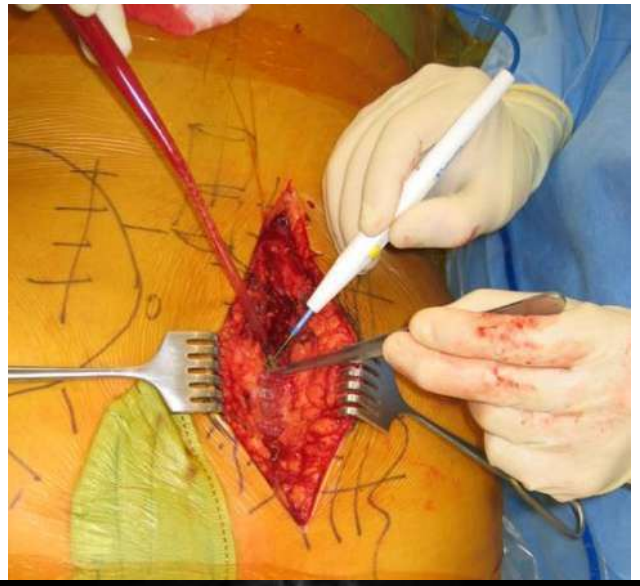
- **ORIF SI joint or sacrum**
  - Can be done prone or supine
  - Prone: reduction followed by SI screw placement of tension band plating
  - Supine performed through lateral window
    - Can plate SI joint or Iliac wing



- 70 yo M unhelmetted MCC,
  - pelvis and posterior urethral injury
  - Ribs 1-12 R, 6-12 L, sternal fx, SDH, splenic lac
- PE: closed NVI, Intubated/sedated, hemodynamics ?
- Diagnosis?
- Next Step?

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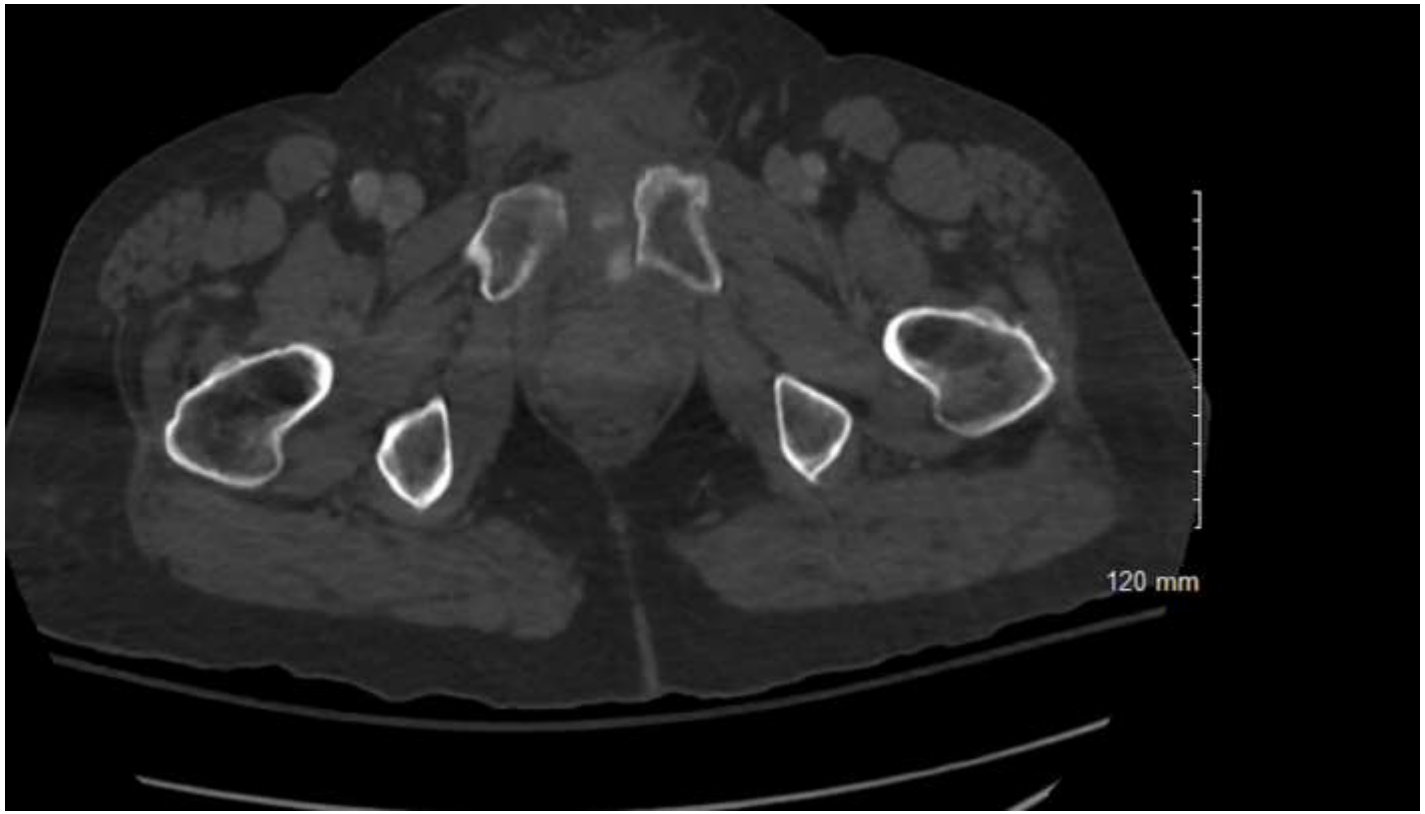
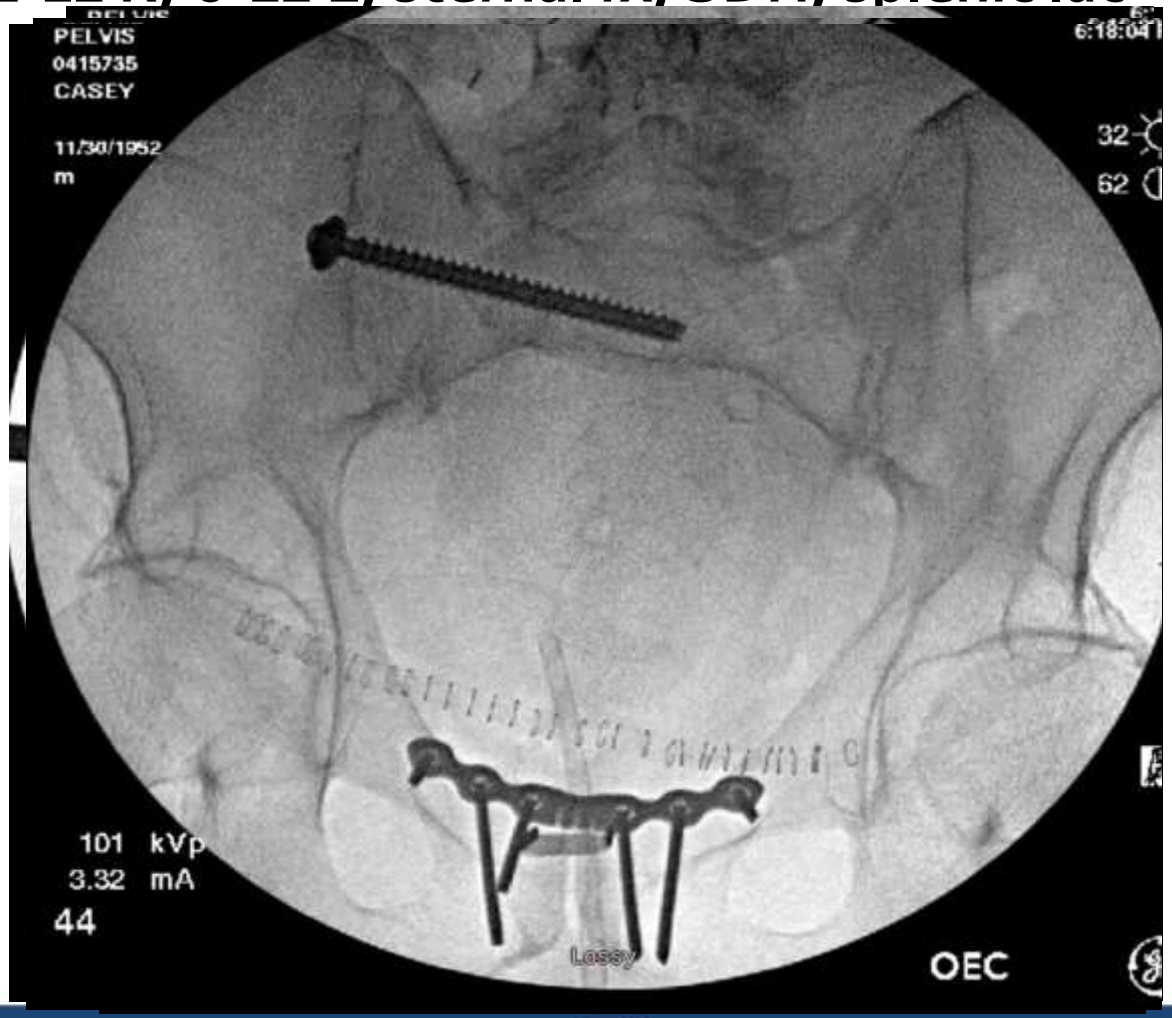
  - pelvis and posterior urethral injury
  - Ribs 1-12 R, 6-12 L, sternal fx, SDH, splenic lac
- Diagnosis?
- Next Step?



- 70 yo M unhelmetted MCC,
  - pelvis and posterior urethral injury
  - Ribs 1-12 R, 6-12 L, sternal fx, SDH, splenic lac
- OR



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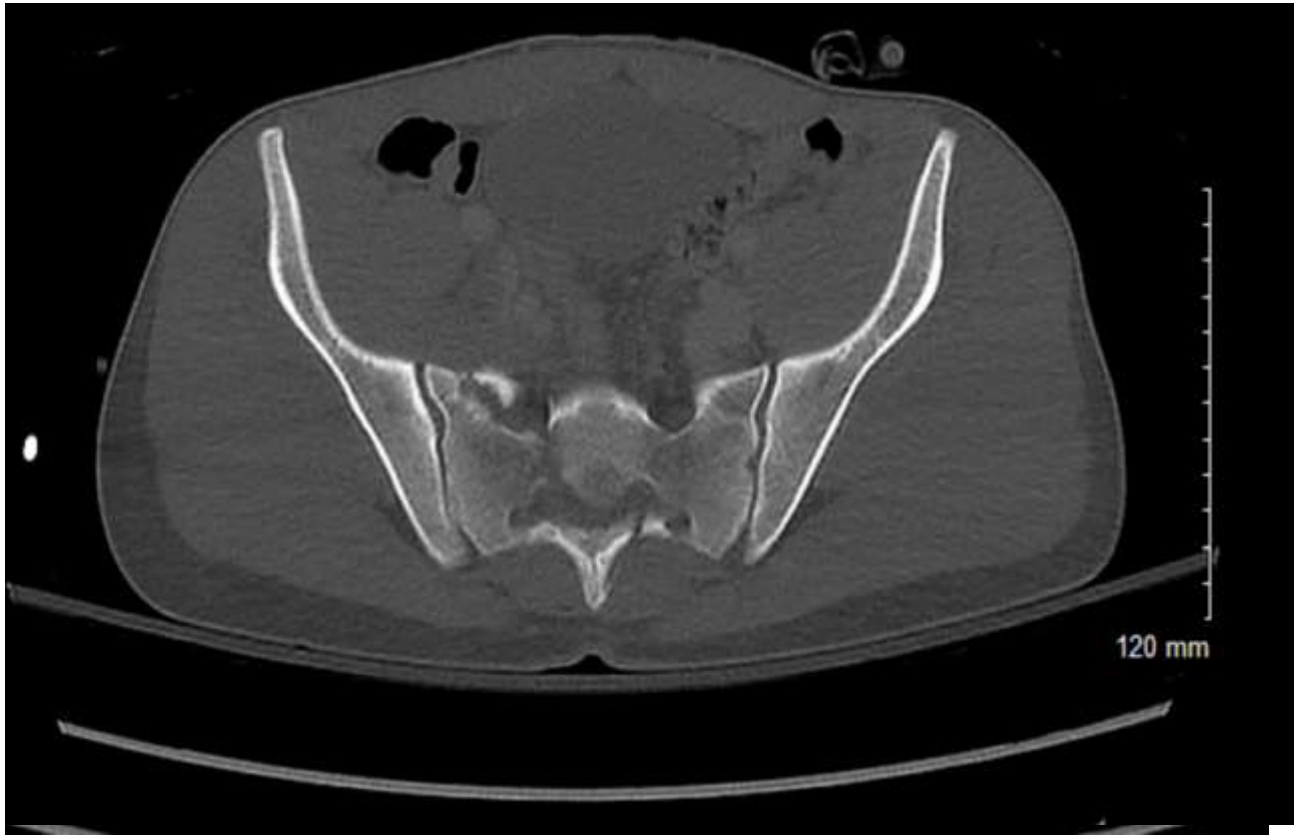
100 mm
Lossy

- 29 yo M fell 30 after attempted burglary, alleged
  - Open DR/Uln fx, gr 2
  - Closed displaced intra artic calc fx
  - L5 b/l TP fx
  - Multi substance abuse
- Closed, NVI, Anterior/posterior pelvic pain
- XR read Neg, CT?

- 29 yo M fell 30 after attempted burglary, alleged
- Diagnosis?
- Next Step?



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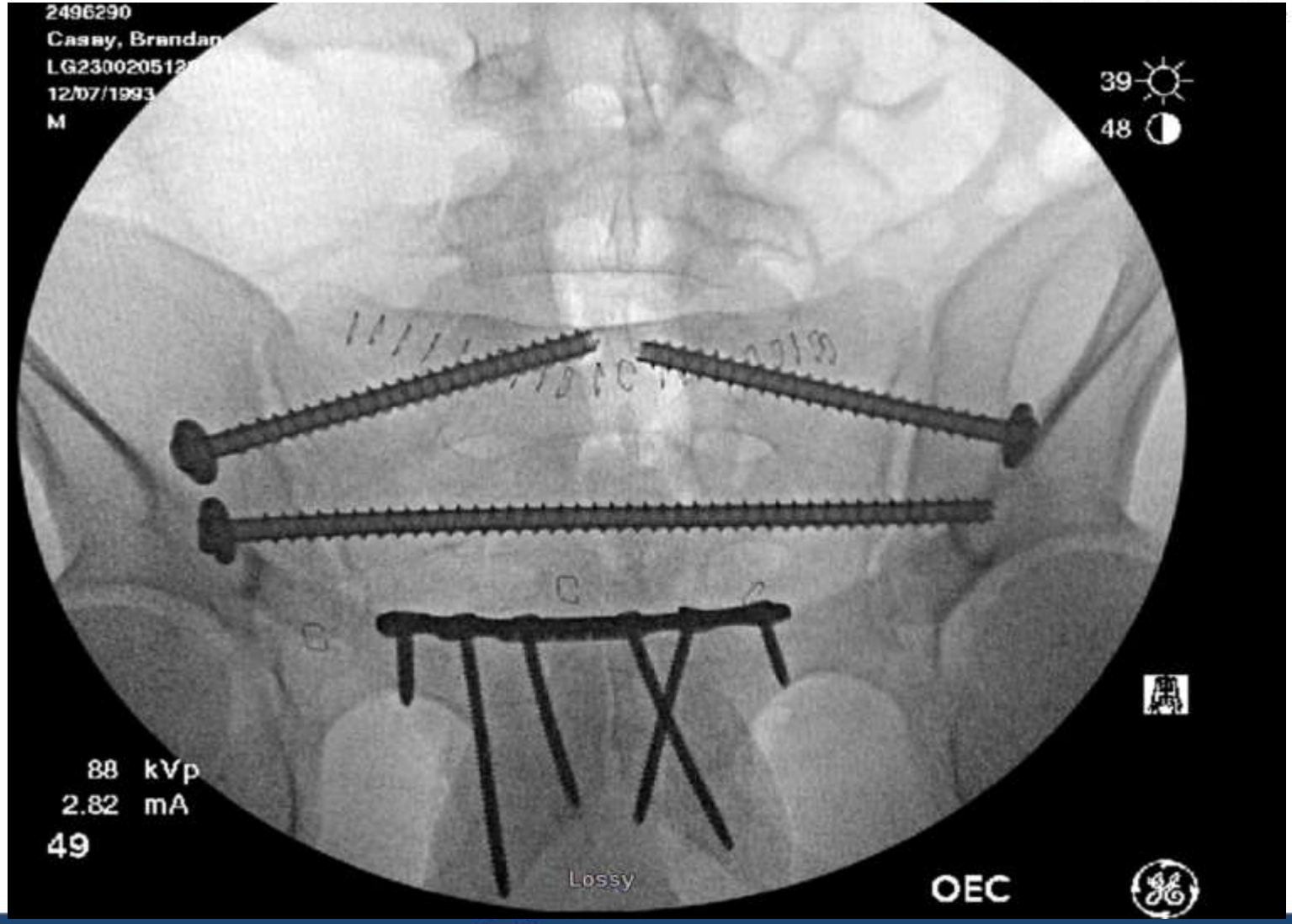
- OR



- 36 yo M MCC rate of speed approx. 120 MPH
  - Open displaced R scap fx
  - Nondisplaced L GT fx
  - SAH, req ICP bolt
  - EtoH 350 upon arrival
  - Mult bilat rib fx
  - Bladder injury req open repair
- Closed, NVI, Intubated/sedated
- Diagnosis?
- Next Step?

- 36 yo M MCC rate of speed approx. 120 MPH

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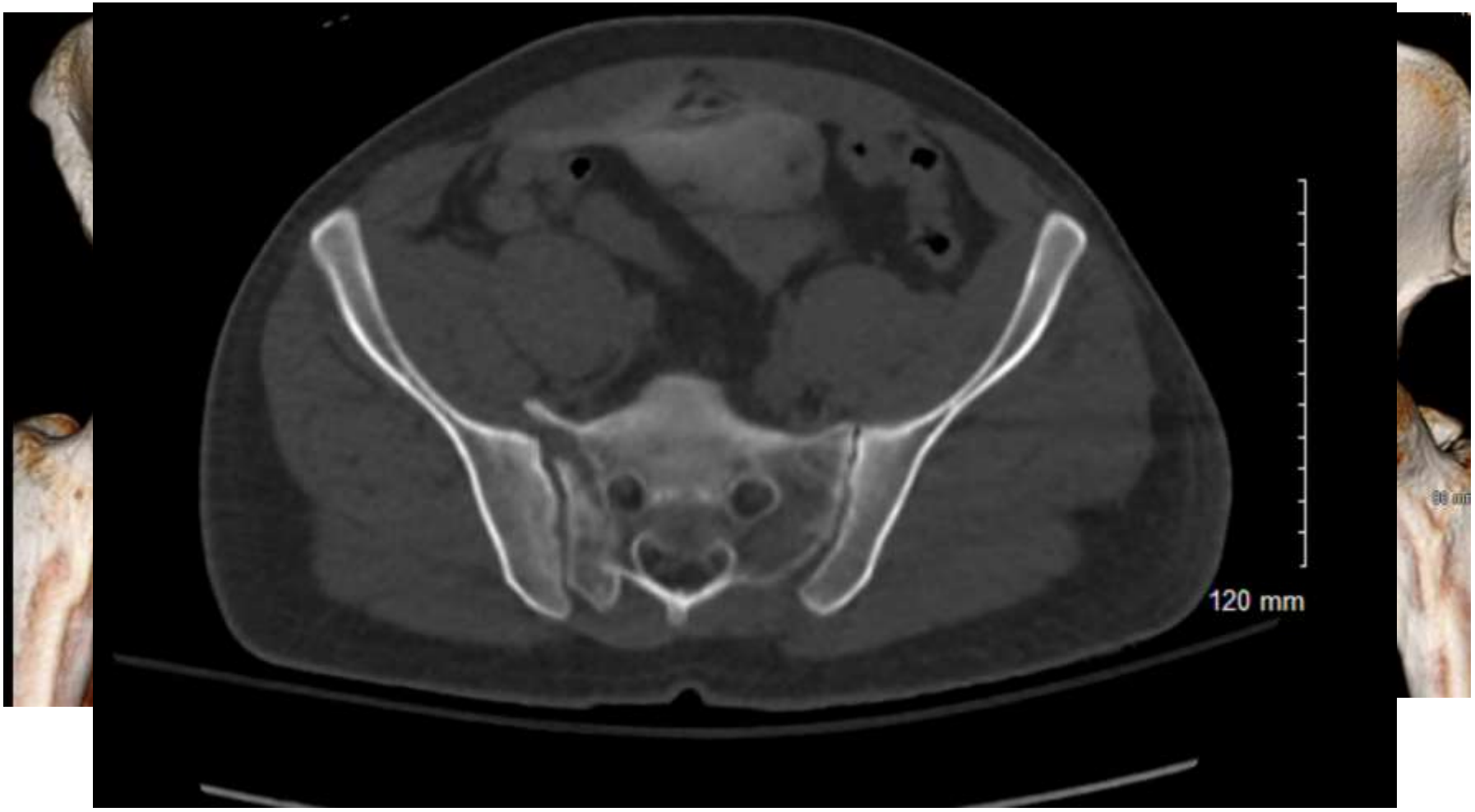

- 36 yo M MCC rate of speed approx. 120 MPH

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- 36 yo M MCC rate of speed approx. 120 MPH
- 1.5 yr post op

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- Understanding injury pattern and mechanism is important
  - Stable fractures (APC1, LC1) do well non-operatively
  - Unstable pelvic fracture may benefit from operative fixation
- Fixation of pelvic fractures is important for mobilization, pain control, and preventing chronic deformity

Outcomes

- Even with anatomic restoration of the pelvis, long-term outcomes are below population norms
- Chronic problems include pain and sexual dysfunction
- Neurologic injury is associated with poor outcomes

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Questions?