Clues for Identifying Unstable Pelvis Fractures

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Conflict of Interest

- Consultant- Stryker Orthopedics, Smith & Nephew
- Stock- Stryker, Wright Medical

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Acknowlegdements

- Andy Burgess, MD
- Cliff Turen, MD

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Clue #1: HISTORY OF INJURY

High vs low energy

- Mechanism
  - MVC
  - MCC
  - Fall from height
- Signs of Shock
  - Best predictor of mortality

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ASSESSMENT

- ABC'S of ATLS
- Soft tissue exam- look for open fractures
- Neuro exam
  - most correlated with long term outcome
  - Highest % with medial sacral fractures (#2 zone 2)
- Vascular exam
- Urogenital exam
  - Blood at meatus- retrograde cystourethrogram
  - Hematuria- bladder injury
- Deformity, asymmetry or instability
- Documentation

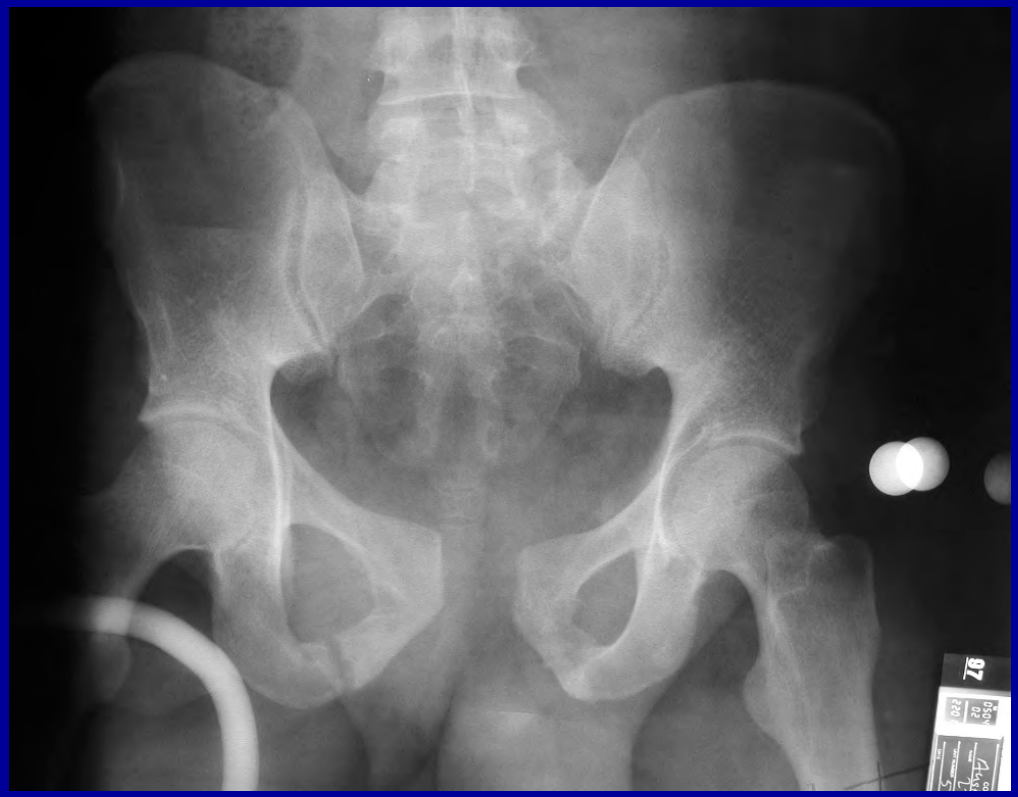
ASSESSMENT

High energy injuries

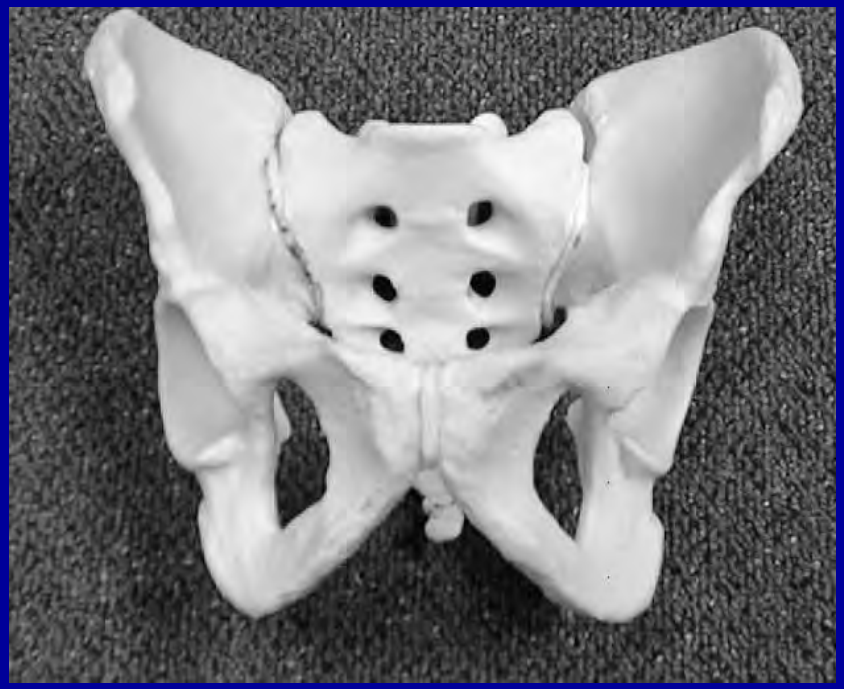
- 75% Hemorrhage
- 12% Urogenital
- 8% Lumbosacral plexus
- 60-80% Other musculoskeletal
- 15-25% Mortality

RADIOGRAPHY

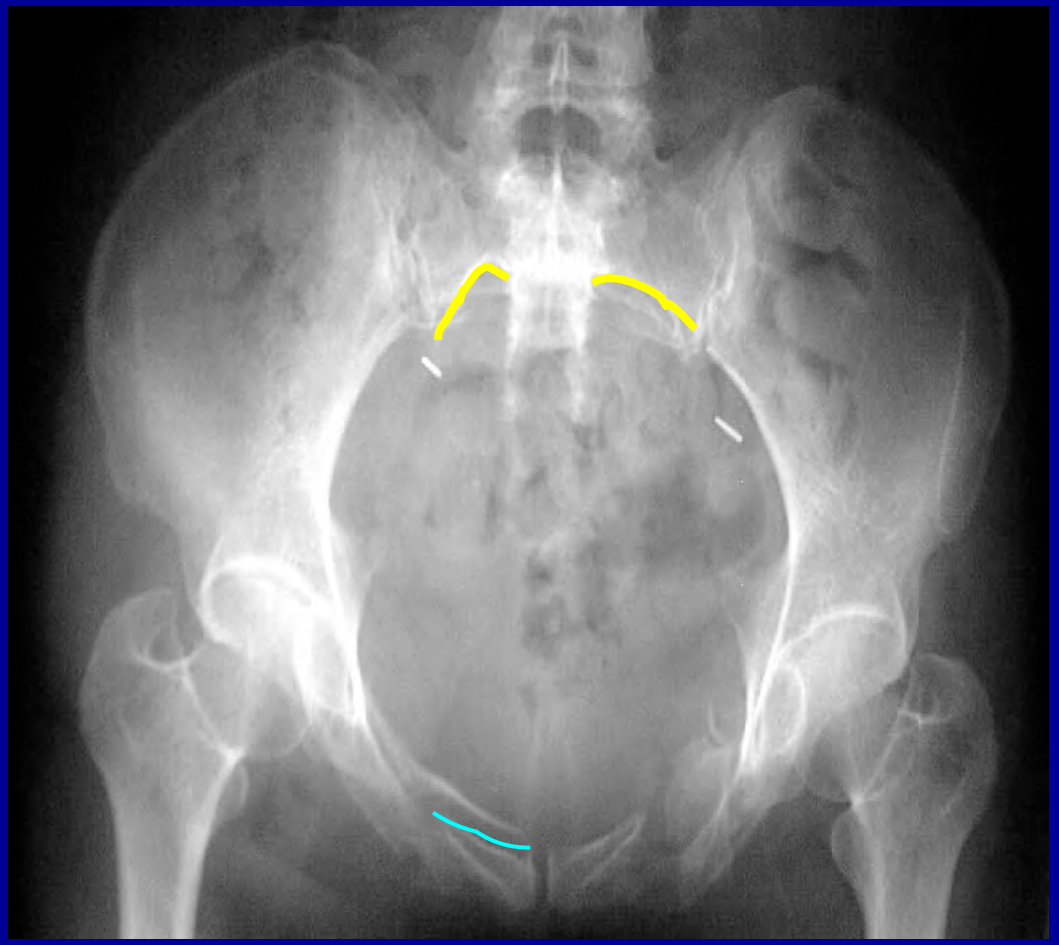
- 3 trauma X-rays
  - Lateral C-spine
  - AP Chest
  - AP Pelvis
    - Inlet/Outlet

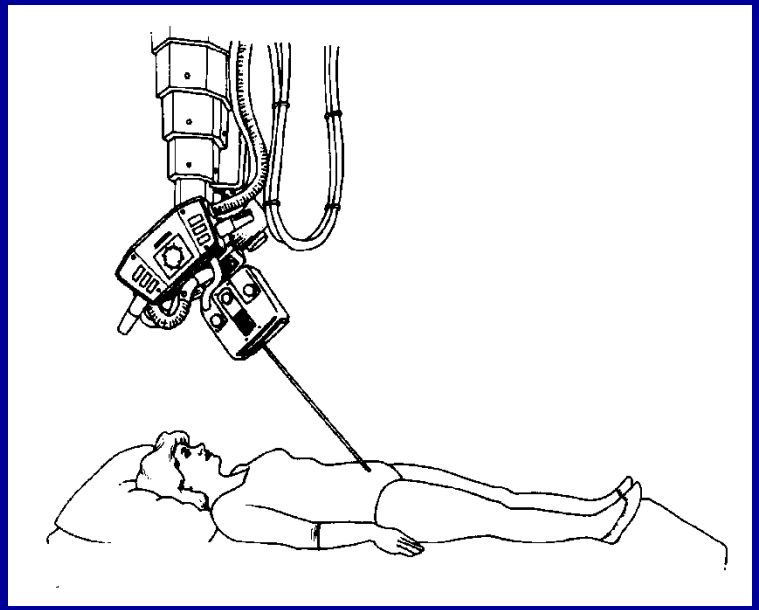


AP VIEW

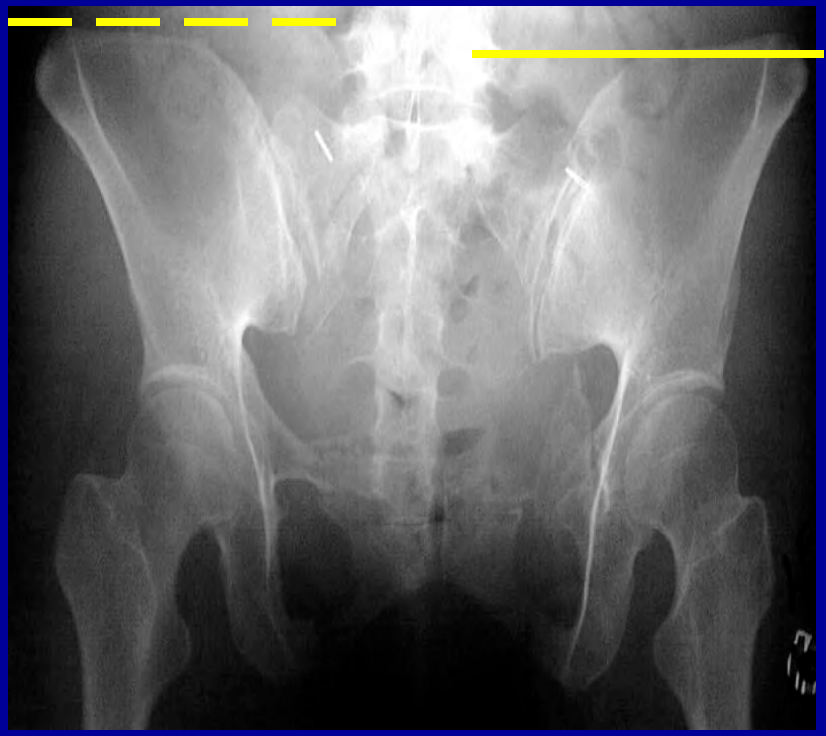


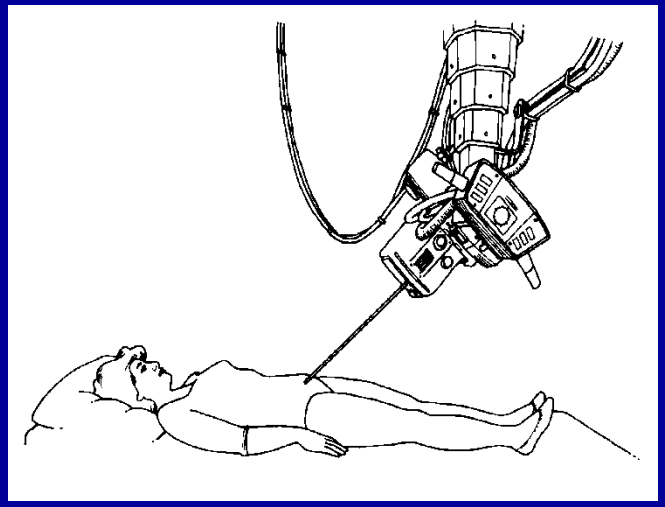
If evidence of pelvic ring fracture...



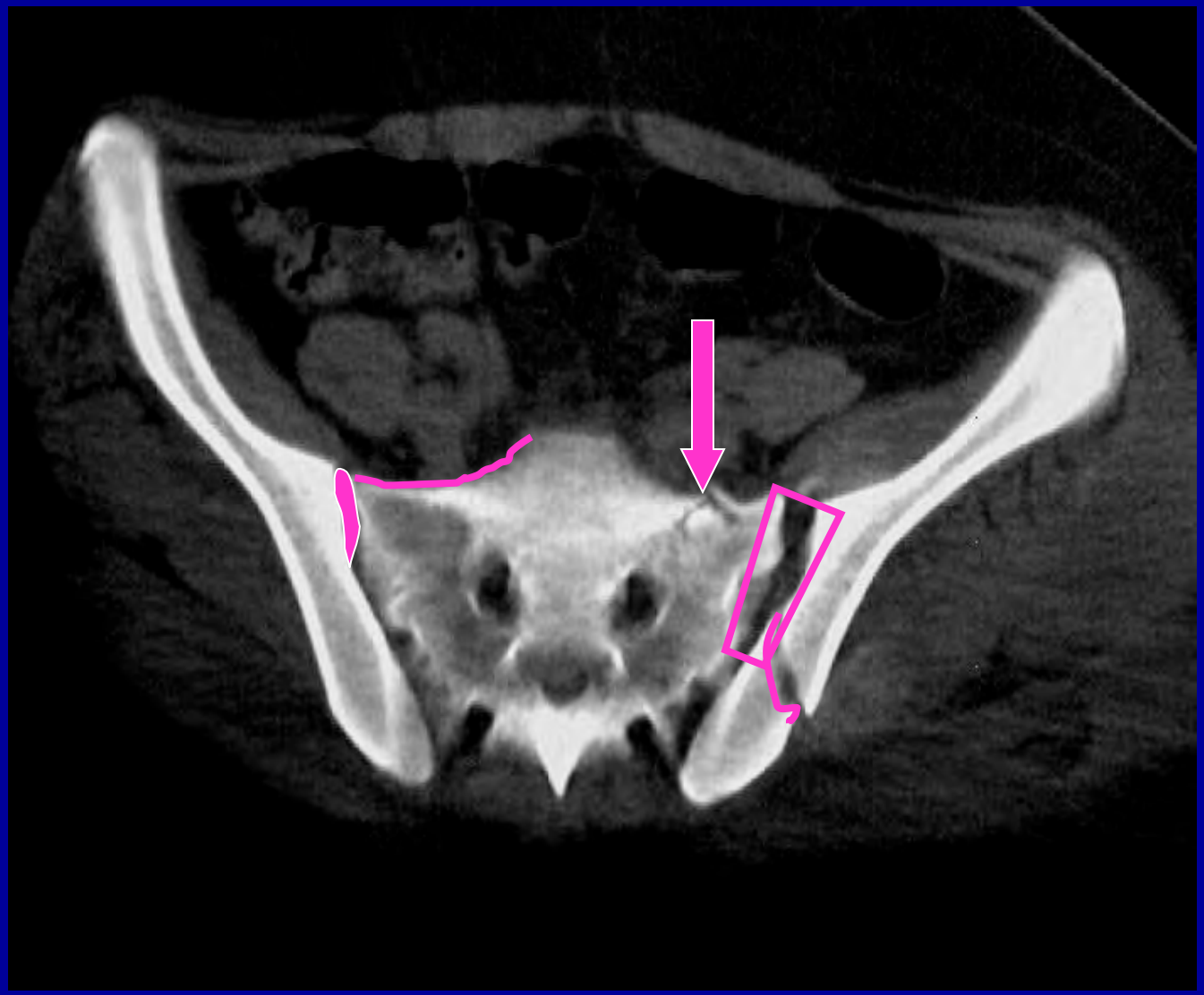


INLET VIEW





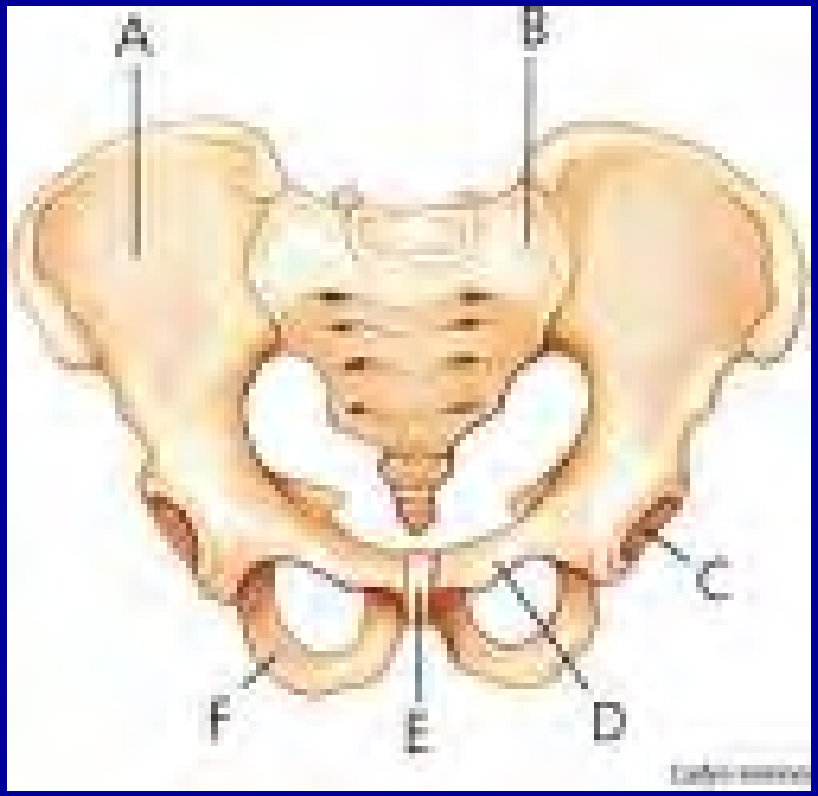
OUTLET VIEW



CT SCAN

ANATOMY

Bone



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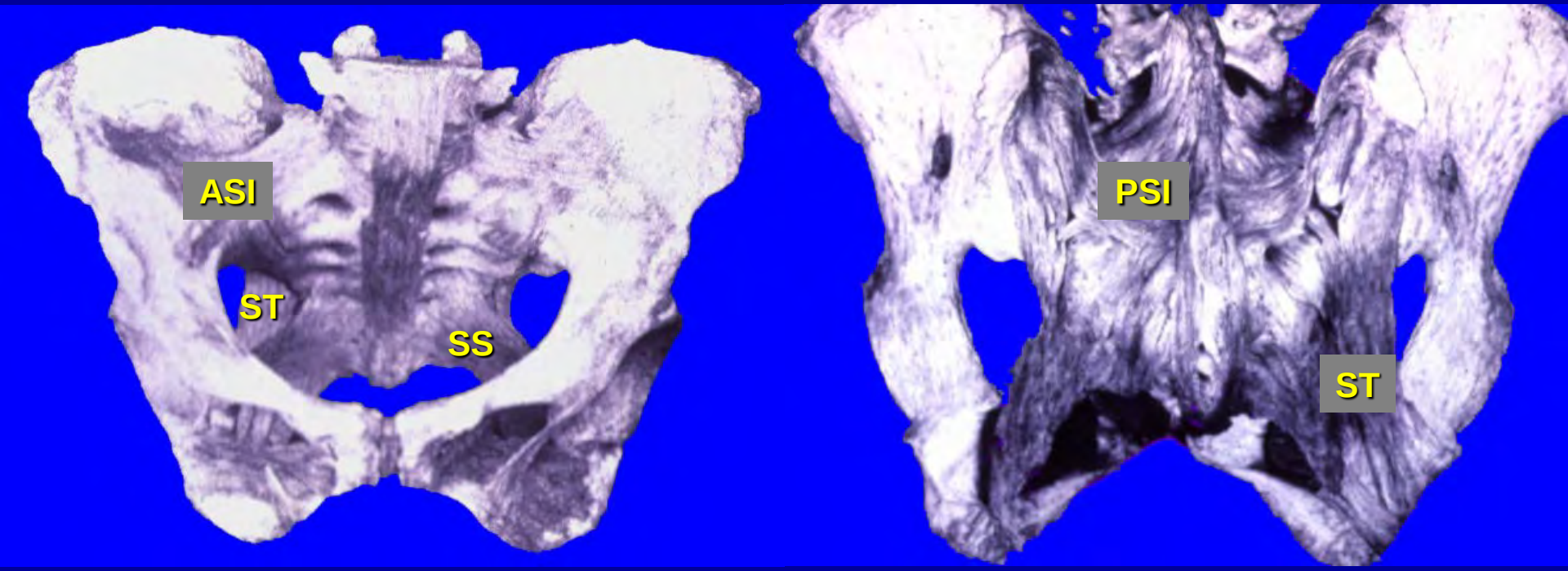
ANATOMY

Ligamentous

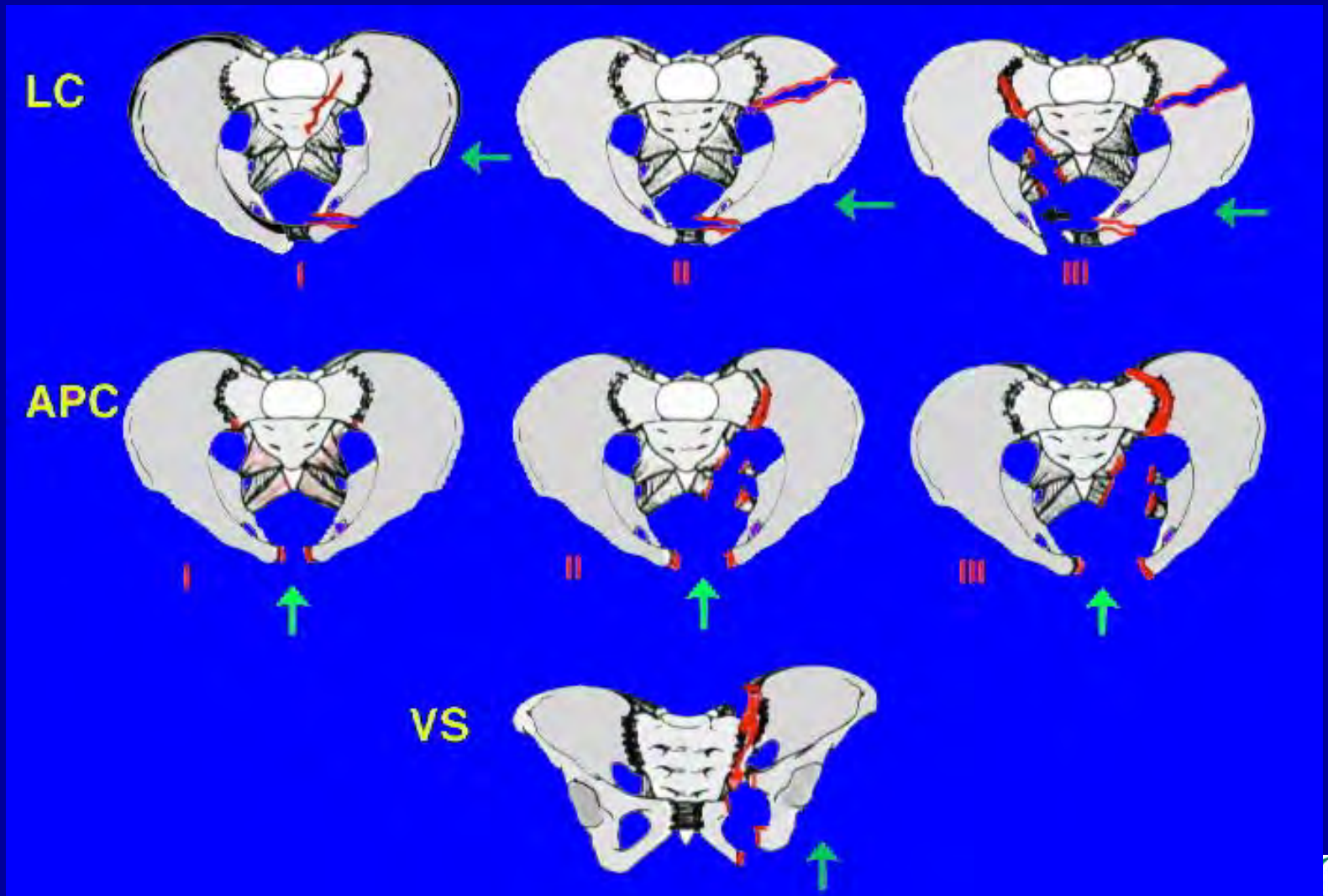


ANATOMY

Relationships

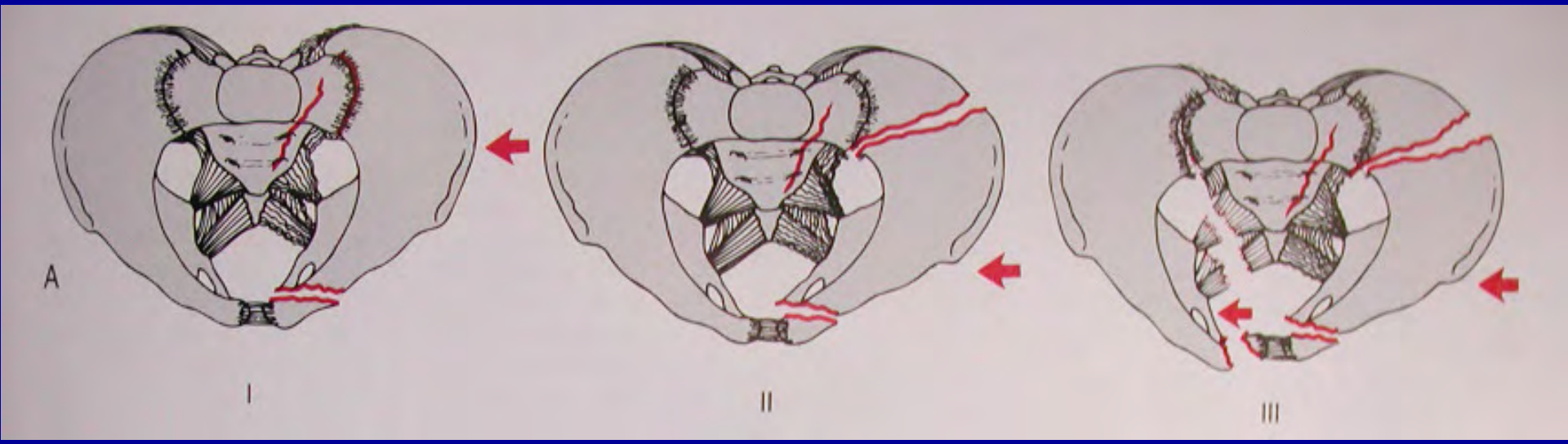
Burgess-Young Classification

- Mechanism and direction of injury



LATERAL COMPRESSION

- Three types, increasing in severity
- Common anterior fracture pattern
- Ligament disruption rare



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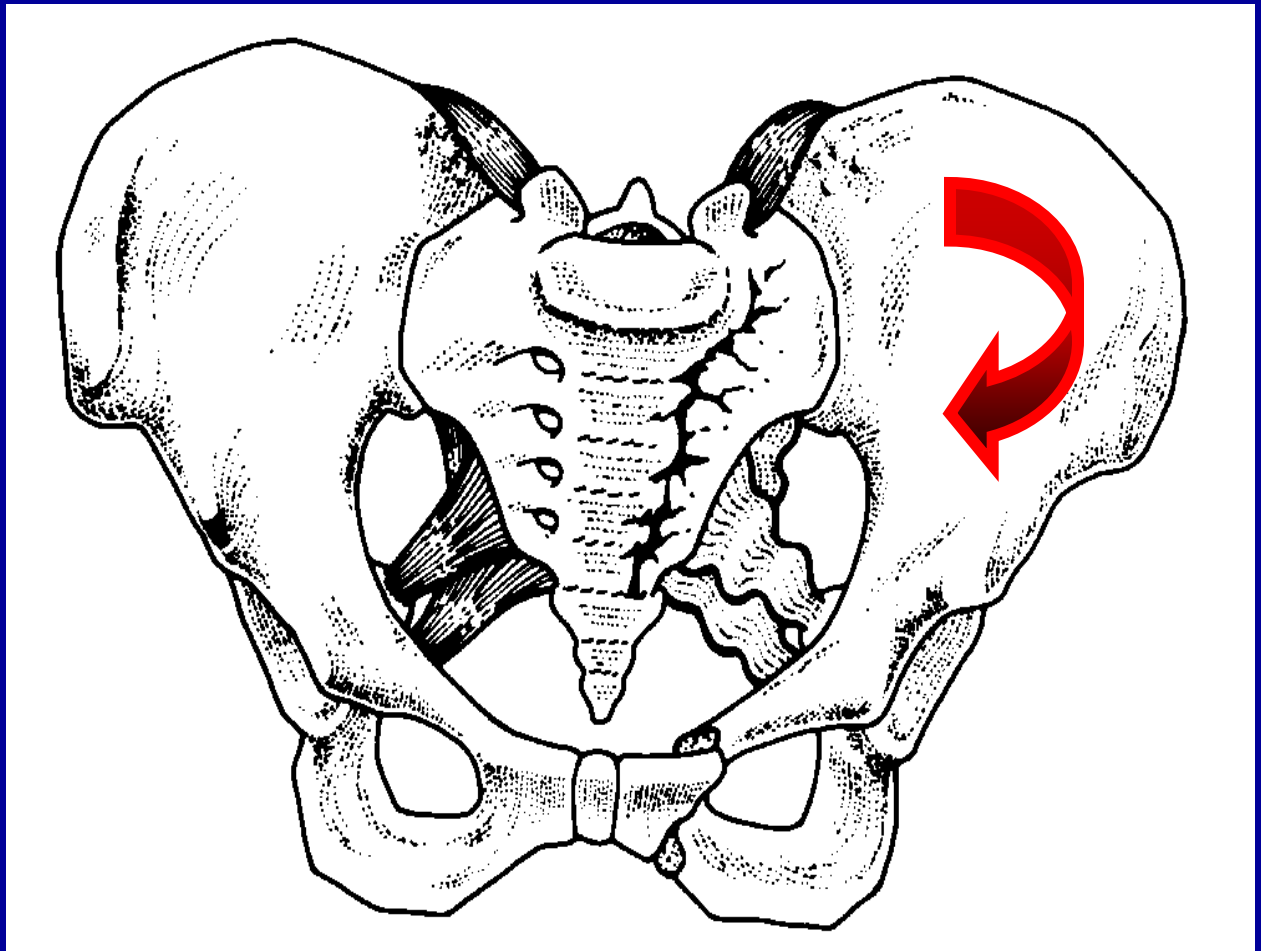
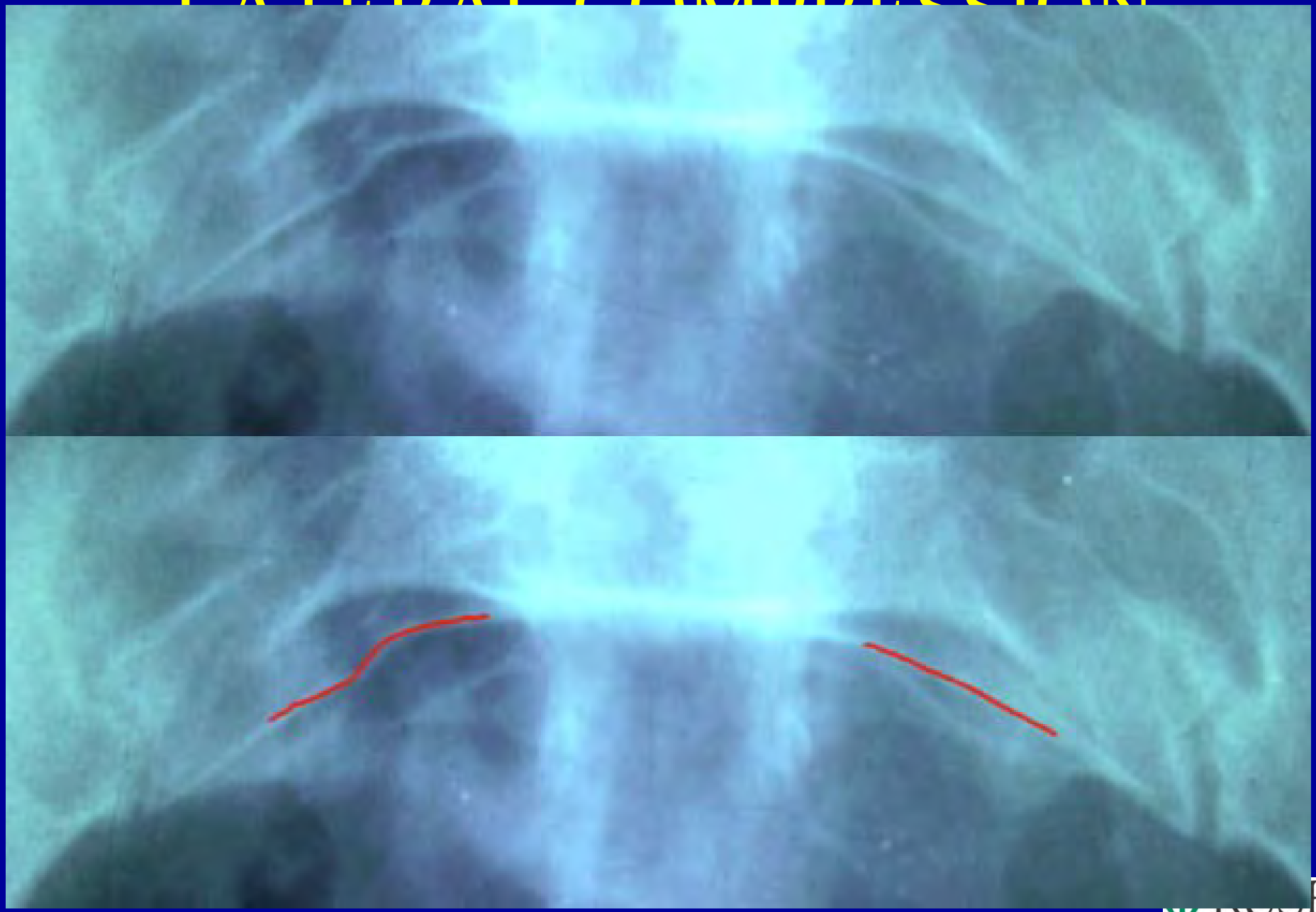
LATERAL COMPRESSION

LC 1: Sacral compression

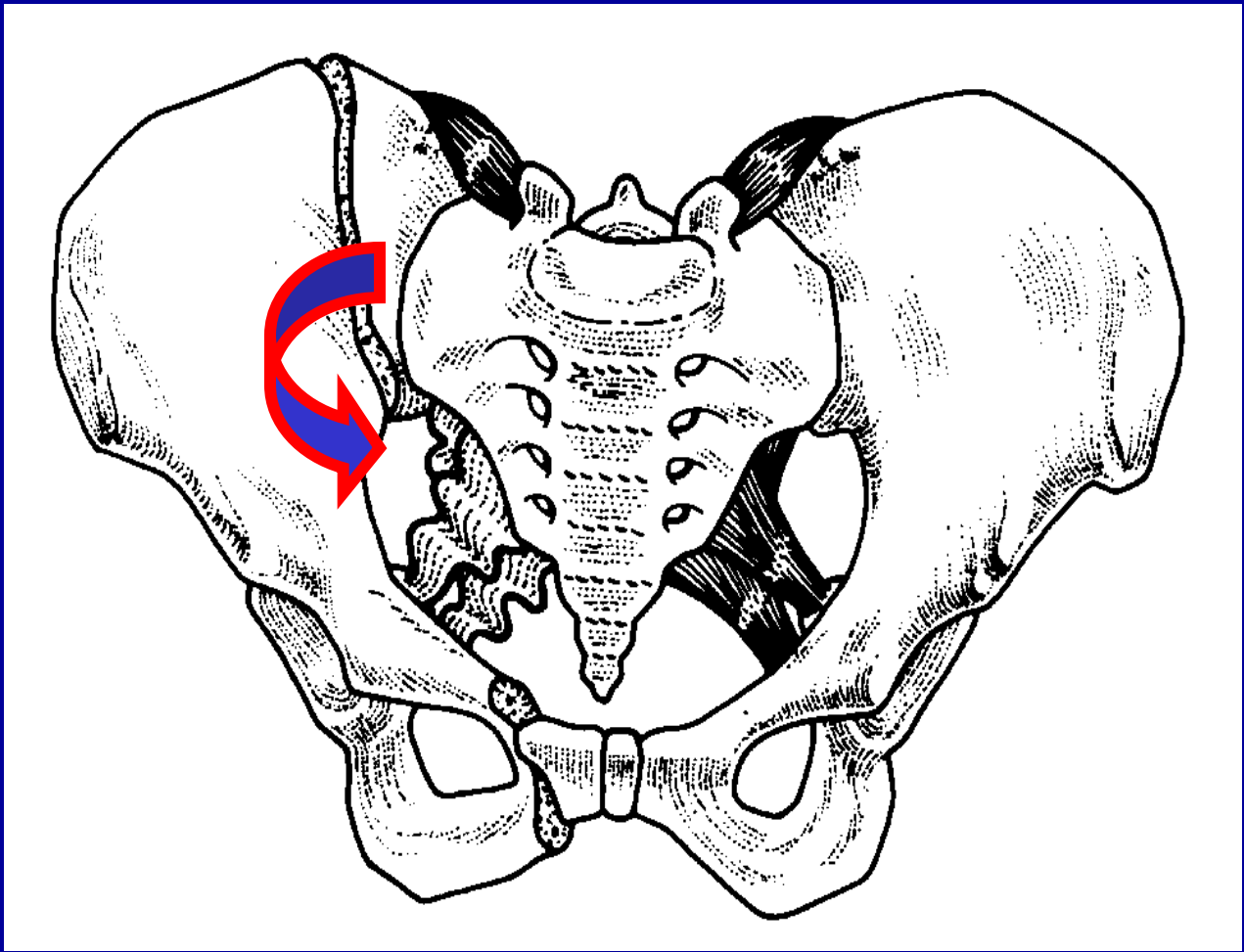


LATERAL COMPRESSION



LATERAL COMPRESSION

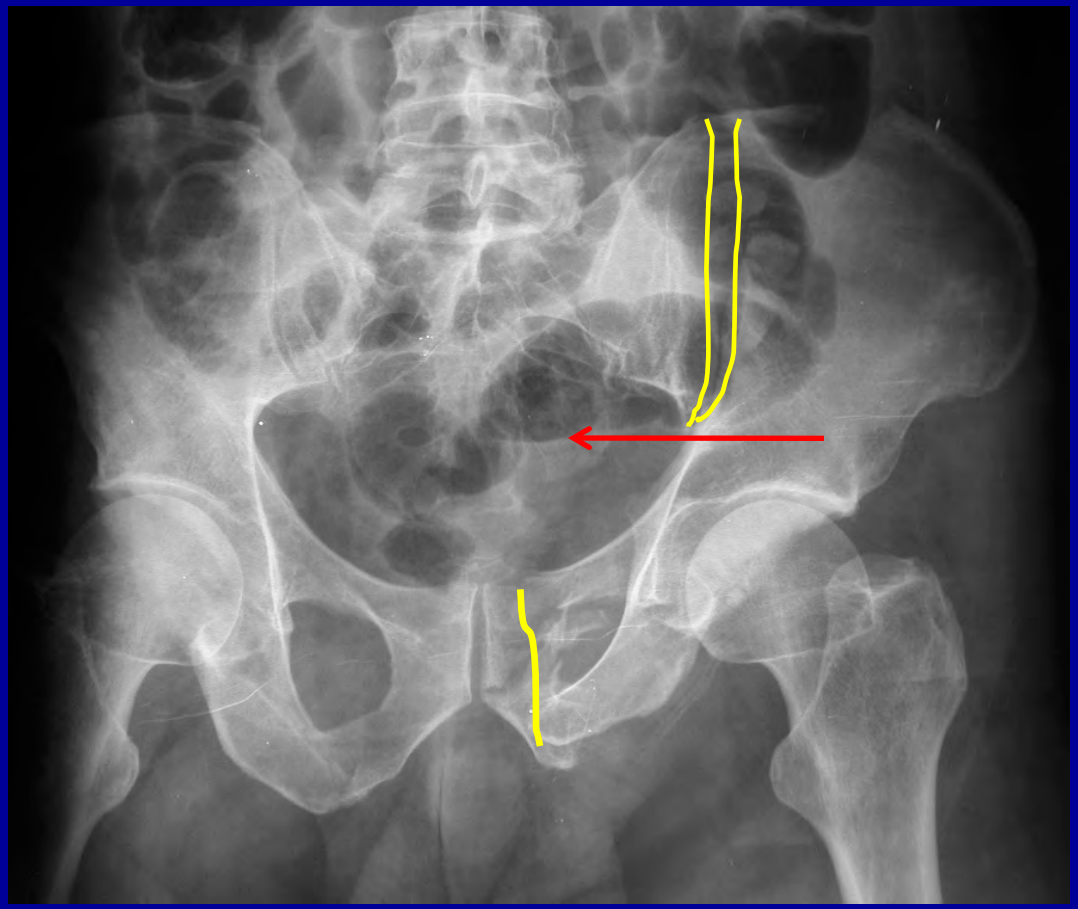
LC 2: “Crescent fracture”

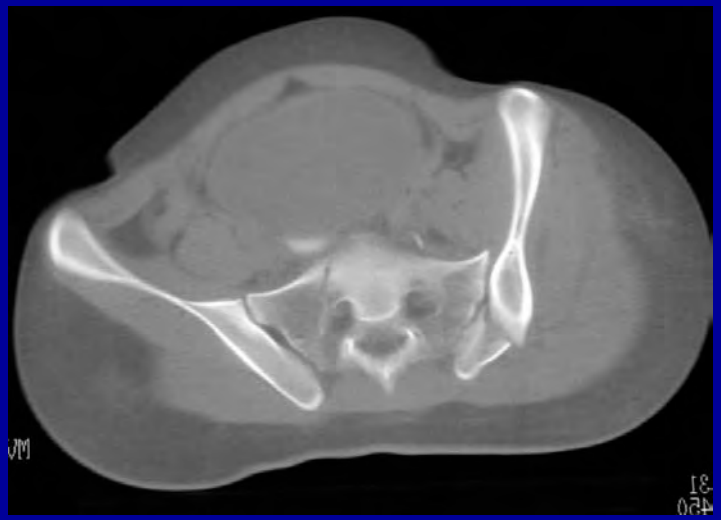


LATERAL COMPRESSION

LC 2: Iliac wing fracture

- Fracture/dislocation of the SI joint
- Internal rotation deformity





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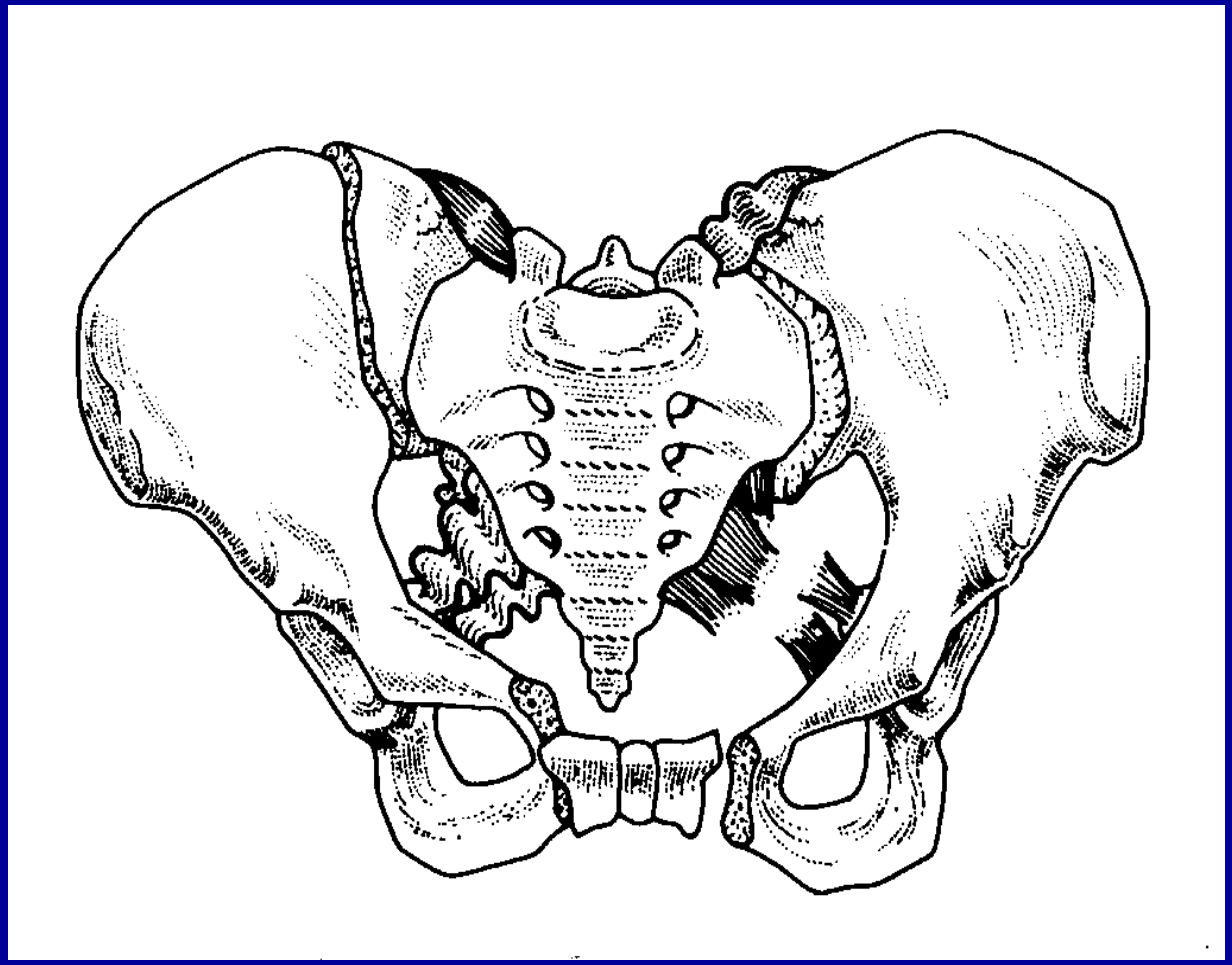
LATERAL COMPRESSION

LC 3: Windswept pelvis



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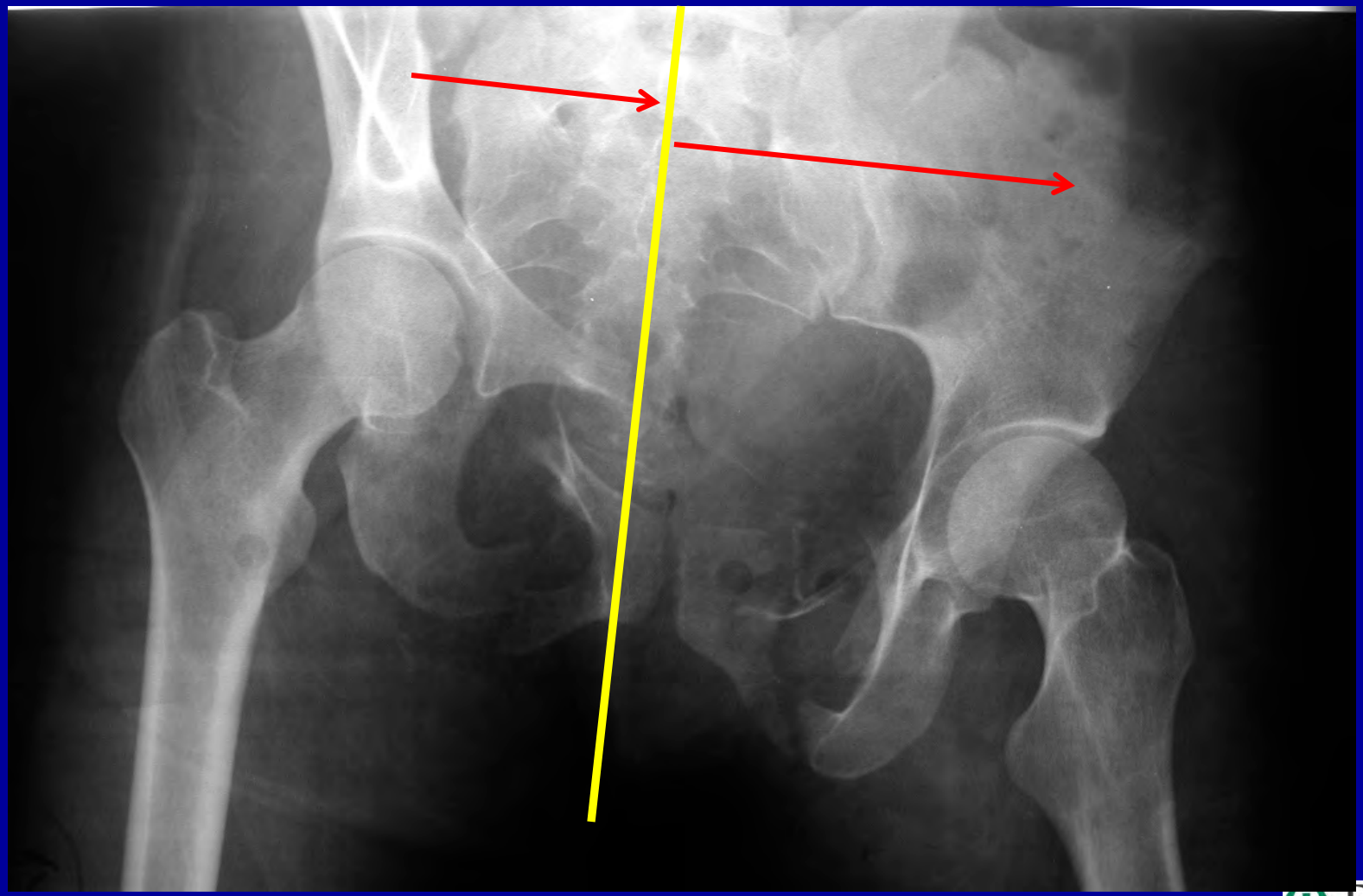
LC3



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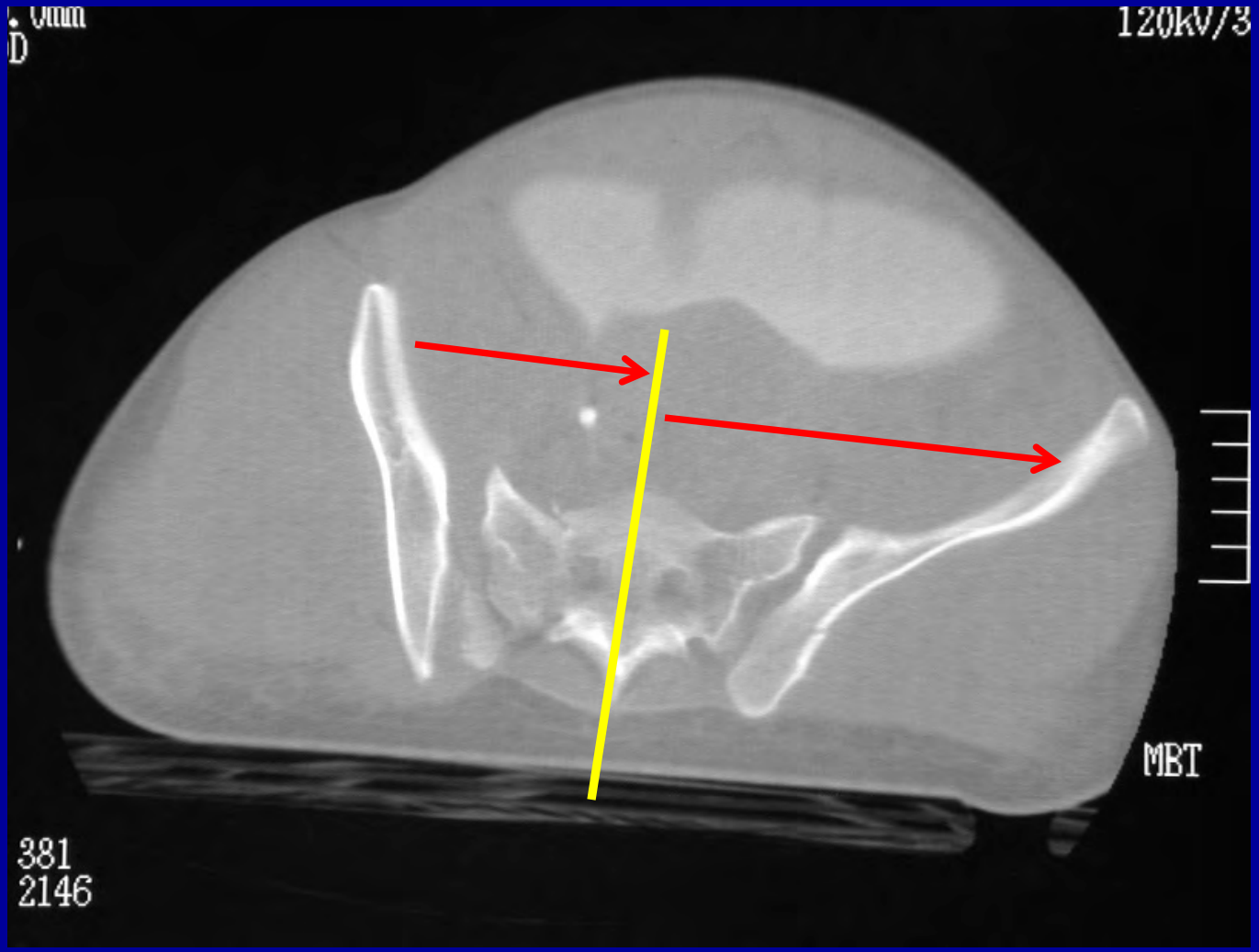
LC3



ANTEROPOSTERIOR COMPRESSION

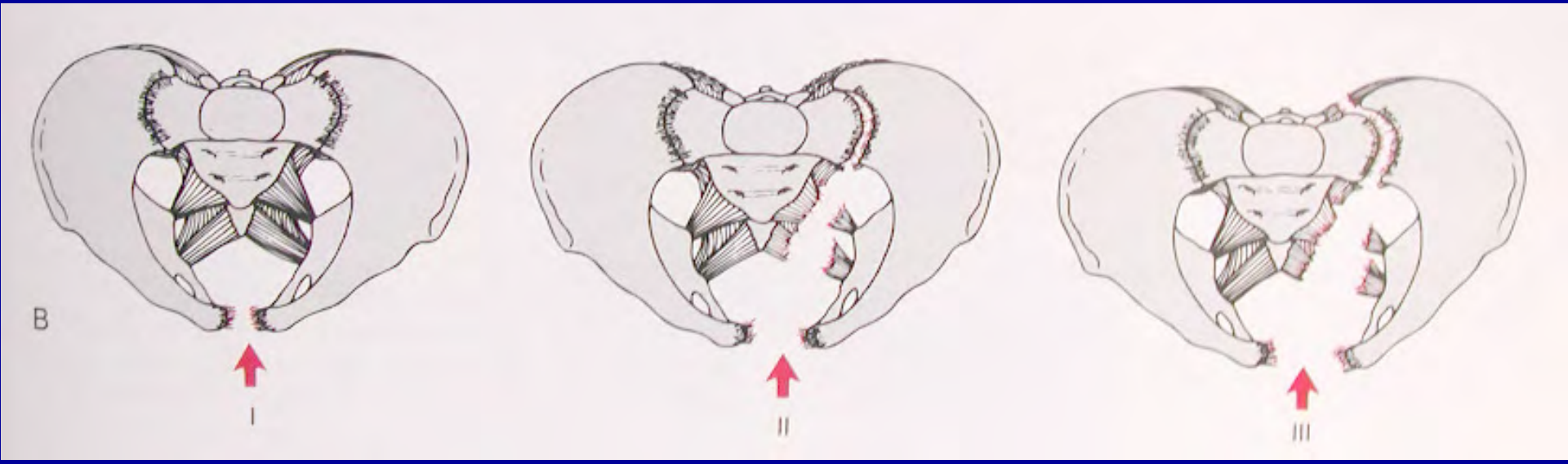
APC

The classic “open book” type of pelvic fractures

- 3 types, increasing in severity
- Diameter acutely increased
- Contents subjected to tensile force
- Ligament disruption common
- Anterior injury through symphysis or rami
- Posterior injury through SI joint or sacrum

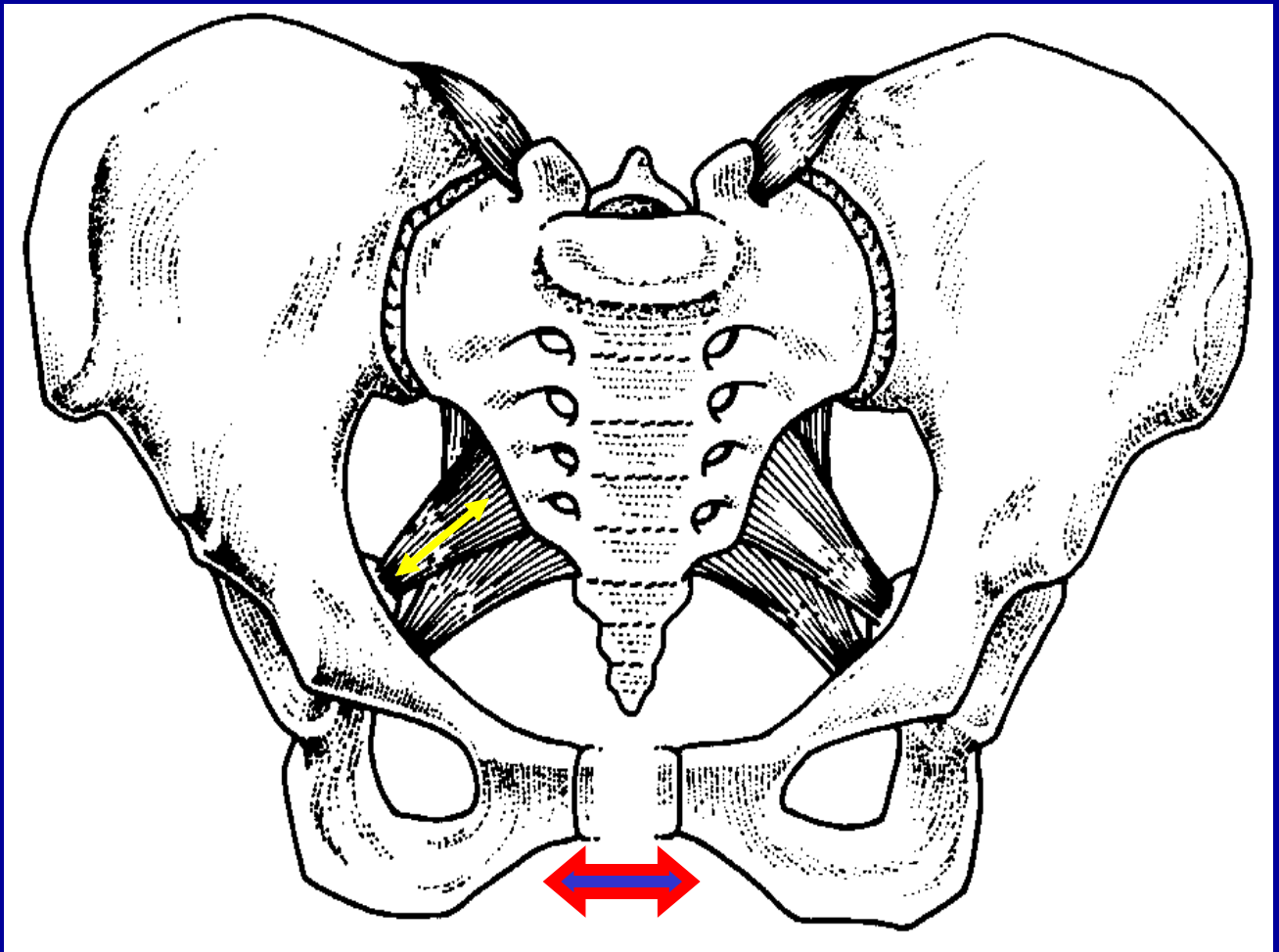
ANTEROPOSTERIOR COMPRESSION

- APC 1 Symphysis open, SI normal
- APC 2 Anterior SI ligaments violated
- APC 3 Complete iliosacral dissociation



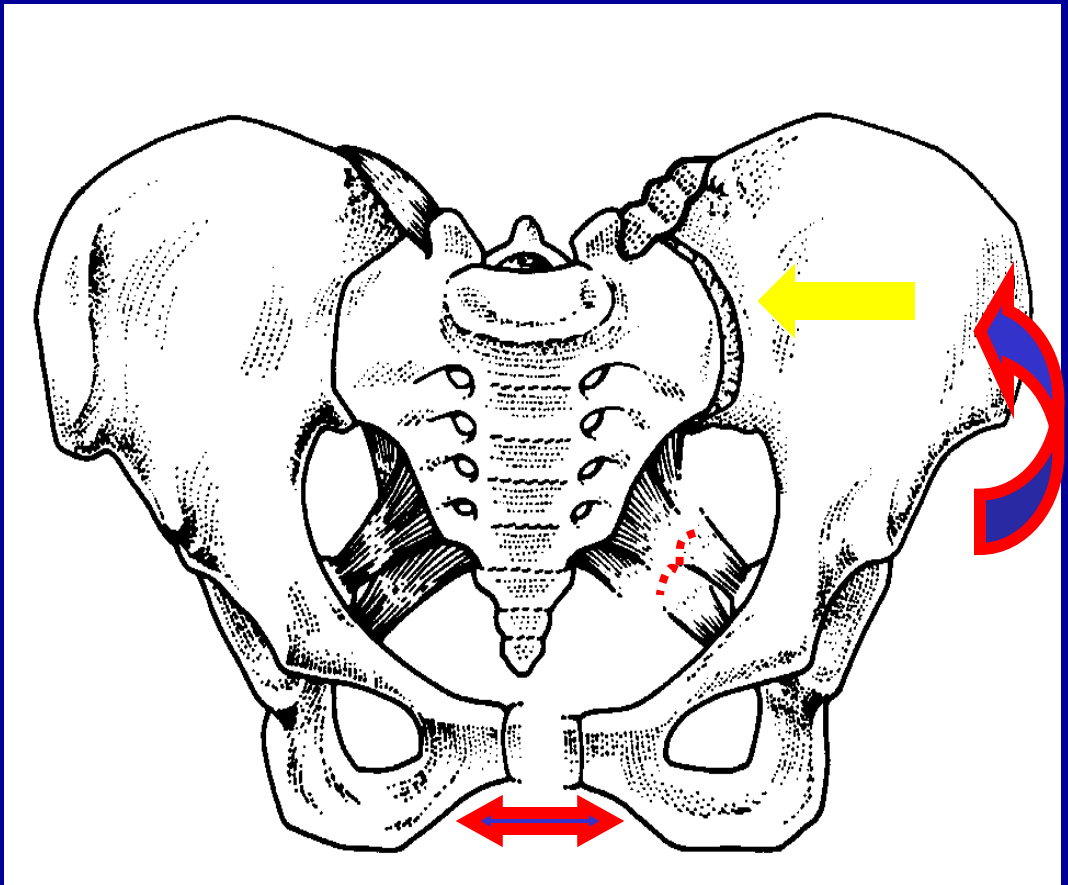
AP 1

- Note that the ligaments are stretched, and not torn

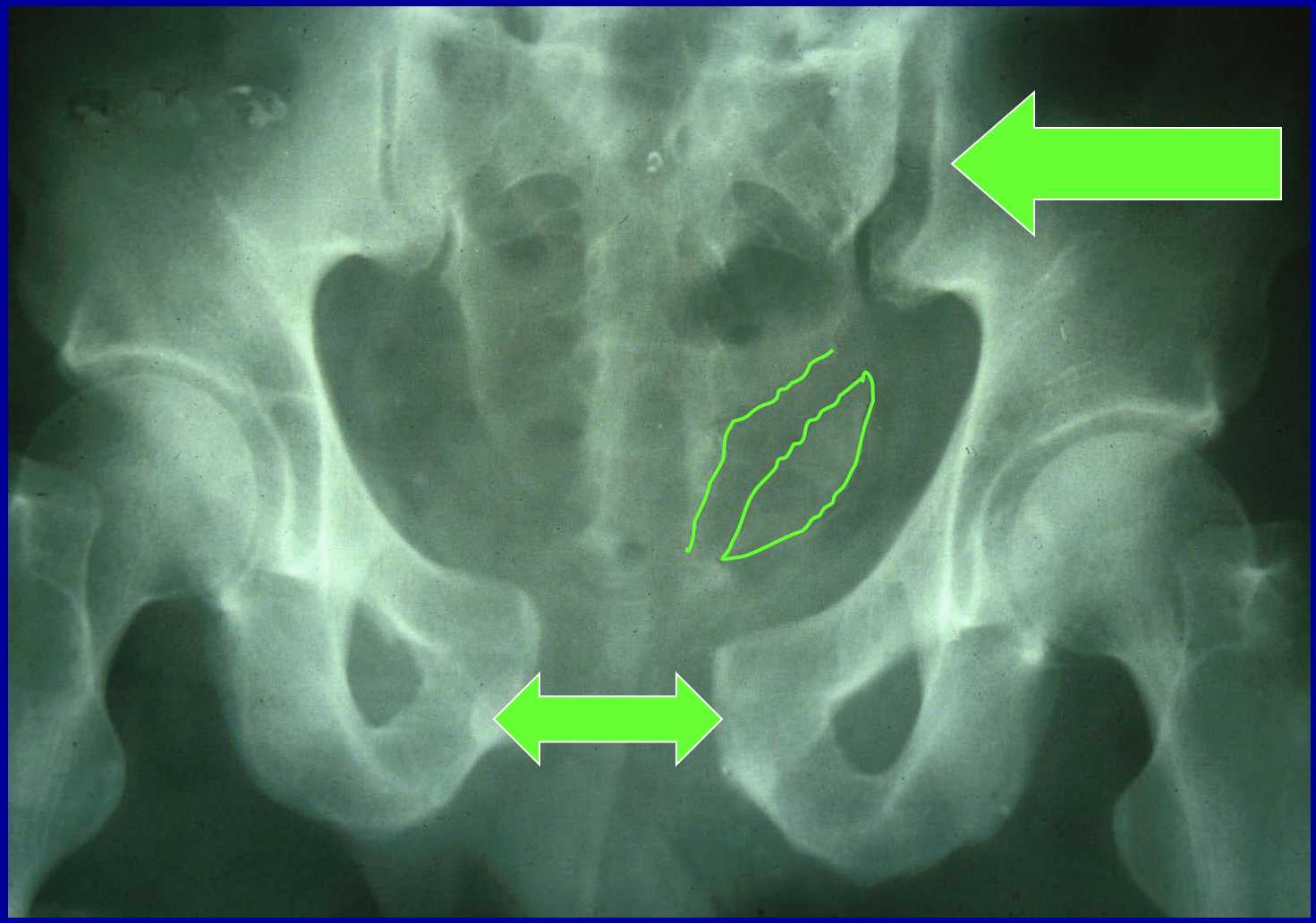


AP 2

- Note: pelvic floor ligaments are violated, as well as anterior SI ligaments and symphysis

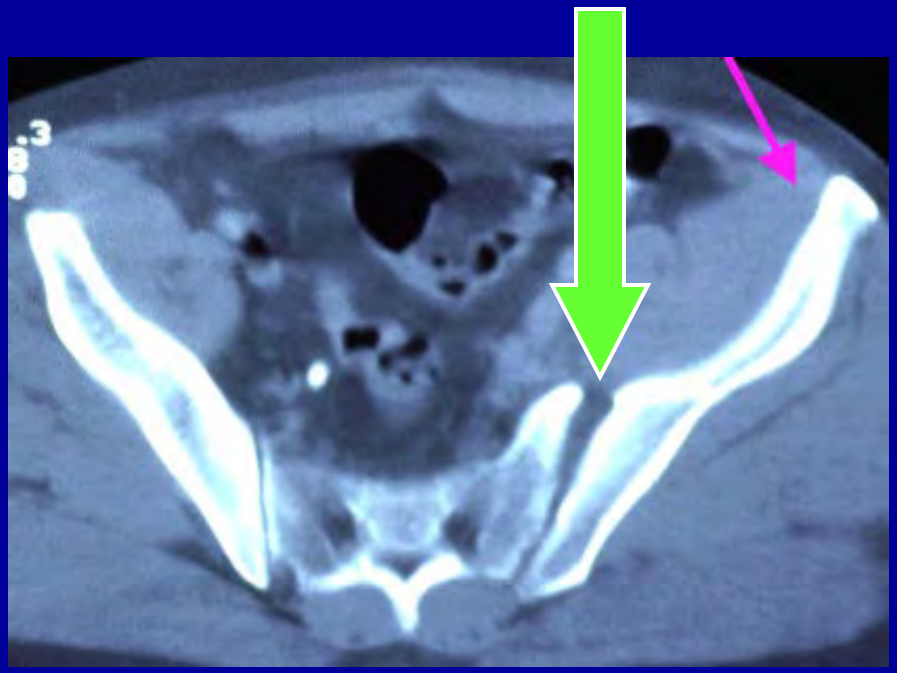


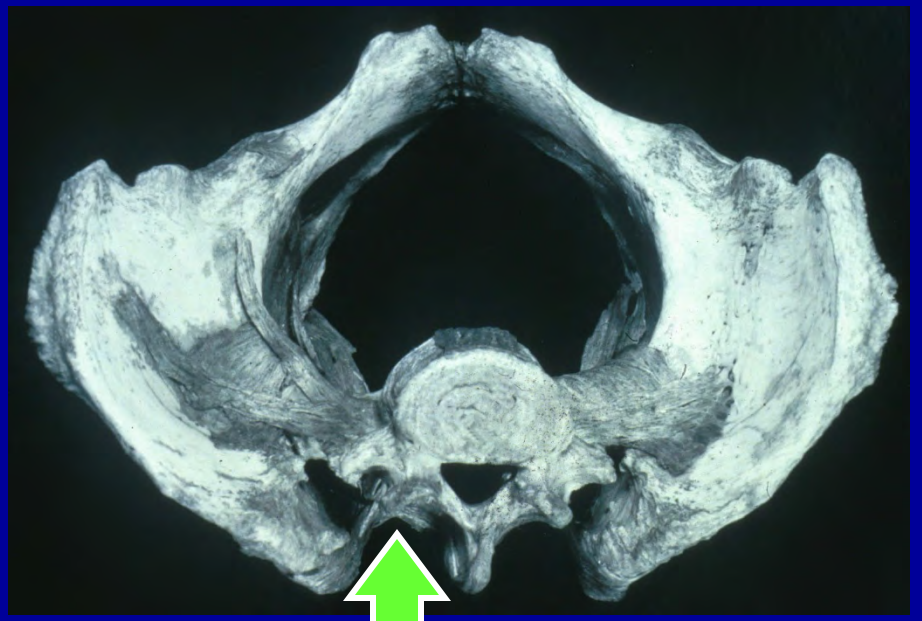
AP 2



AP 2

These anterior SI ligaments are disrupted...

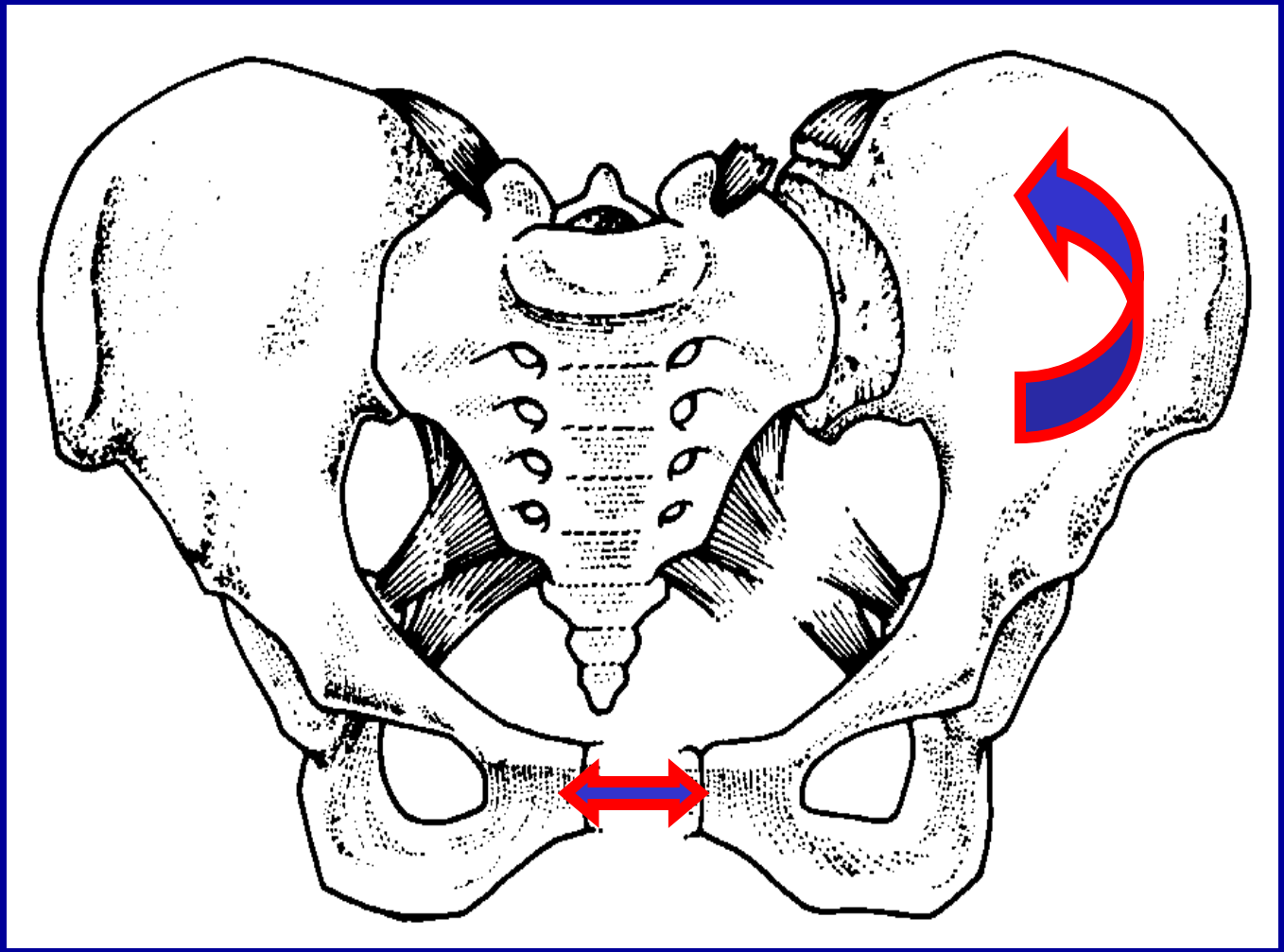




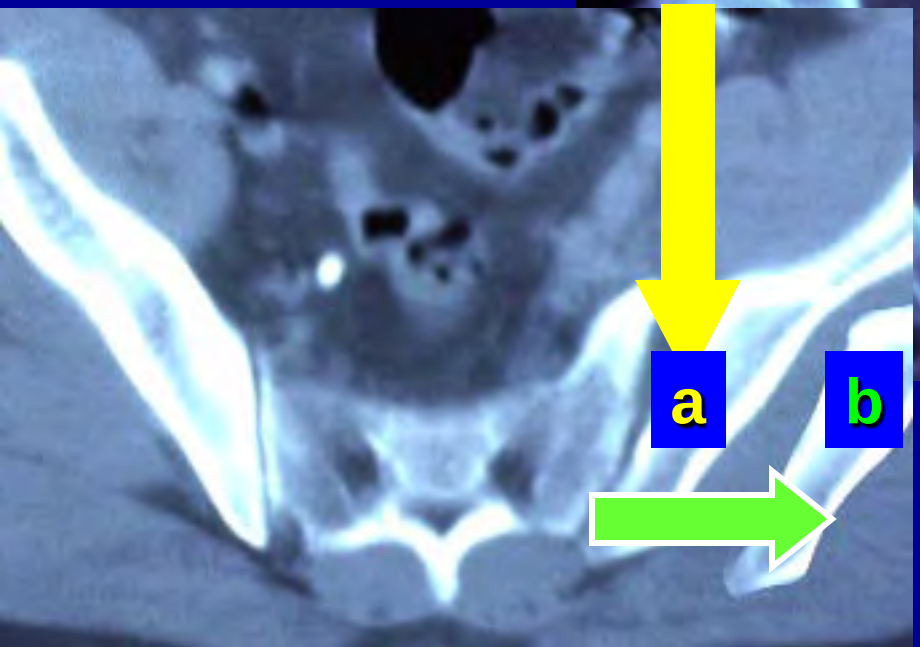
But these <u>posterior</u> SI ligaments remain intact

APC 3

Complete iliosacral dissociation



AP 3



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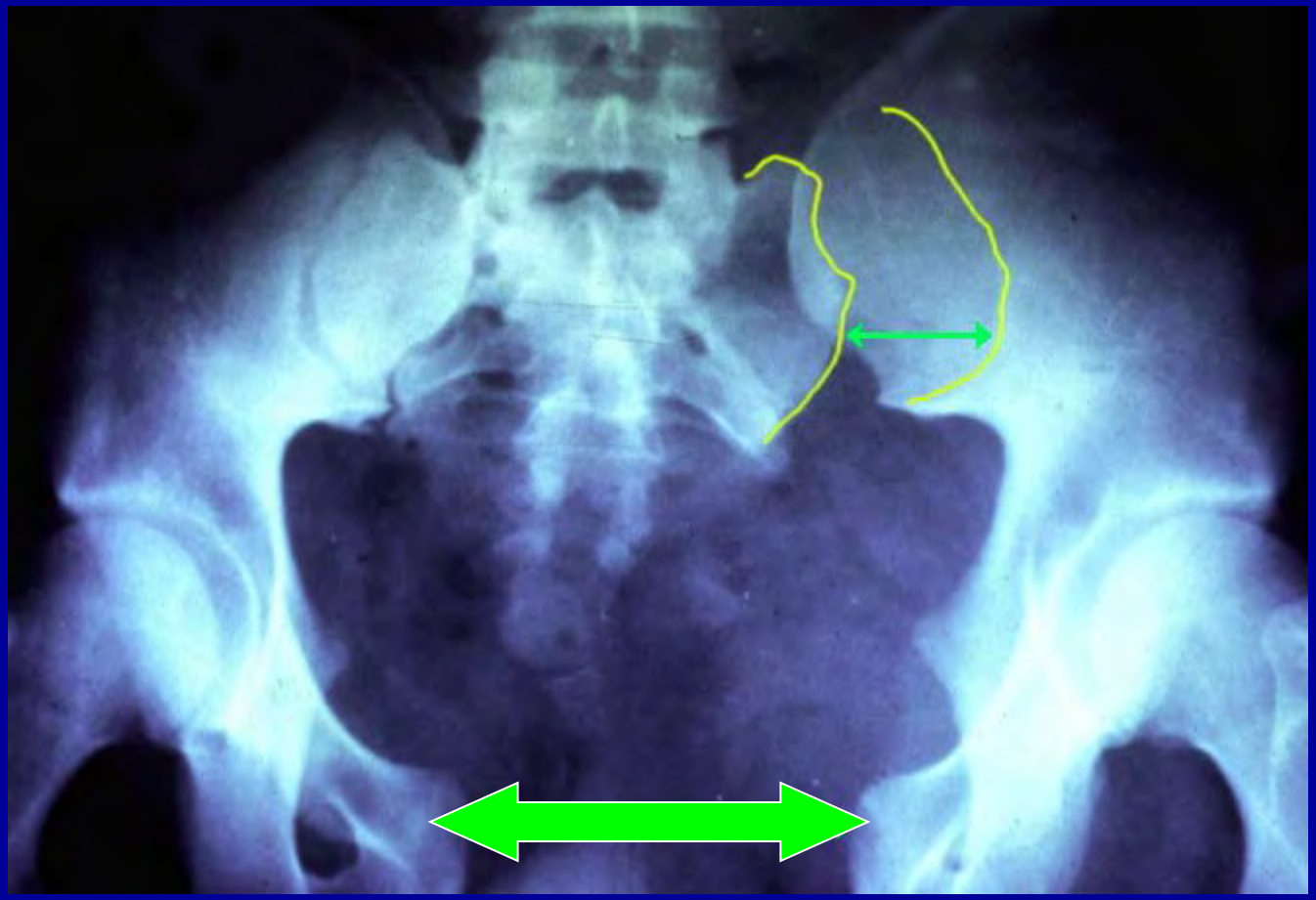
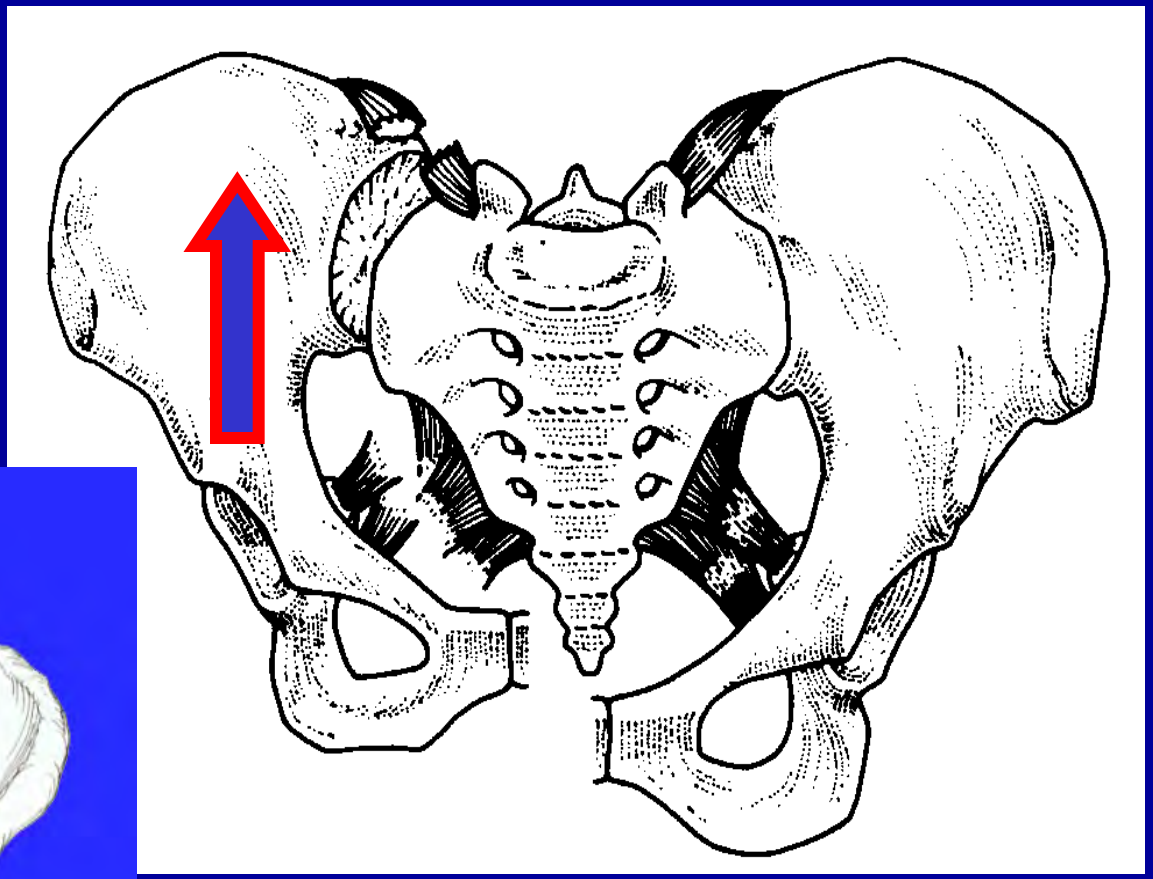
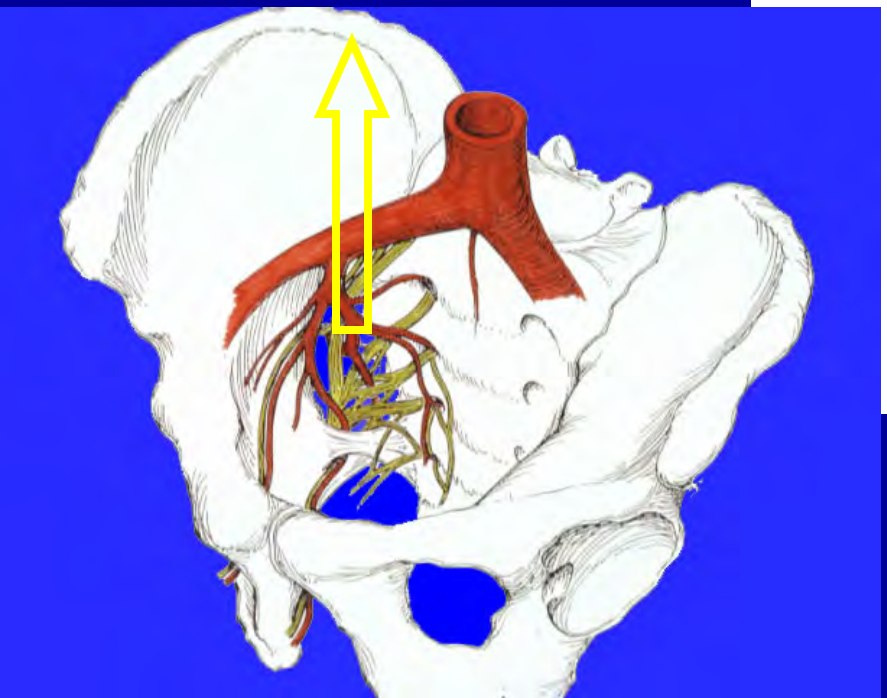


AP 3

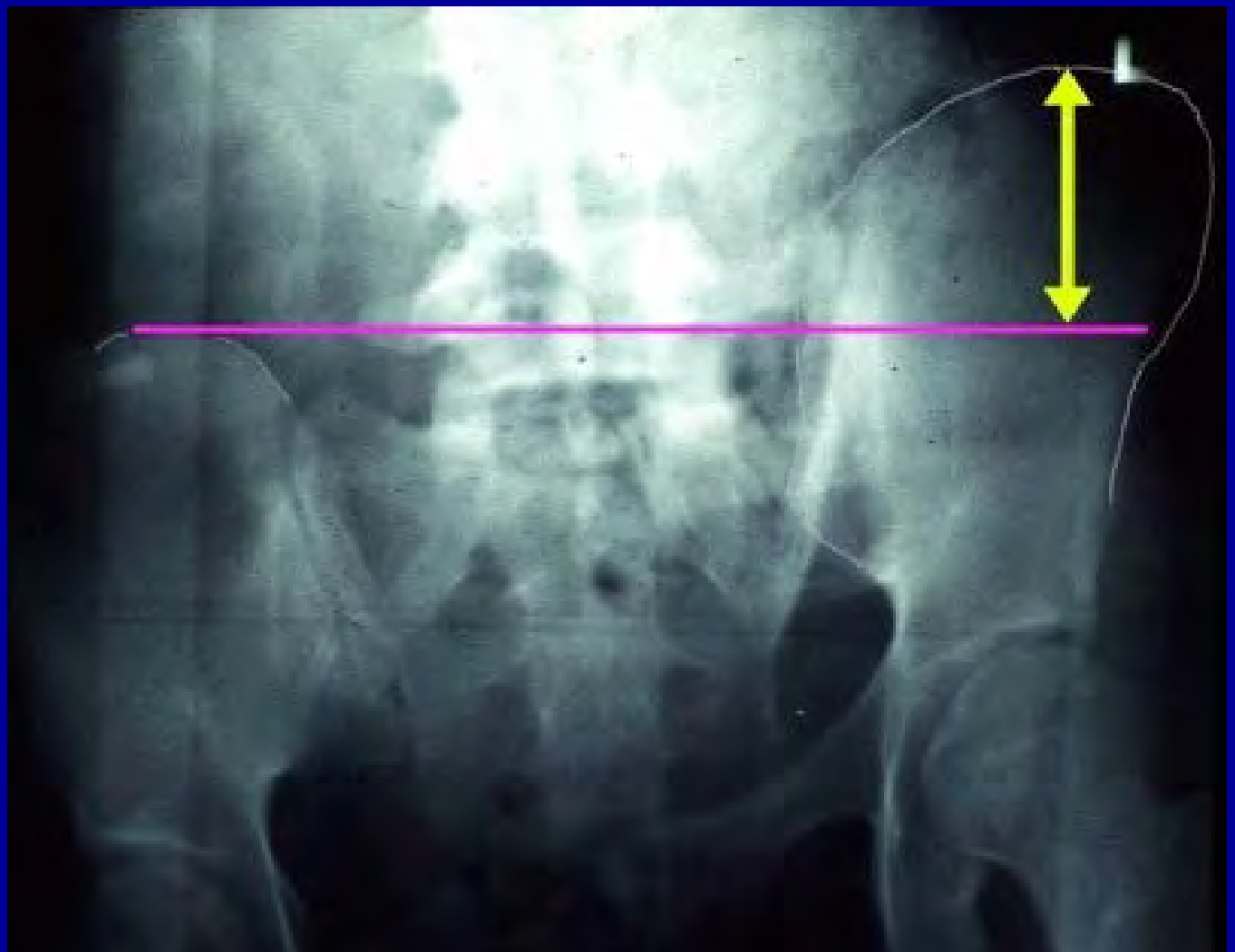
RUSH

VERTICAL SHEAR





VERTICAL SHEAR



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ASSOCIATED INJURIES

Lateral Compression:

- Abdominal visceral injury
- Head injury
- Few pelvic vascular injuries

AP Compression:

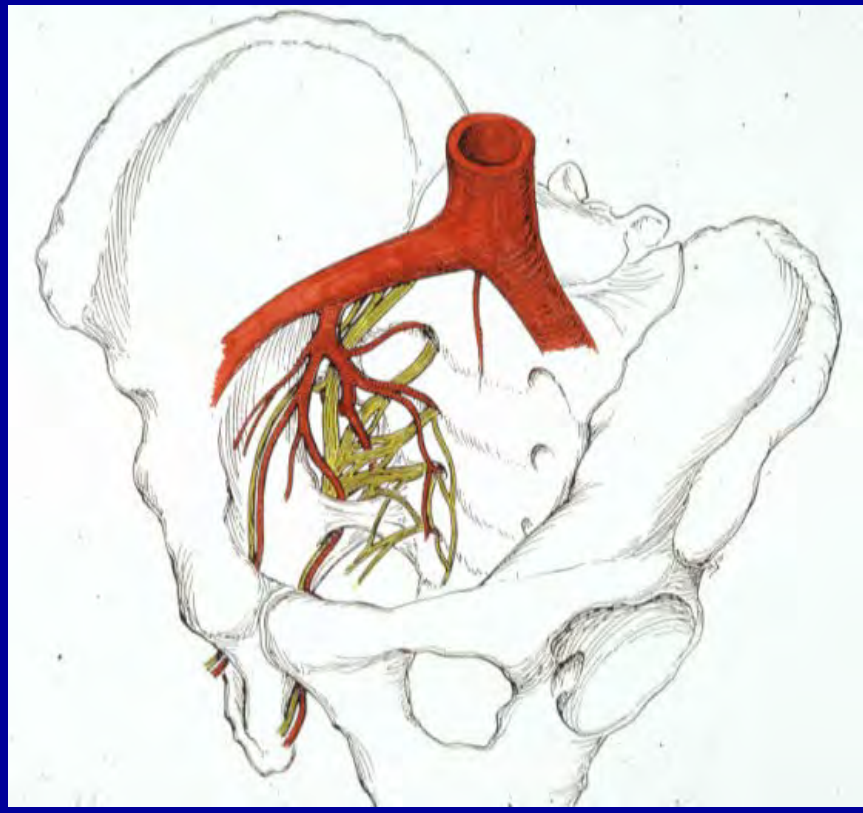
- Urologic injury
- Hemorrhage/pelvic vascular injury:

  APCII-10%, APCIII-22%

ASSOCIATED INJURIES

NEUROLOGIC

- Lumbo-sacral plexus
- L5, S1 most common
- Exploration not indicated
- Incomplete lesions may improve
- Often most important factor in long-term outcome



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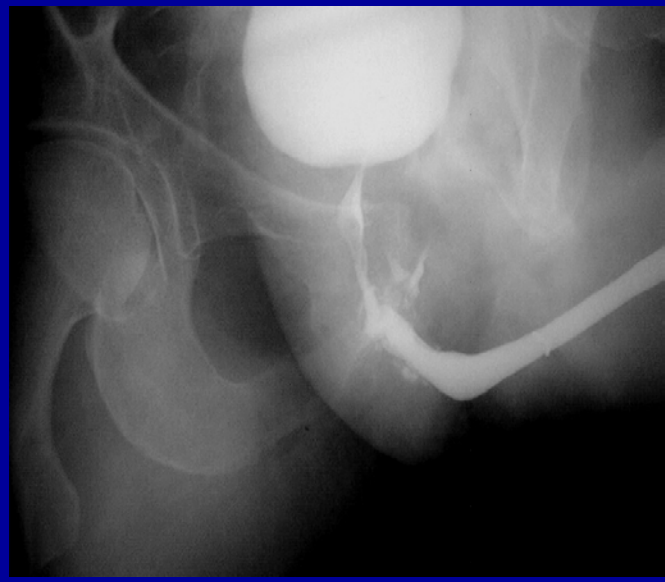
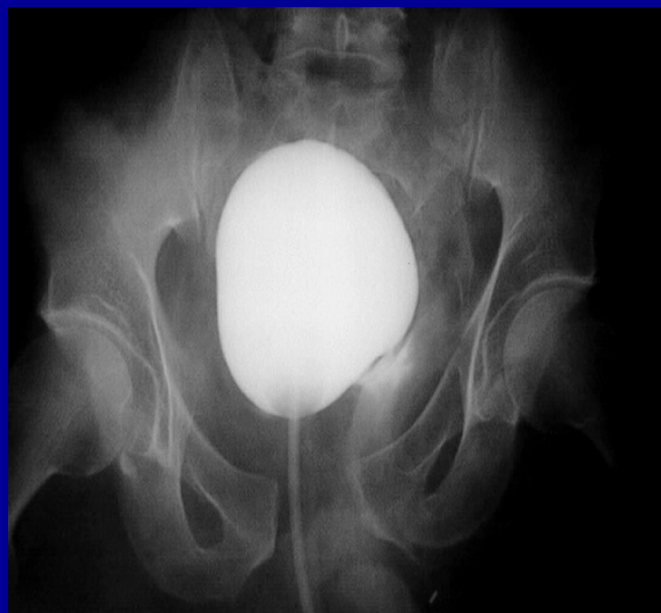
ASSOCIATED INJURIES

UROLOGIC

- Urethra - retrograde urethrogram
- Bladder - cystogram
  - Extraperitoneal - Foley vs. SP tube
  - Intraperitoneal - Repair, SP tube
- Suprapubic tube may complicate surgical treatment





Subtle Markers of High Energy

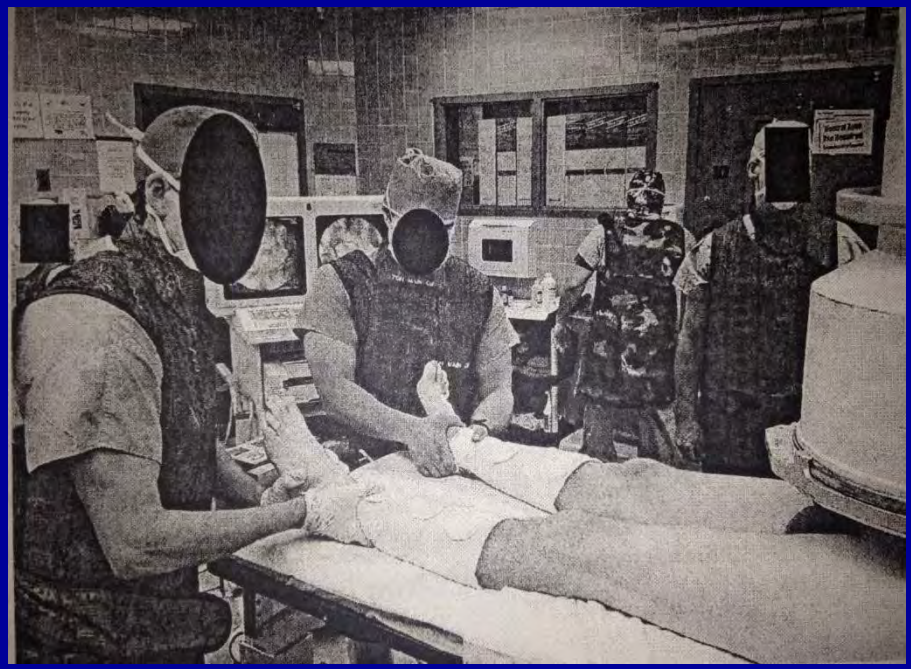
- Lumbar transverse process fractures
  - Iliac wing attached to lumber spine by stout iliolumbar ligament
  - Sign of vertical instability

Dynamic Instability

- Soft tissue attachments allow pelvis to recoil after initial displacement
- Curved CT table can help reduce pelvis
- Result can be imaging that looks “non displaced”

EUA

- Fluoroscopic exam of pelvis under general anesthesia
- Can demonstrate displacement
- Testing
  - Internal rotation/compression
  - External rotation
  - Push/pull

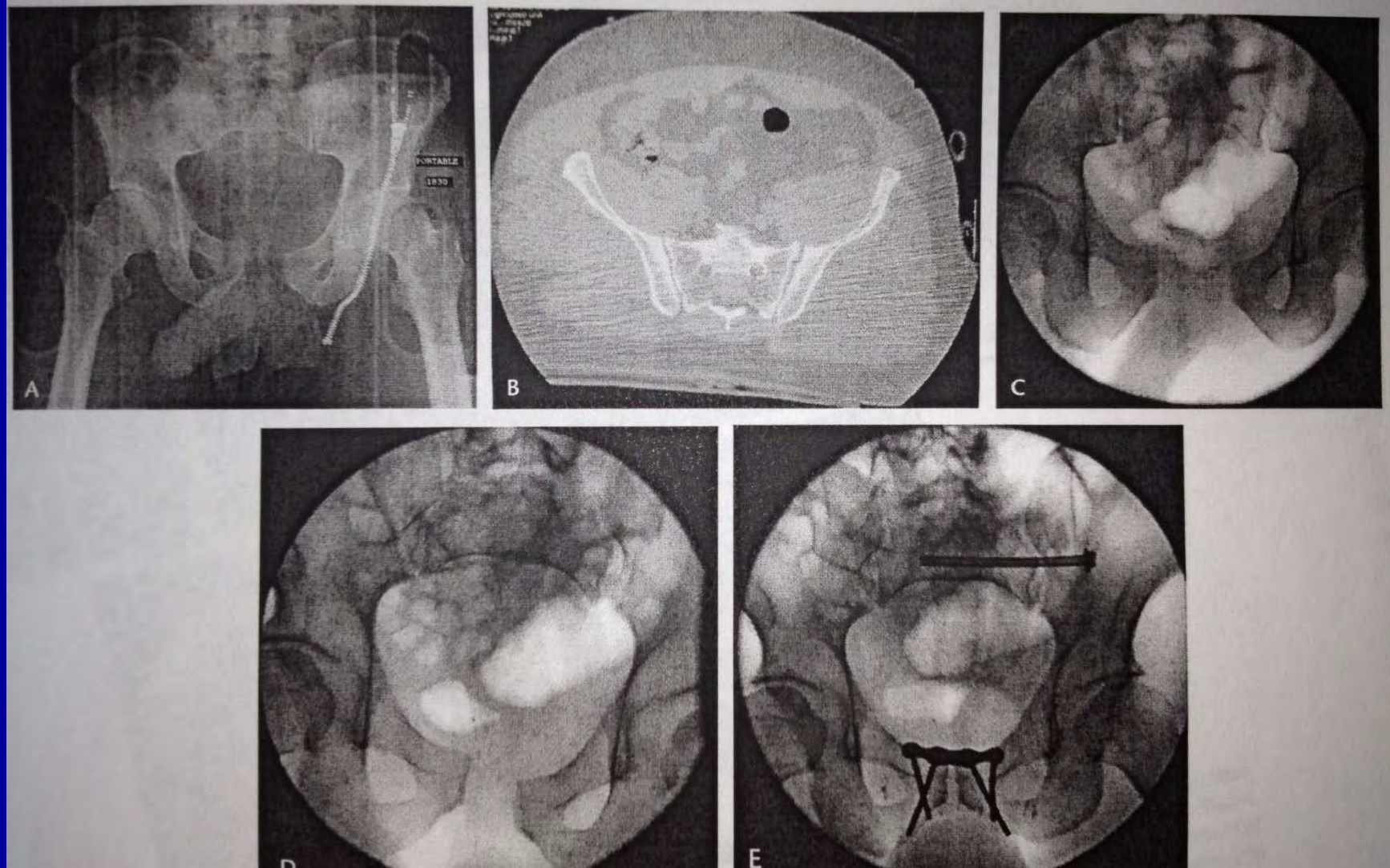


EUA

- 50% AP1 ⟹ AP2 (fixation)
- 39% AP2 ⟹ AP2b (posterior fixation)
- 35% LC1 ⟹ LC1b (fixation)

  – Sagi et al, JOT, 2011

EUA



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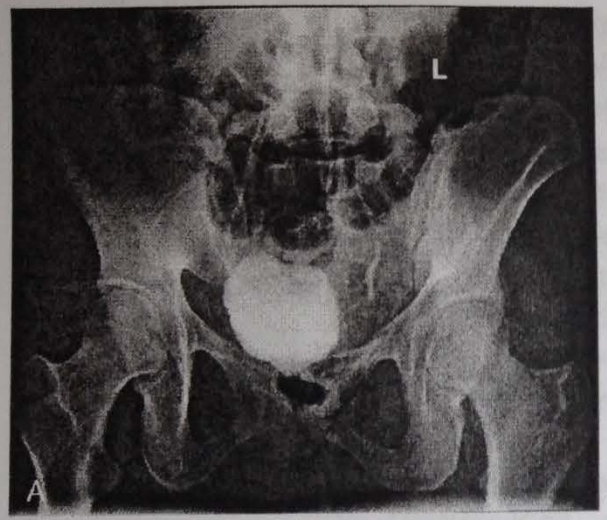

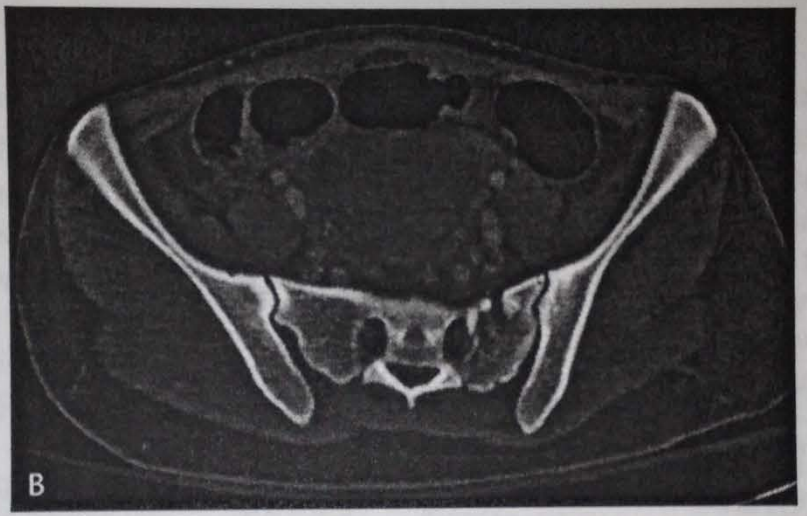

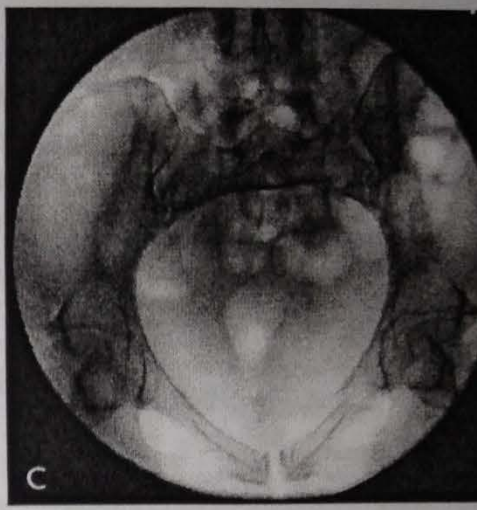

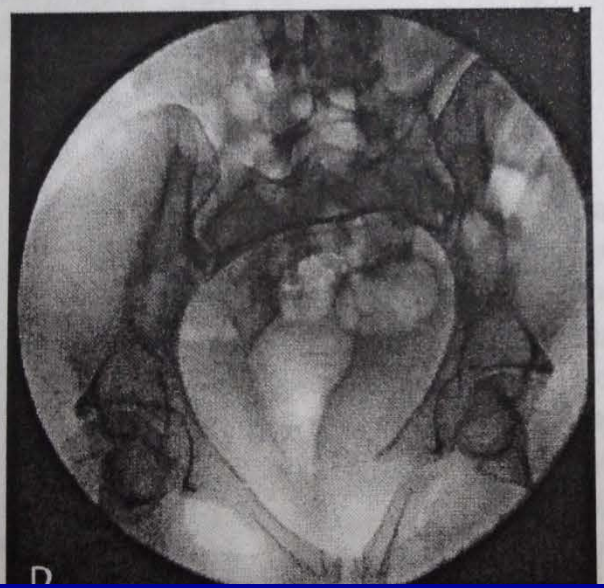

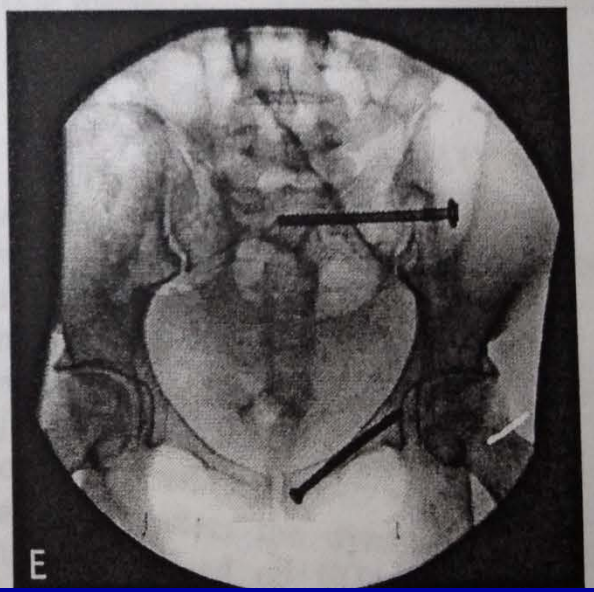

Management

- ATLS
  - Airway
  - Breathing
  - Circulation
- Early Orthopaedic Involvement
  - Examine Pelvis Once ?
  - Examine and Pack Open Wounds
  - Neuro Exam

Early Management

- Radiographs
- ‘Unstable’ Pelvic Ring
- Provisional Stabilization
  - Sheet
  - Binder
  - Caution w LC Injuries

Hemodynamically Stable

- Complete Trauma Workup/Resuscitation
- Completion Pelvis Imaging
- Watch Vitals Closely
- Consider Removing Binder
- *Elective Stabilization*

Hemodynamic Instability

- Source of Instability Blunt Trauma
  - Hemorrhage 95%
  - Cardiac, Hypothermia, Mediastinal, Brain, Neural,
- Hemorrhage
  - Thorax
  - Abdomen
  - Retroperotineum
  - Extremity
  - Environment

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Hemodynamic Instability

- Rapid Assessment of Chest/ Abdomen
  - Chest Radiograph
  - FAST
  - CT
  - DPL

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Instability & CT/Fast Negative

- Continues Resuscitation 1+1+1
  - Hypothermia, Coagulopathy, Acidosis
- Provisional Stabilization w Binder
- Continued Instability >>> Angio
- Definitive Pelvic Ring Stabilization

Instability & CT/Fast Positive

- Laparotomy
- Ex Fix prior to Lap
- Maintain Binder &
  Fix After Lap
- Be Flexible Depending on Patient Status and Surgeon Comfort Level
- Continued Blood Loss >> Angio

EXTERNAL FIXATION/BINDER

- Immediate application to pt. in extremis
- Controls volume & therefore tamponade
- Stabilizes clots prior to pt. movement

Stabilization Options

- Sheet/Binder/ Ex Fix
- ORIF
- Percutaneous Fixation

What does a Ex Fix/Binder/Sheet do?

- Reduces Pelvic Volume
- Tamponade Effect to Limit Hematoma Expansion
- Limits Motion
  - Comfort
  - Clot Stabilization
- Useful w APC Injuries

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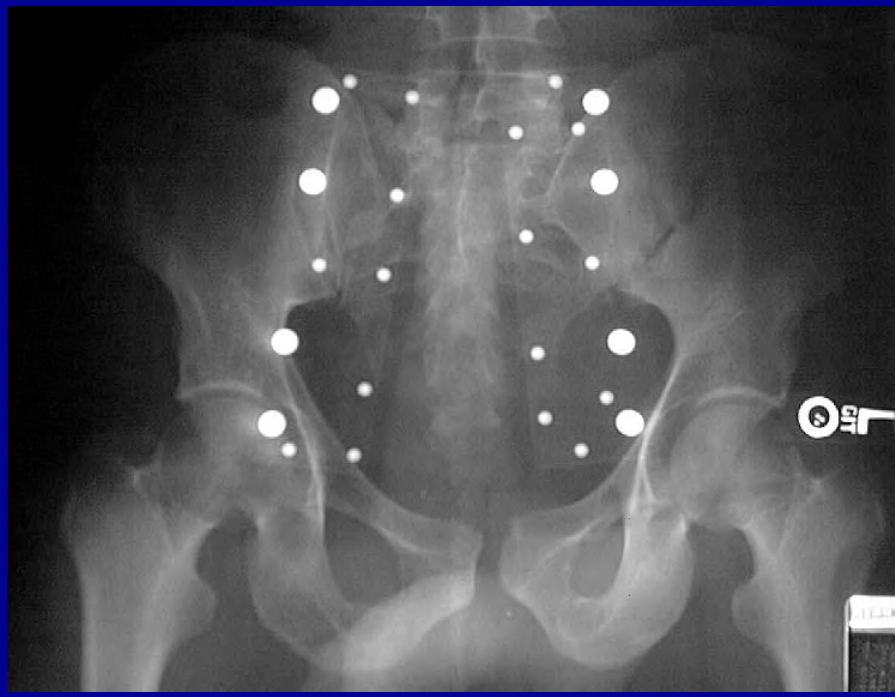
Sheet / Binder

- Apply at Greater Trochanter Level
- Allows Access to Abdomen
- Temporary
  - Access Issues
  - Soft Tissue Breakdown
- May Modify For Angio Access

Pelvic Binder



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INTERVENTIONAL ANGIOGRAPHY

- Much hemorrhage is venous
- Timeliness & availability of intervention
- May be useful adjunct to other methods
- Angiography suite often not optimal for patient resuscitation
- Institution dependent

Angiography

- Allows eval of other organ systems
- Embolization
  - Selective gelfoam
  - Multiple Embolization
  - Proximal Occlusion

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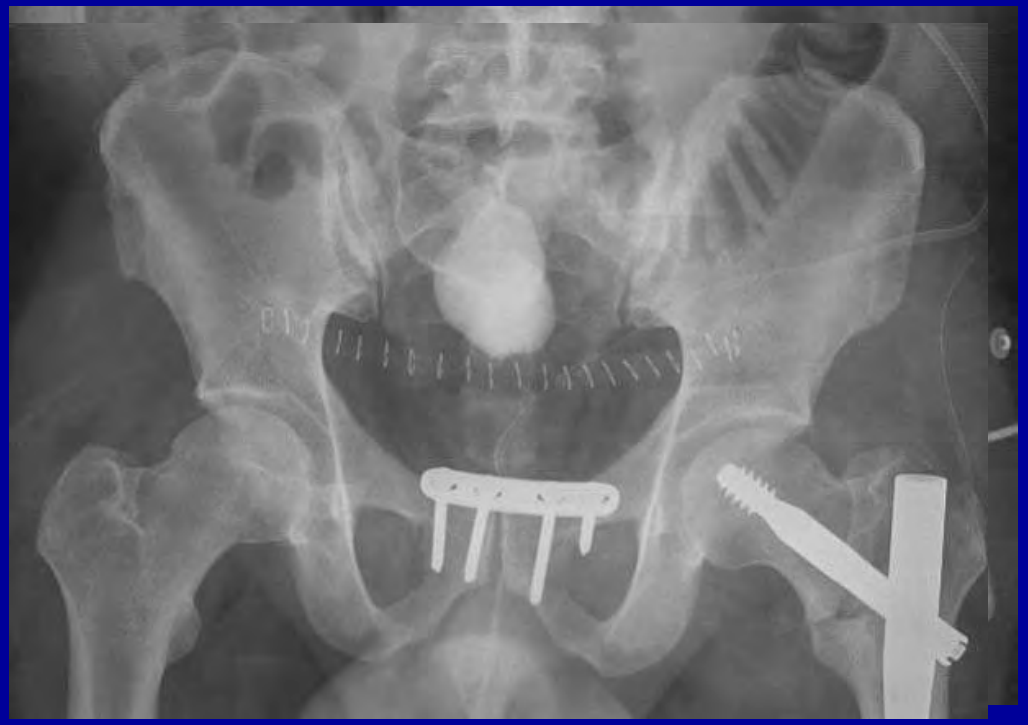
Immediate Symphyseal ORIF

- APC, CMI
- Laparotomy
- Pfannensteil
- Avoid Lengthy Surgery



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Definitive Treatment Summary

- Rotational and vertically stable injuries – Protected weightbearing
- Rotationally unstable but vertically stable injuries – Protected weightbearing with or without anterior stabilization
- Rotationally and vertically unstable injuries – Posterior stabilization with or without anterior stabilization

Treatment

- LC1 – Protected weightbearing 6 weeks
- LC2 – ORIF posterior fracture/dislocation +/- anterior stabilization
- LC3 – Bilateral posterior stabilization with anterior stabilization

Treatment

- AP1 – Protected weightbearing
- AP2 – Controversial – standard treatment is anterior stabilization, but may not be necessary
- AP3 – Posterior stabilization +/- anterior stabilization

Treatment

- Vertical shear – Posterior stabilization, usually with anterior stabilization
- CMI - Treatment directed towards individual injury components

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Posterior Fixation

- Open vs. closed reduction
- Percutaneous SI screws
- Anterior SI joint plating
- Sacral bars
- Posterior sacral plating

Thank You

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