

# **Pelvic Ring Injuries**

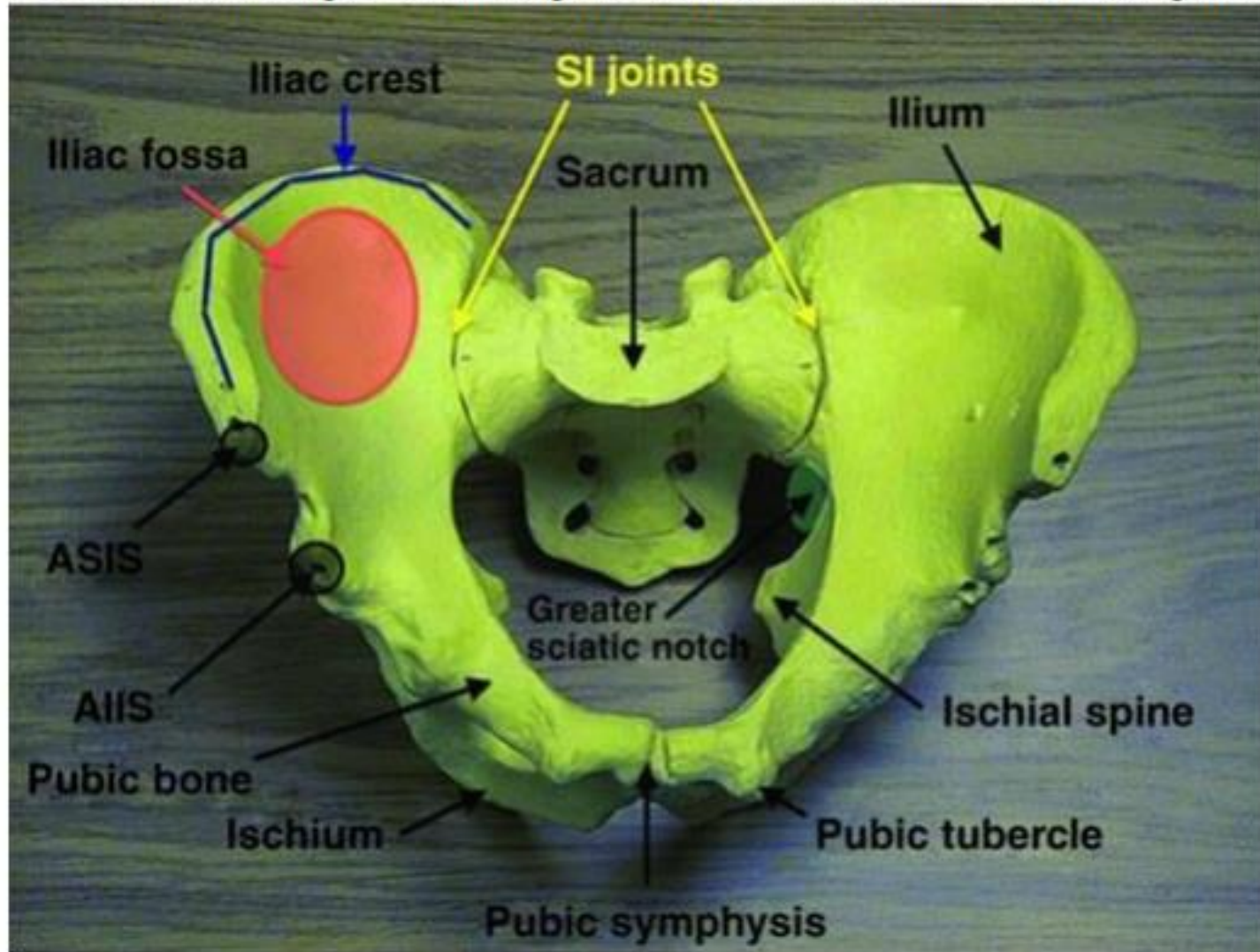
## **Animesh Agarwal**

# *Introduction to Pelvic Ring Injuries*

- The pelvis is divided into anterior and posterior parts,
- a single break in the ring does not lead to instability,
- for unstable injuries there are always injuries to at least two areas of the pelvis

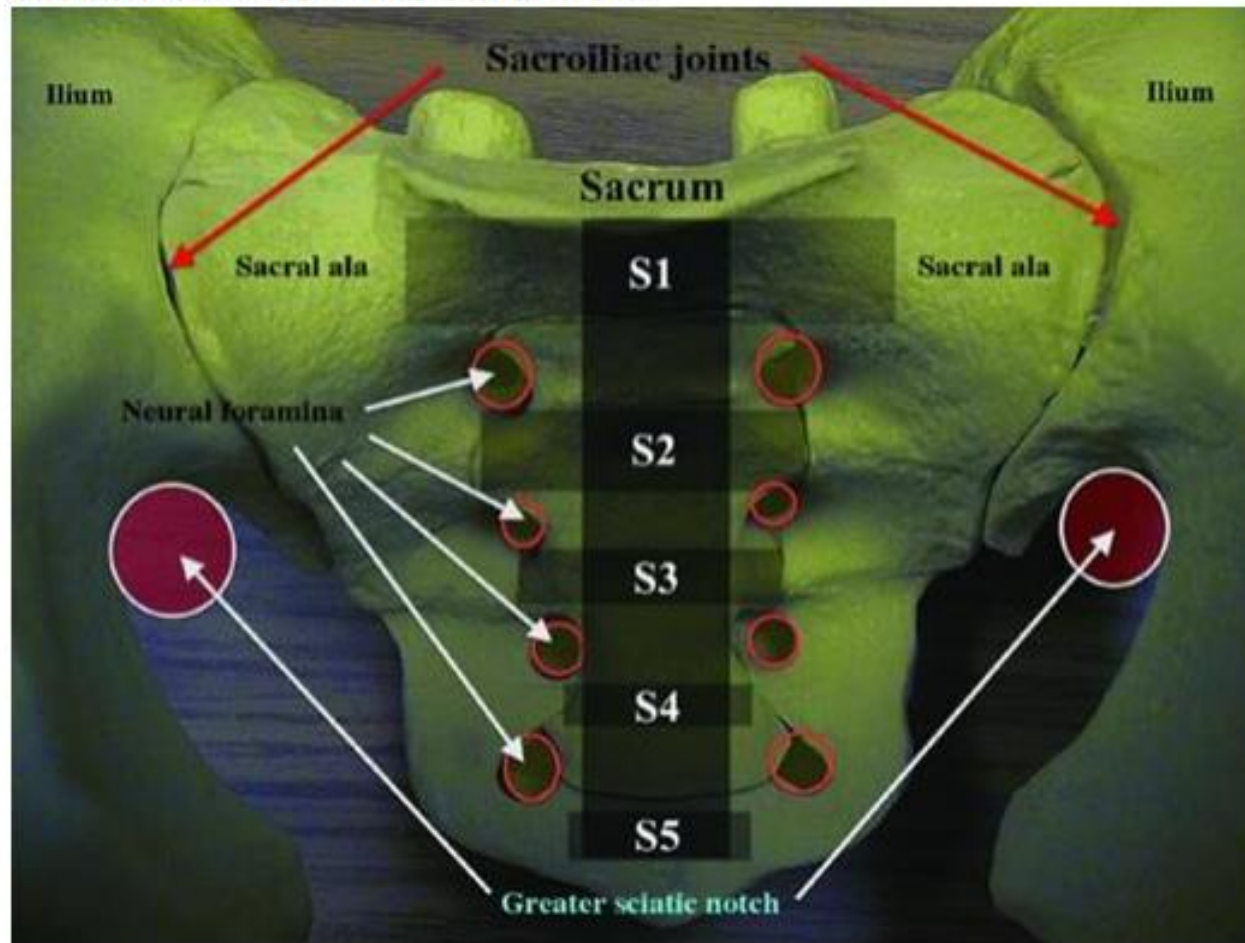
**Figure 49-23 Bony model of pelvis with indicated landmarks.**

ASIS, anterior superior iliac spine; AIIS, anterior inferior iliac spine; SI, sacroiliac.

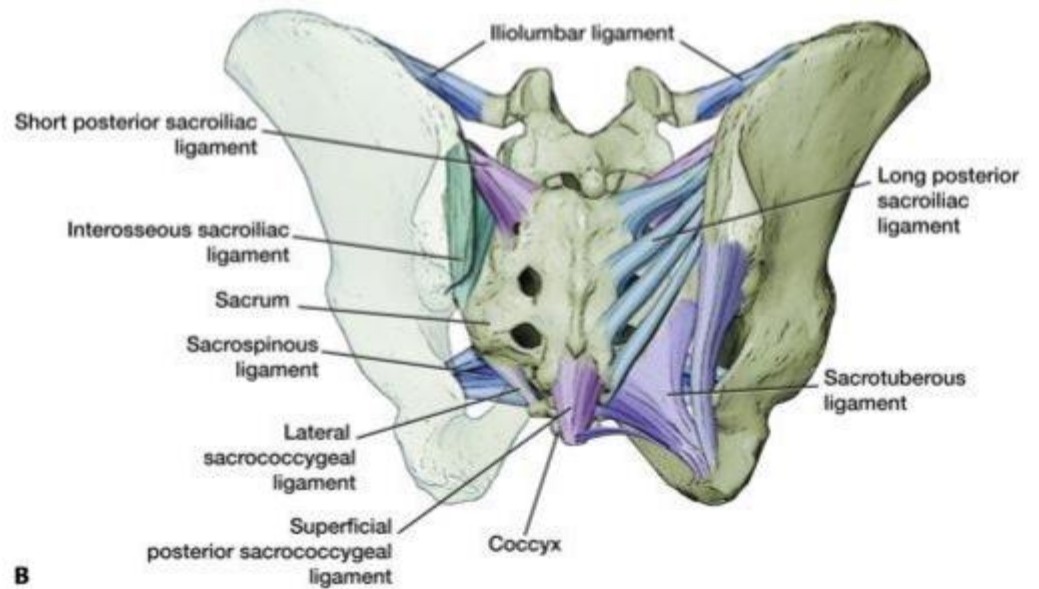
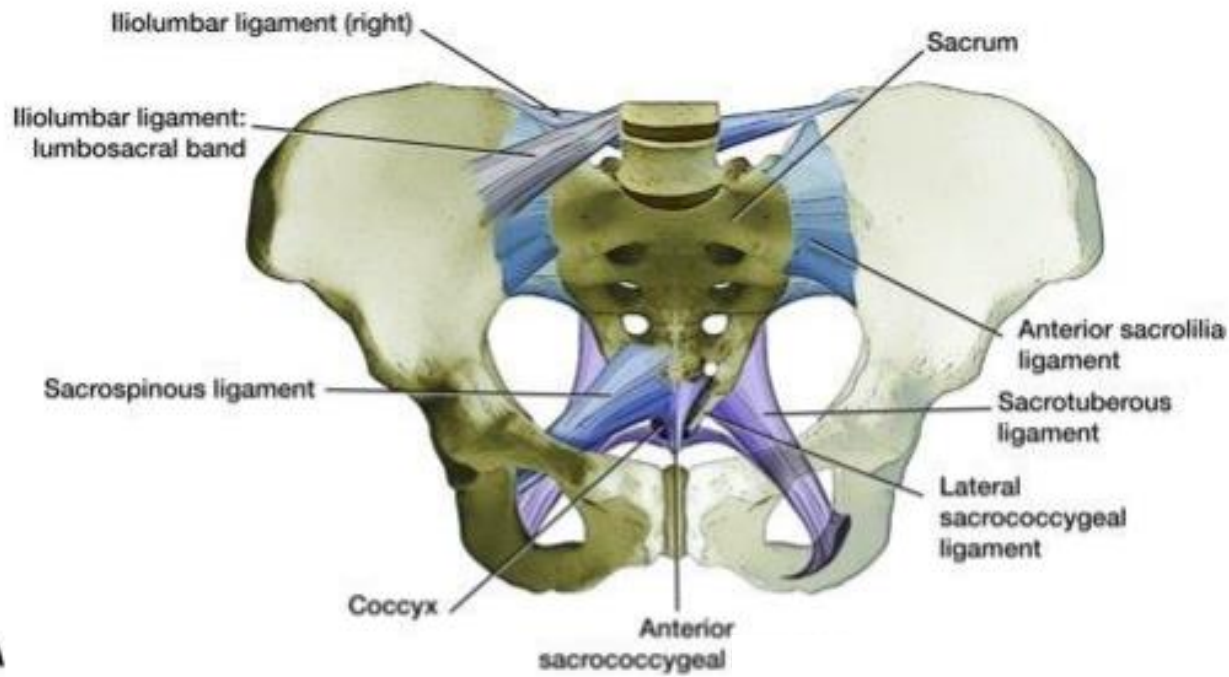


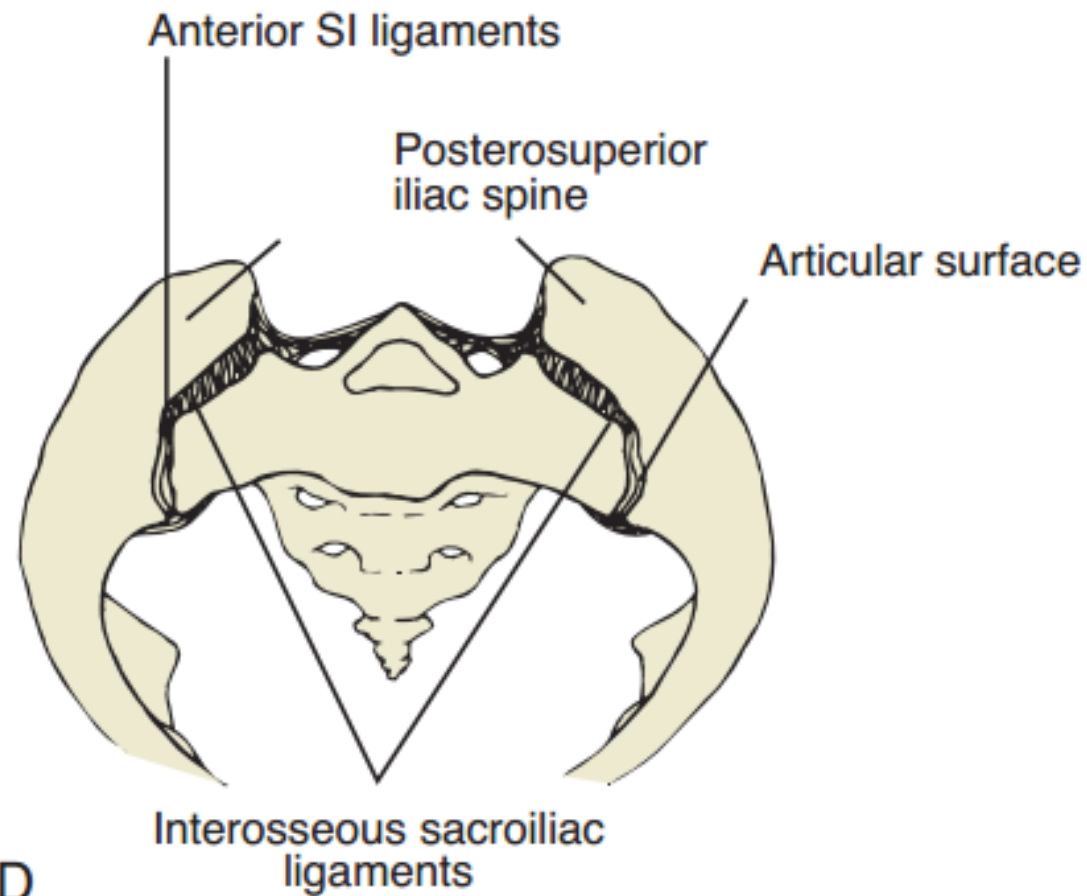
**Figure 49-24 Magnified view of bony model of the sacrum viewed in the outlet position.**

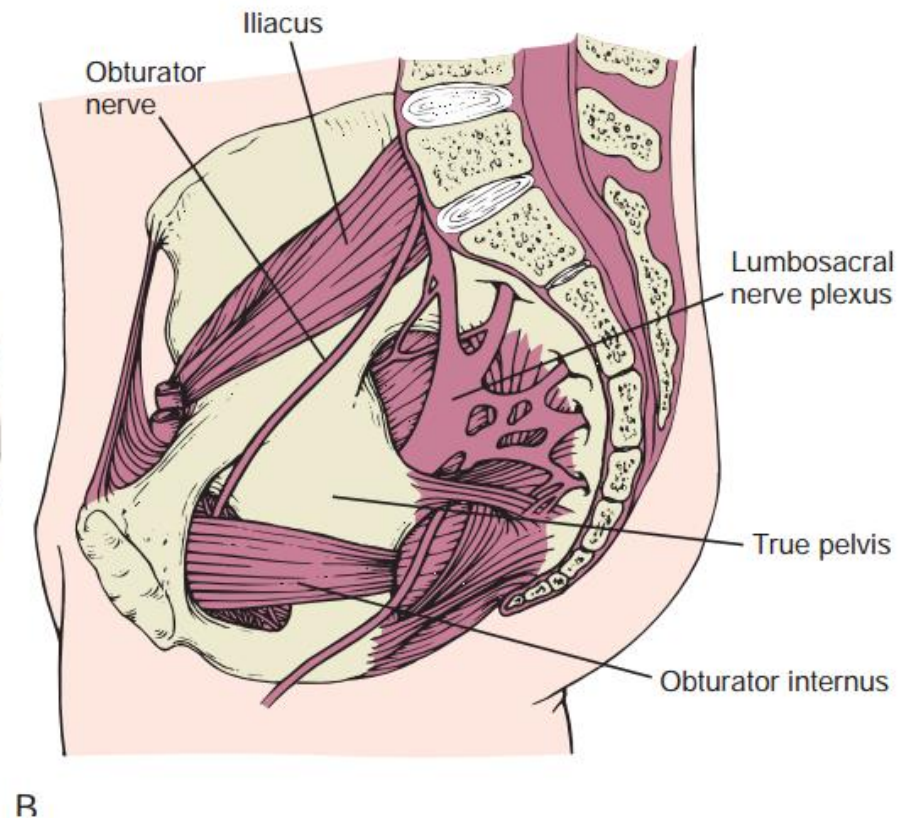
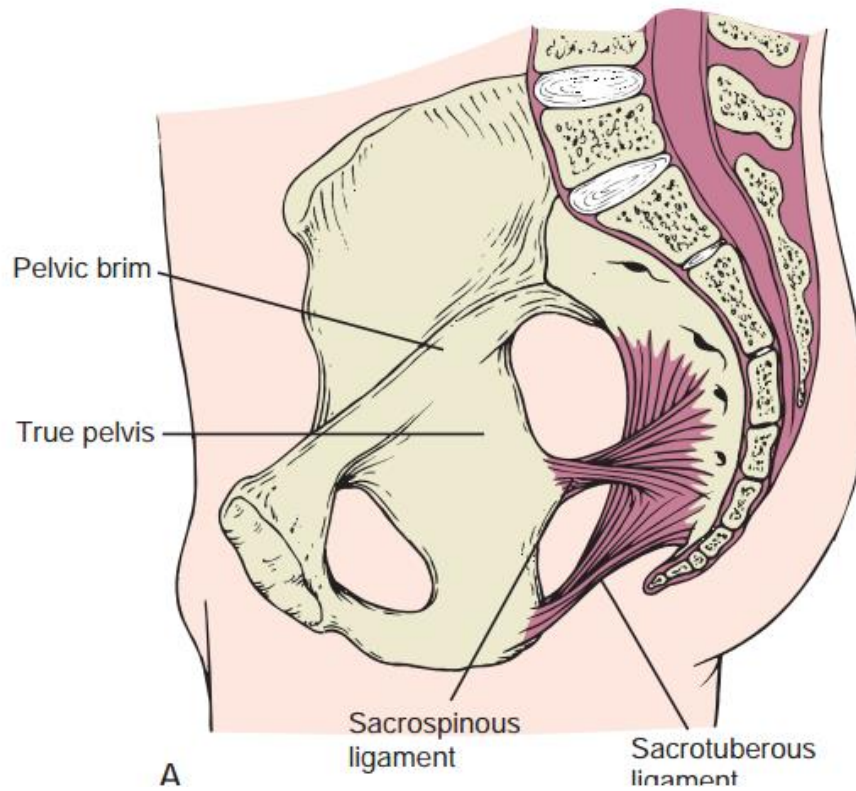
The fusion of five sacral bodies is demonstrated by the *black bars*. Foramen is seen on the end as visualized in the outlet view.



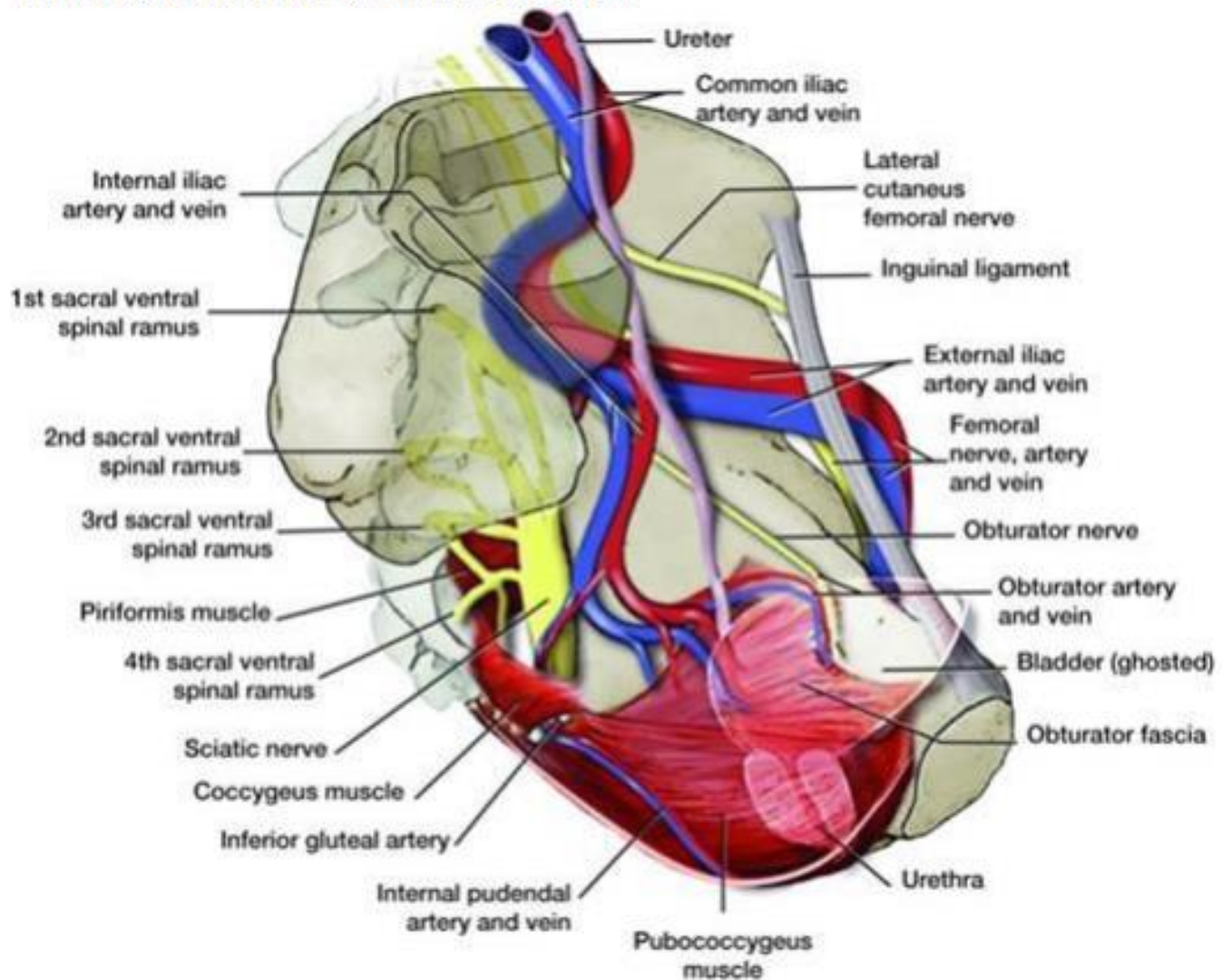






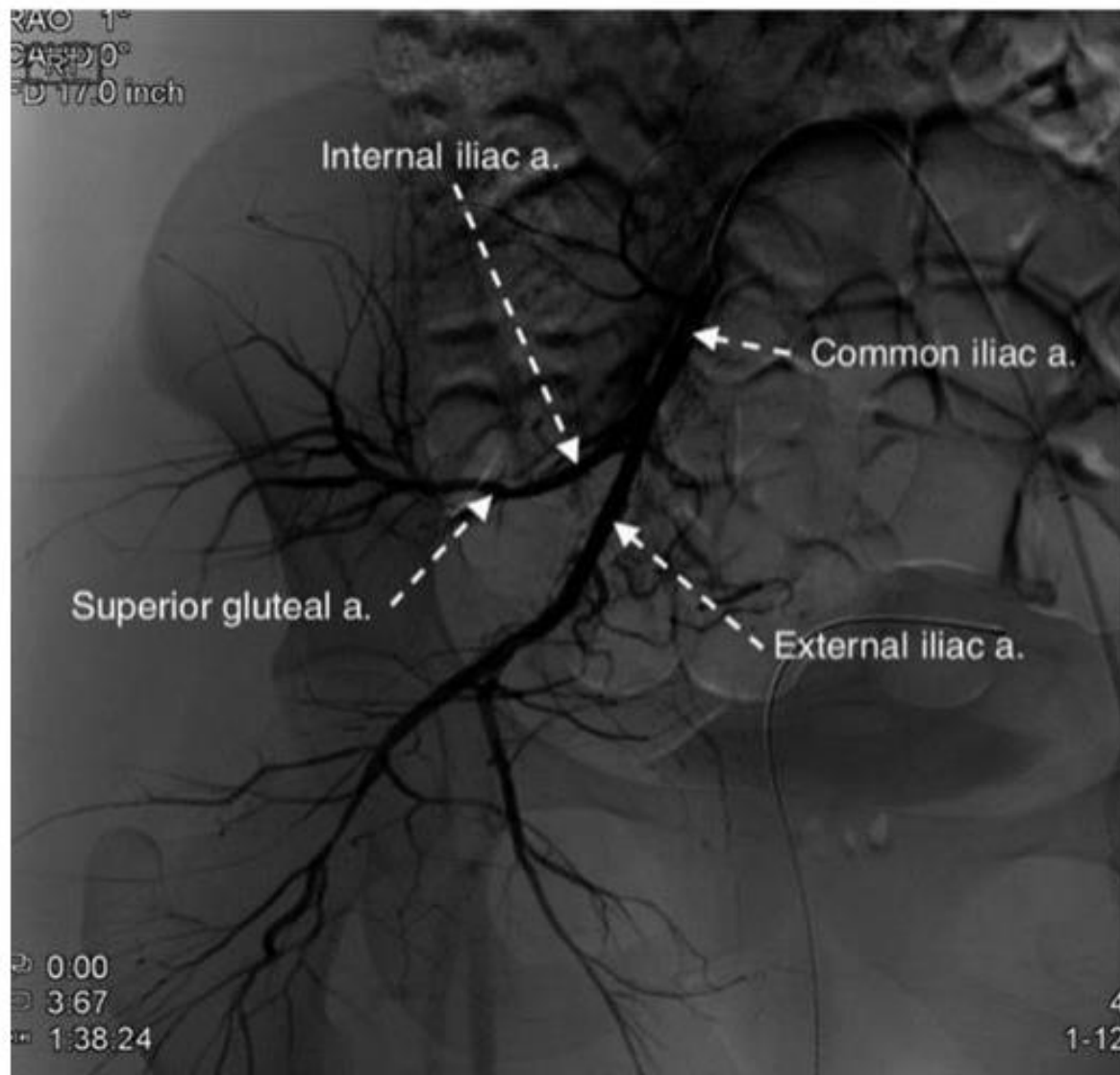


nerve root anterior on the sacral ala.





RAO 1°  
CA 10°  
FD 17.0 inch



# *Mechanism of Injury for Pelvic Ring Injuries*

- APC, LC, VS, and CM
- The overall mortality
  - APC injuries : 20%,
  - LC injuries : 7%

# *Injuries Associated with Pelvic Ring Injuries*

- chest injuries (63%),
- long bone fractures (50%),
- head injury (40%),
- solid organ injury (40%),
- spinal fracture (25%).
- Intestinal injuries 14%

# *Genitourinary Tract Injuries*

- EPBR
- IPBR
- gross hematuria/more than 30 to 50 red blood cells
- a dynamic retrograde urethrogram (RUG)  
urethra: 25 mL of water-soluble contrast  
bladder: 300-400
- (AP) view of the pelvis or a 30- to 45-degree oblique view is obtained under fluoroscopy



**Figure 49-1** Normal retrograde urethrogram and the appearance of intact bladder.



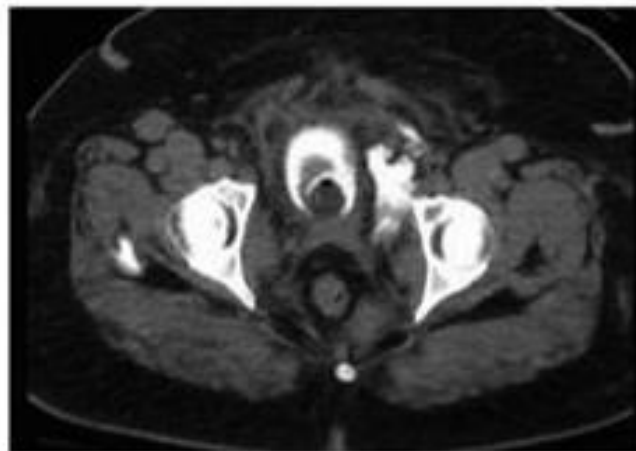
**Figure 49-2** Proximal urethral disruption seen by contrast extravasation over the perineum; bladder is intact.



ct



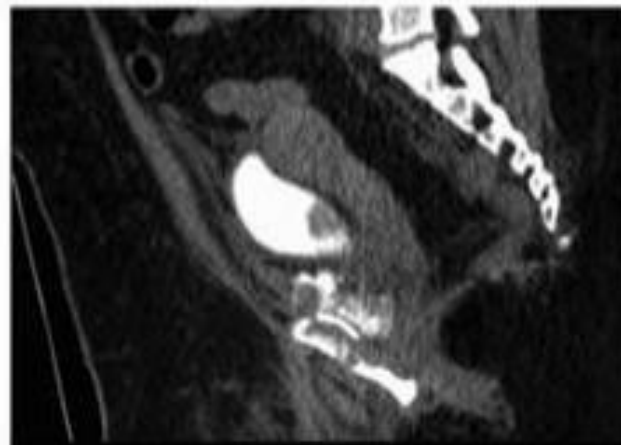
A



B



C



D

**Figure 49-4** Patient with pelvic ring injury and associated bladder disruption. Suprapubic catheter has been placed in a poor position, directly in the way of the Pfannenstiel incision (*dashed line*).



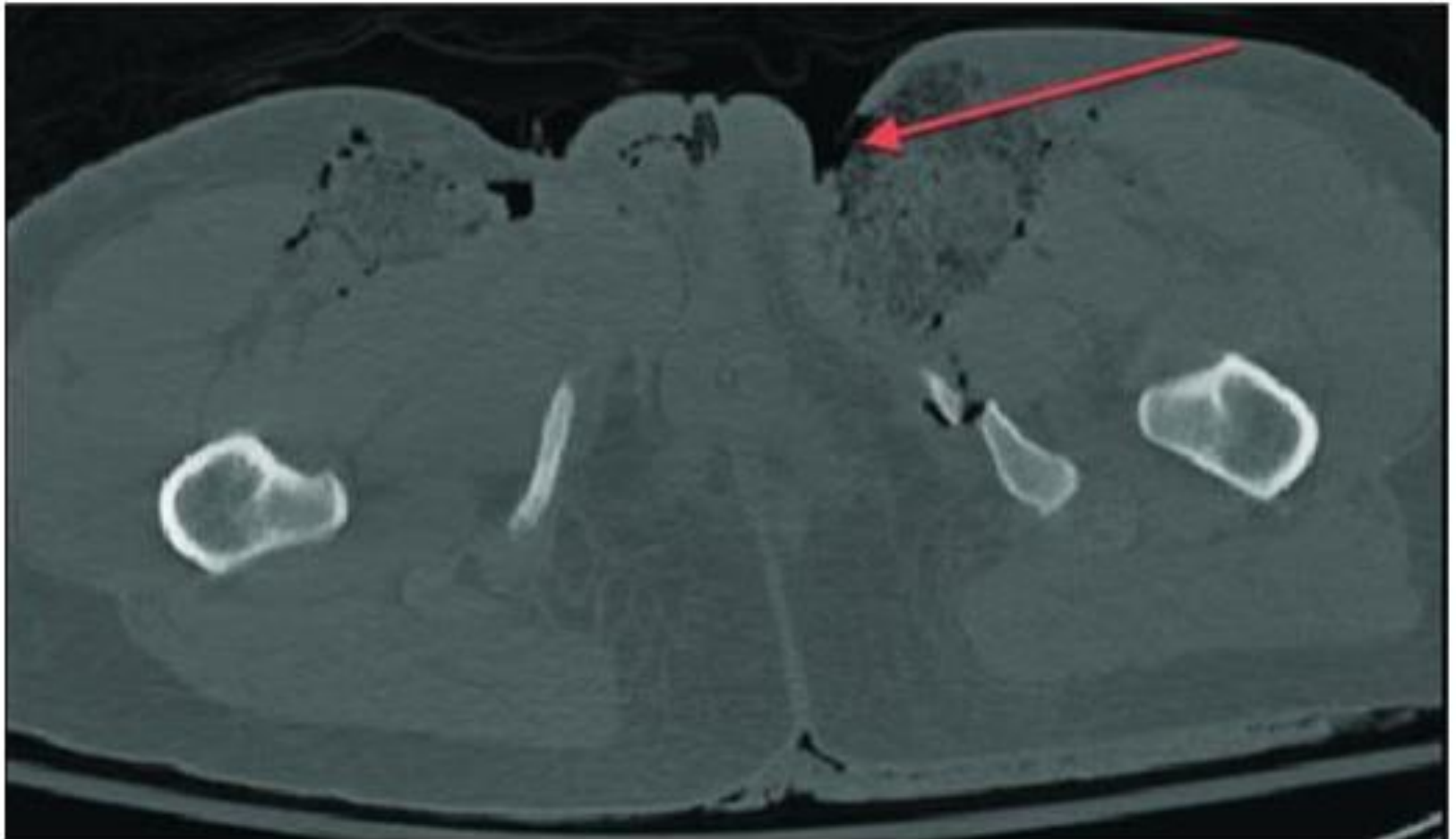


# *Open Pelvic Ring Injuries and Gastrointestinal Injuries*

- 5%
- Complications> osteomyelitis, deep pelvic infection, long-term disability, and mortality.
- **classification**
- Class : pelvic ring is stable.
- class 2: the pelvic ring is rotationally or vertically unstable
- class 3 class2 +, rectal or perineal wound
- Many of these class 3patients developed sepsi

Figure 49-5 CT scan showing paralabial open wound (arrow).

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# *Physical Examination*

**TABLE 49-1**

**Pelvic Ring Injuries: Possible Clinical Findings**

- - Open wounds of the groin, buttock, or perineum
  - Blood at the urethral meatus
  - Blood in or around the rectum
  - Pelvic, flank or perineal contusions, ecchymoses, or abrasions
  - Blood out of the vagina (rule out laceration vs. menses)
  - Neurologic deficit involving the lumbosacral plexus
  - Leg length inequality
  - High-riding prostate (urethral injury)
  - Abnormal pelvic motion on anteroposterior or lateral compression of the anterior iliac spines and iliac crests
  - External or internal rotation deformity of the hemipelvis
  - Scrotal edema
  - Pain on palpation of posterior pelvis

## TABLE 49-2

### Lower-Extremity Motor Testing

L1–2: Hip flexors

L3–4: Quadriceps/knee extension

L4–5: Ankle and toe dorsiflexion

L5: Ankle abduction

S1: Ankle plantarflexion

S2–3: Toe plantarflexion



# *Imaging and Other Diagnostic Studies*

- An anteroposterior view of the pelvis should be obtained
- immediate CT scan as the initial diagnostic examination
- Ghost" images—images (AP, inlet, and outlet) reconstructed from CT scan

A



AP View  
37  
R/L

R



10.00 mm

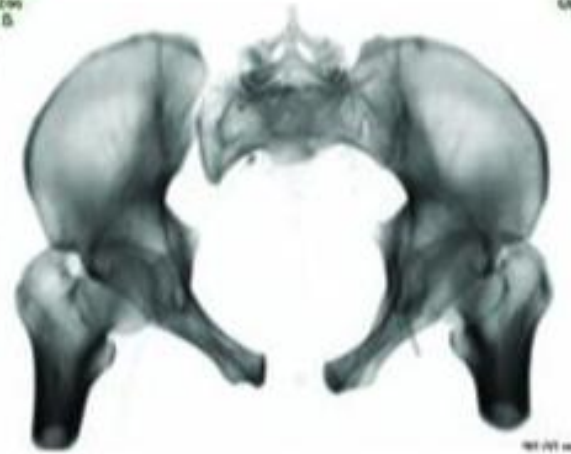
B

C



AP View  
37  
R/L

R



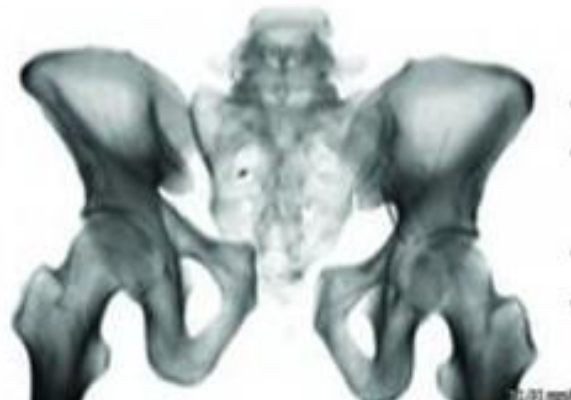
10.00 mm

D



R/L

R

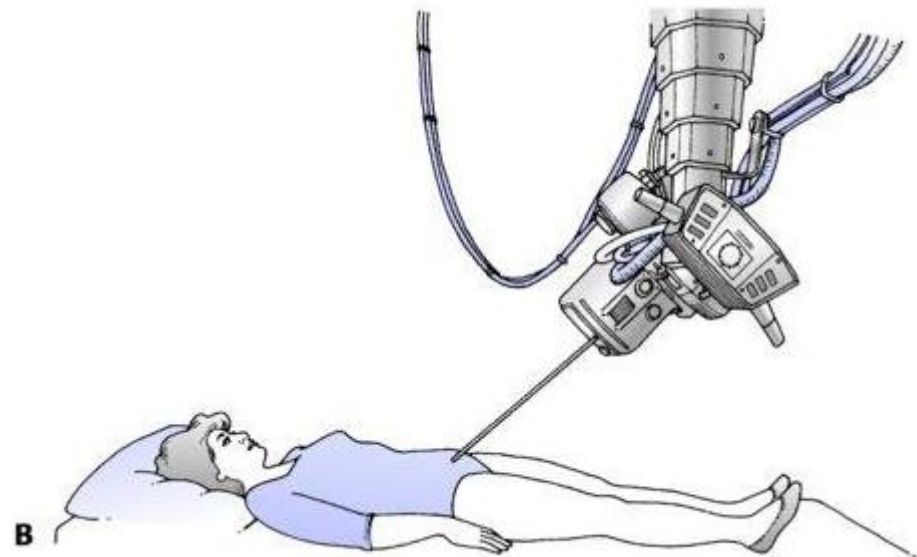
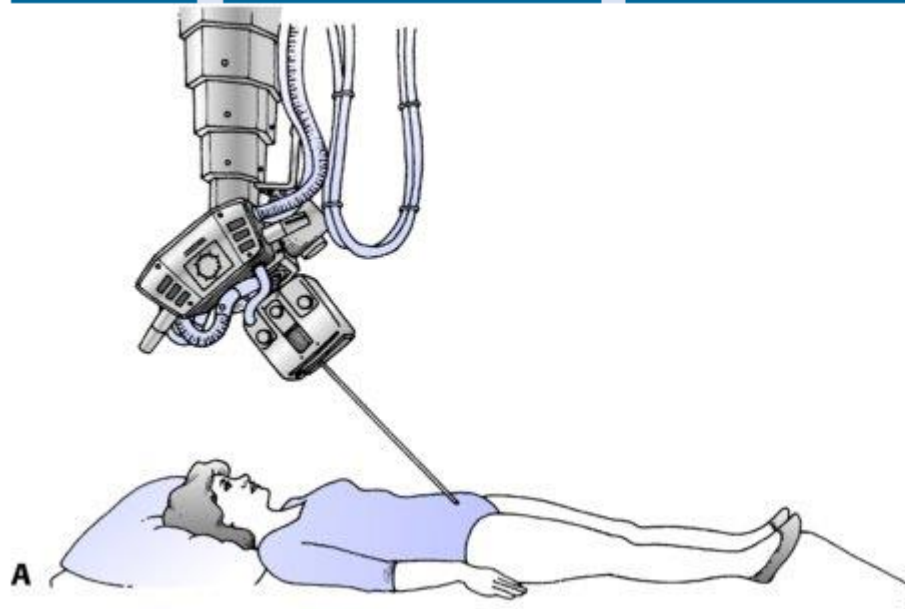


10.00 mm

# dysmorphic sacrum

- The upper sacrum being collinear with the iliac crest
- Presence of mammillary processes in the alar region
- Uppermost sacral foramen are larger, misshapen, and irregular
- Residual disc space between the dysmorphic upper and second sacral segments
- An anterior cortical indentation is present in the dysmorphic sacral ala

**Figure 49-8** Schematic representing the direction of the incident x-ray beam for inlet projection (A) and outlet projection (B) of the pelvic ring.





## ***Tile Classification of Pelvic Ring Injuries***

- Type A: Pelvic ring stable
  - A1: Fractures not involving the ring (i.e., avulsions, iliac wing, or crest fractures)
  - A2: Stable minimally displaced fractures of the pelvic ring
- Type B: Pelvic ring rotationally unstable, vertically stable
  - B1: Open book
  - B2: LC, ipsilateral
  - B3: LC, contralateral, or bucket-handle-type injury
- Type C: Pelvic ring rotationally and vertically unstable
  - C1: Unilateral
  - C2: Bilateral
  - C3: Associated with acetabular fracture

## ***Young and Burgess Classification of Pelvic Ring Injuries***

- LC: Anterior injury = rami fractures
  - LC I: Sacral fracture on side of impact
  - LC II: Crescent fracture on side of impact
  - LC III: Type 1 or 2 injury on side of impact with contralateral open-book injury
- APC: Anterior injury = symphysis diastasis/rami fractures
  - APC I: Minor opening of symphysis and SI joint anteriorly
  - APC II: Opening of anterior SI, intact posterior SI ligaments (PSILs)
  - APC III: Complete disruption of SI joint
- VS type: Vertical displacement of hemipelvis with symphysis diastasis or rami fractures anteriorly, iliac wing, sacral fracture, or SI dislocation posteriorly
- CM type: Any combination of the above injuries

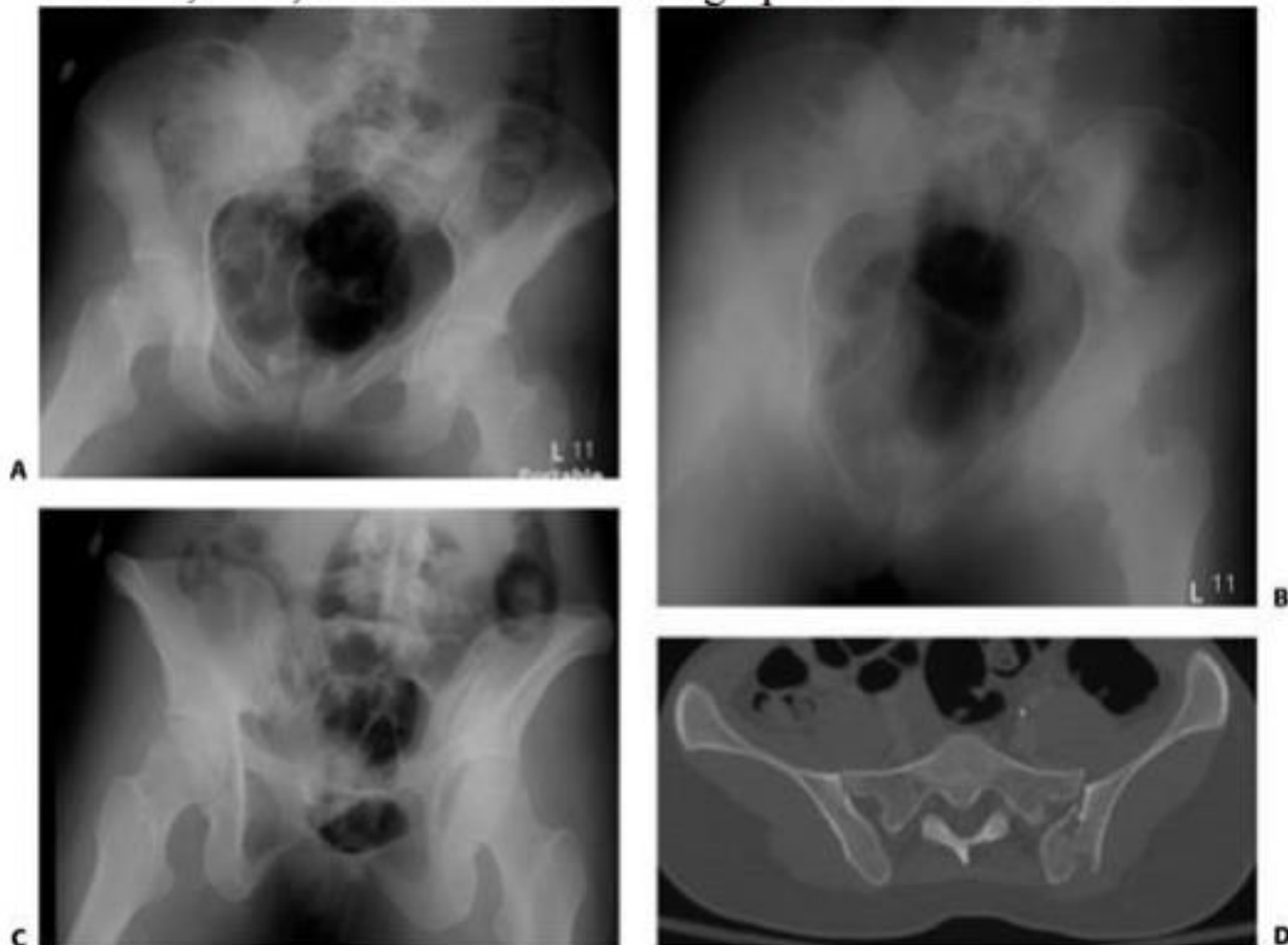
**Figure 49-12 Patient with LC I injury in Figure 49-11.**

**A:** AP radiograph showing posterior lesion (*red oval*) and anterior lesions (rami fractures;*arrows*). **B:** CT scan axial cut showing impaction fracture of sacrum (*arrow*). **C–E:** 3D reconstructions of AP, inlet, and outlet views showing injury.



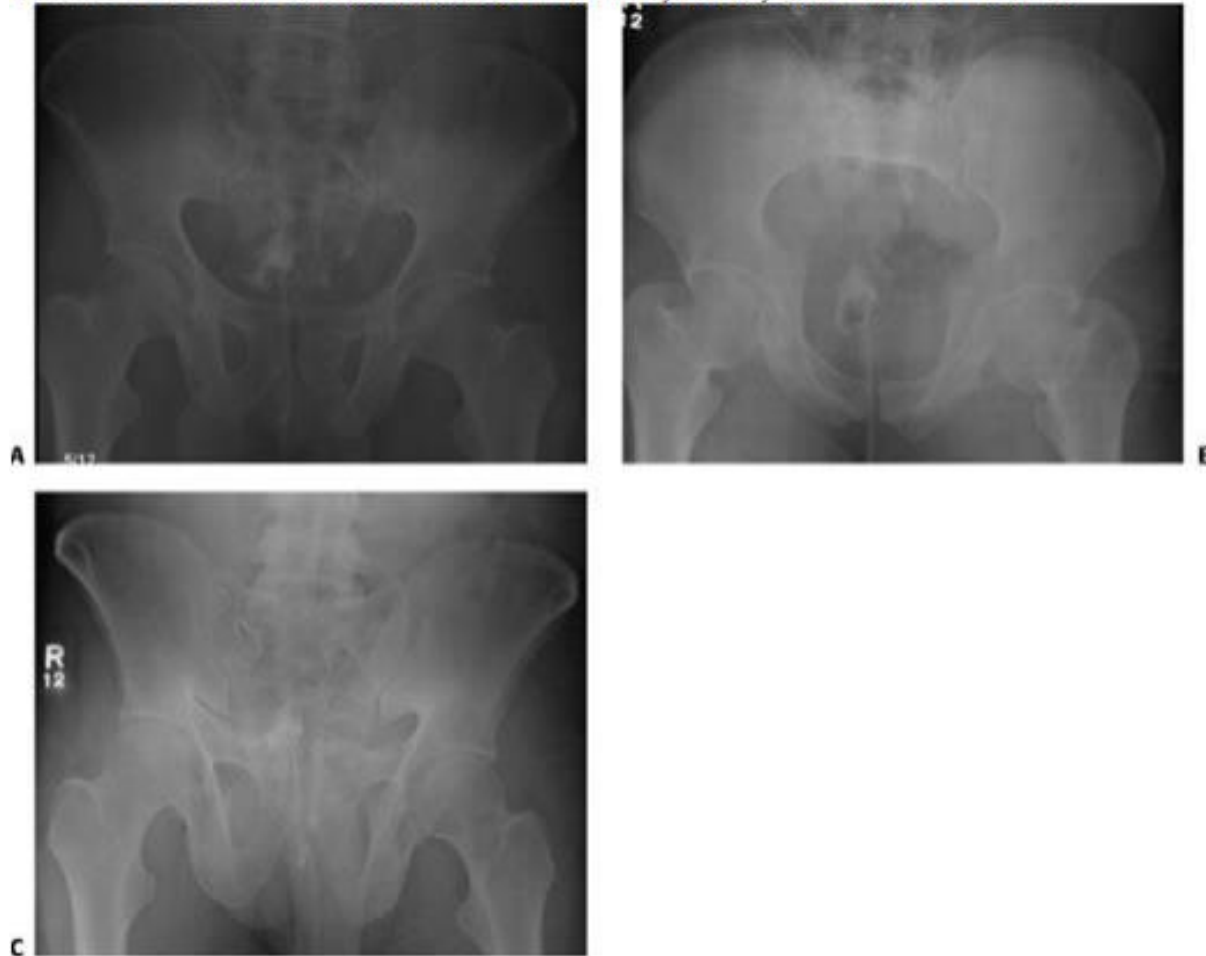
**Figure 49-13** Patient with LC II showing fracture–dislocation (crescent fracture) through left SI joint.

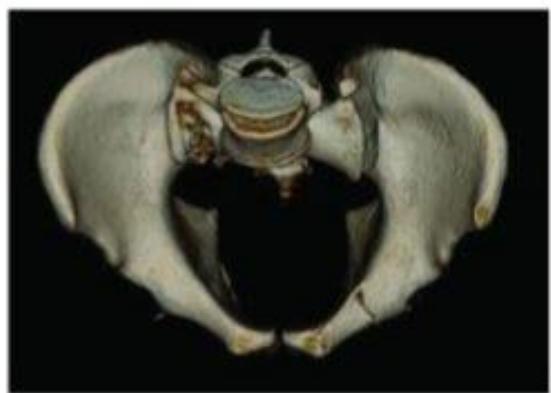
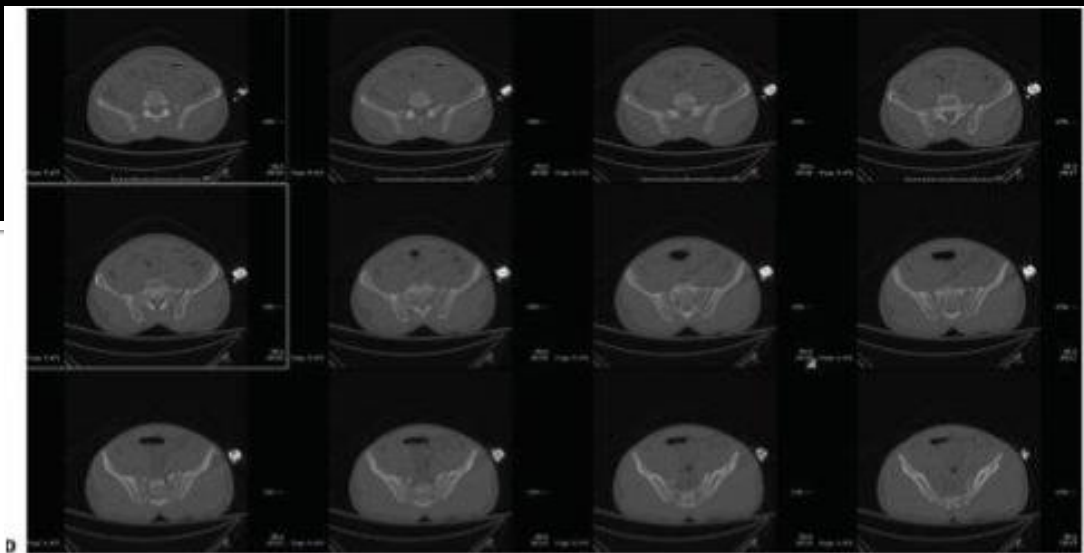
**A–C:** AP, inlet, and outlet view radiographs. **D:** Axial CT scan.



**Figure 49-14** Patient with LC III fracture with right-sided LC injury and left-sided APC injury.

**A–C:** AP, inlet, and outlet view radiographs. **D:** Multiple CT scan images showing right-sided LC injury with sacral fracture and left-sided APC injury with SI joint widening. **E–G:** 3D CT scan reconstructions of AP, inlet, and outlet views.







**Figure 49-15 Patient with APC I injury.**

**A:** AP radiograph showing widened symphysis. **B, C:** CT scan axial and coronal cuts showing measurement of  $<2.5$  cm at symphysis. **D–F:** 3D reconstructions of AP, inlet, and outlet views. Note the left ramus fracture with external rotation displacement.



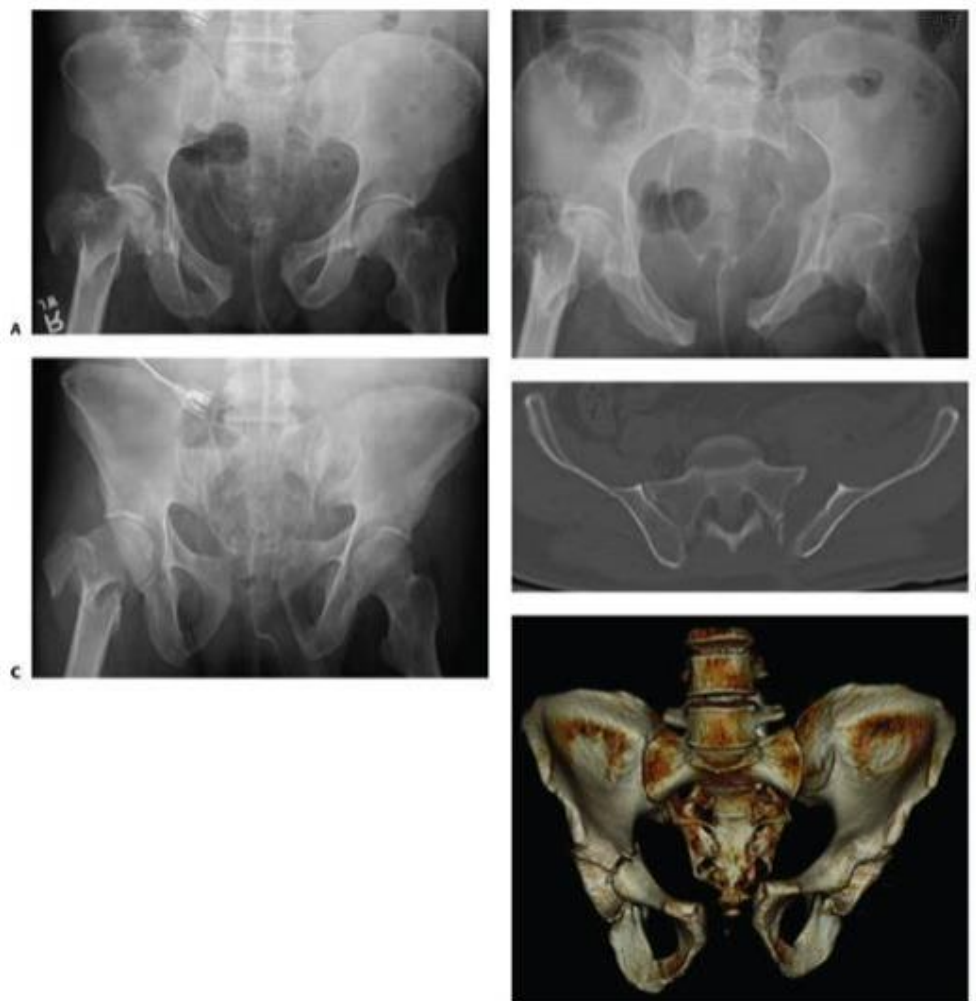
**Figure 49-16 Patient with APC II injury.**

**A–C:** AP, inlet, and outlet view radiographs. **D:** CT scan posterior axial cut showing widening of right SI joint. **E:** CT scan anterior axial cut showing more than 5.7 cm of widening. **F:** A 3D reconstruction of AP view.



**Figure 49-17 Patient with APC III injury.**

**A–C:** AP, inlet, and outlet view radiographs. **D:** CT scan showing complete left SI joint dislocation. **E:** A 3D CT reconstruction of the AP view.



**Figure 49-18 Patient with vertical shear injury.**

**A–C:** AP, inlet, and outlet view radiographs showing vertical displacement of right hemipelvis through a complete sacral fracture and transverse process fracture avulsion (arrow). **D, E:** Axial and coronal CT scans. **F, G:** 3D CT scan reconstructions of inlet and outlet views.





**Figure 49-19 Patient with CM pelvic ring injury.**

**A–C:** AP, inlet, and outlet view radiographs showing multiple patterns of APC, VS, and LC injuries. **D:** CT scan axial cut showing posterior injuries. **E–G:** 3D CT scan reconstructions of AP, inlet, and outlet views showing the multiple patterns of injury.



# *Fragility Fractures of the Pelvic Ring*

- type I involves the anterior ring only The FFP
- type II has a nondisplaced posterior injury with anterior involvement
- type III has a displaced unilateral posterior injury
- type IV has bilateral posterior involvement



## ***Classification of Sacral Fractures***

### ***Denis Classification***

structures usually at the S5 level and below.

**Figure 49-20** CT scan showing zone I sacral fracture (lateral to the foramen).

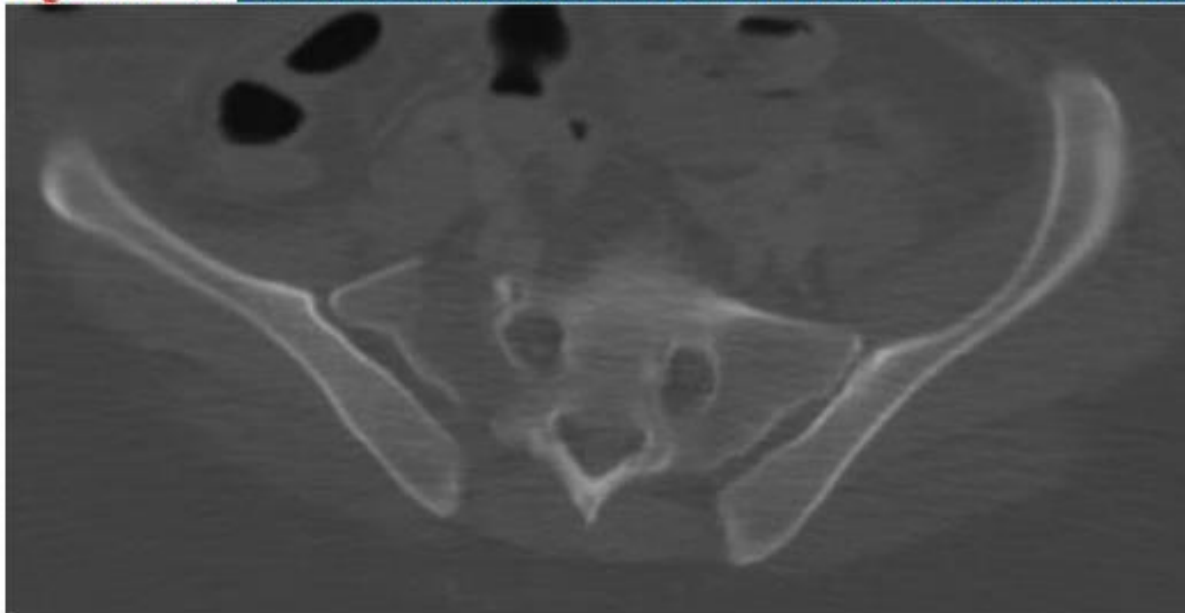
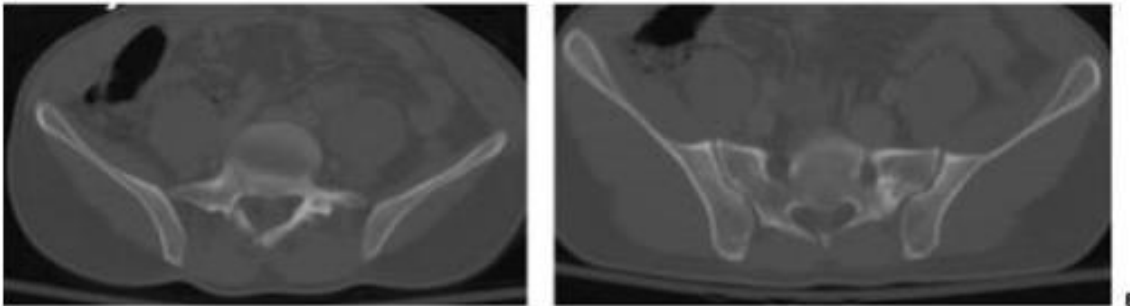


Figure 49-21 CT scan showing zone II sacral fracture—through the foramen—with fragment (*arrow*) in the S1 foramen resulting in neurologic deficit.



**Figure 49-22** CT scan cuts showing zone III sacral fracture through the S1 body (A) and lateral to foramen with extension into spinal canal (B).

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## ***Nonoperative Treatment of Pelvic Ring Injuries: Indications and Contraindications***

### **Indications**

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Stable Pelvic Ring Injury e.g., APC I, most LC I and FFP I injuries; Stable/Incomplete Sacral Fractures; Patient that is too sick to undergo surgery

### **Relative Contraindications**

Unstable Pelvic Ring Injuries e.g., APC II and APC III, LC II and LC III, VS, CM, FFP II–IV; Unstable/Complete Sacral Fractures

## ***Operative Treatment of Pelvic Ring Injuries***

### ***Indications***

#### ***Pelvic Ring and Sacral Fracture Stabilization: Indications***

##### ***Anterior Ring Stabilization***

Symphyseal dislocations demonstrating >2.5 cm of diastasis on either static or dynamic (examination under anesthetic) imaging, indicating at least rotational instability

Augmentation of posterior fixation in vertically displaced unstable pelvic ring injuries

Augmentation of posterior fixation in completely unstable pelvic ring injuries

To augment poor posterior fixation in osteopenic bone

Significantly displaced rami fractures

Locked symphysis

Straddle fractures (bilateral superior and inferior rami fractures)

Pain and inability to mobilize (relative indication)

1 aim and inability to mobilize (relative indication)

### ***Posterior Ring Stabilization***

Complete disruption of the SI joint and anterior and posterior sacroiliac ligaments, resulting in multiplanar instability

Any posterior ring injury, SI dislocation, or sacral fracture with vertical displacement or the propensity to do so

Displaced crescent fractures—displaced iliac wing fractures that enter and exit both the crest and greater sciatic notch or SI joint

Complete sacral fractures with the potential for displacement

Displaced sacral fractures

Lumbopelvic disassociation

Augmentation of anterior fixation in APC II injury

## *Sacral Fracture Stabilization*

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VS sacral fracture posteriorly and a concomitant anterior ring injury is present  
Comminuted sacral alar fractures with external rotation deformity of the hemipelvis  
Lumbopelvic disassociation injury  
LC fractures with sacral impaction and excessive internal rotation