



Pelvic fractures

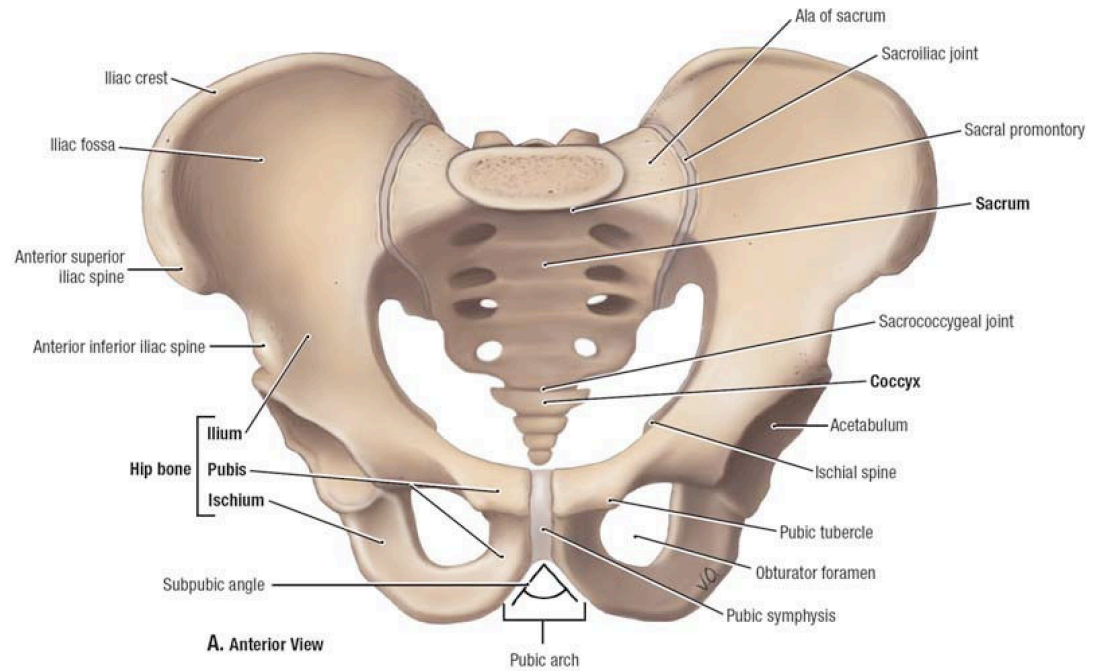
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PELVIC FRACTURES

- Pelvic fracture account for 2-8% all skeletal injuries
- Associated with
- High energy trauma
- Soft tissue injuries and blood loss.
- Shock,
- Sepsis
- ARDS
- High Mortality rates (~15-25%)

Bone anatomy

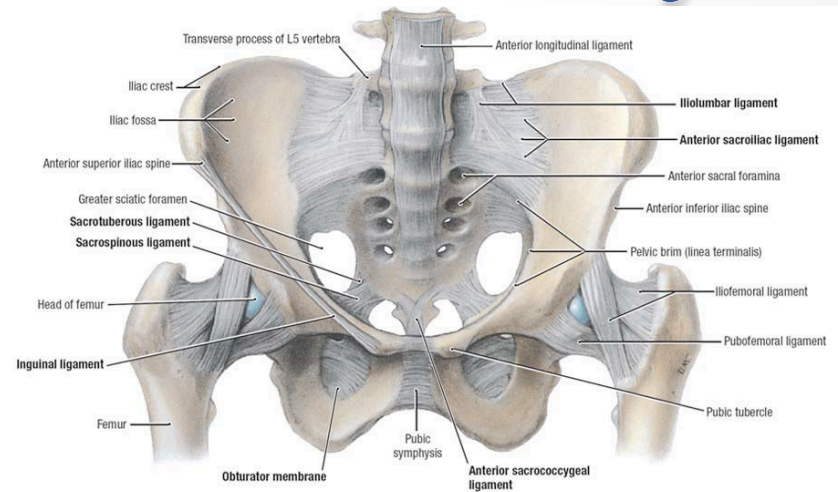
- Two innominate bones with sacrum.
- Ilium, ishium and pubis have three separate ossification centers that fuse at sixteen years.
- Gap in symphysis < 5 mm
- SI joint 2-4 mm
-



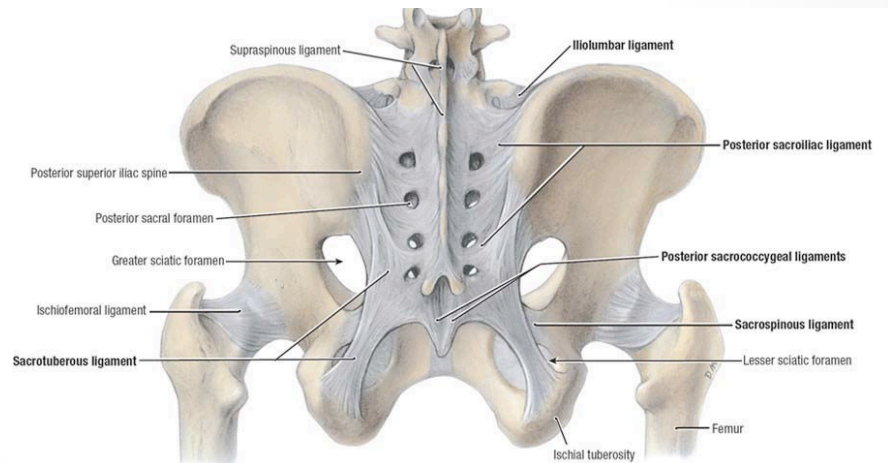
Ligamentous anatomy

- Ligaments - posterior ligaments are stronger than anterior ligaments:

- Posterior SI
- Anterior SI
- Interosseous ligaments
- Pubic symphysis
- Sacrotuberous
- Sacrospinous



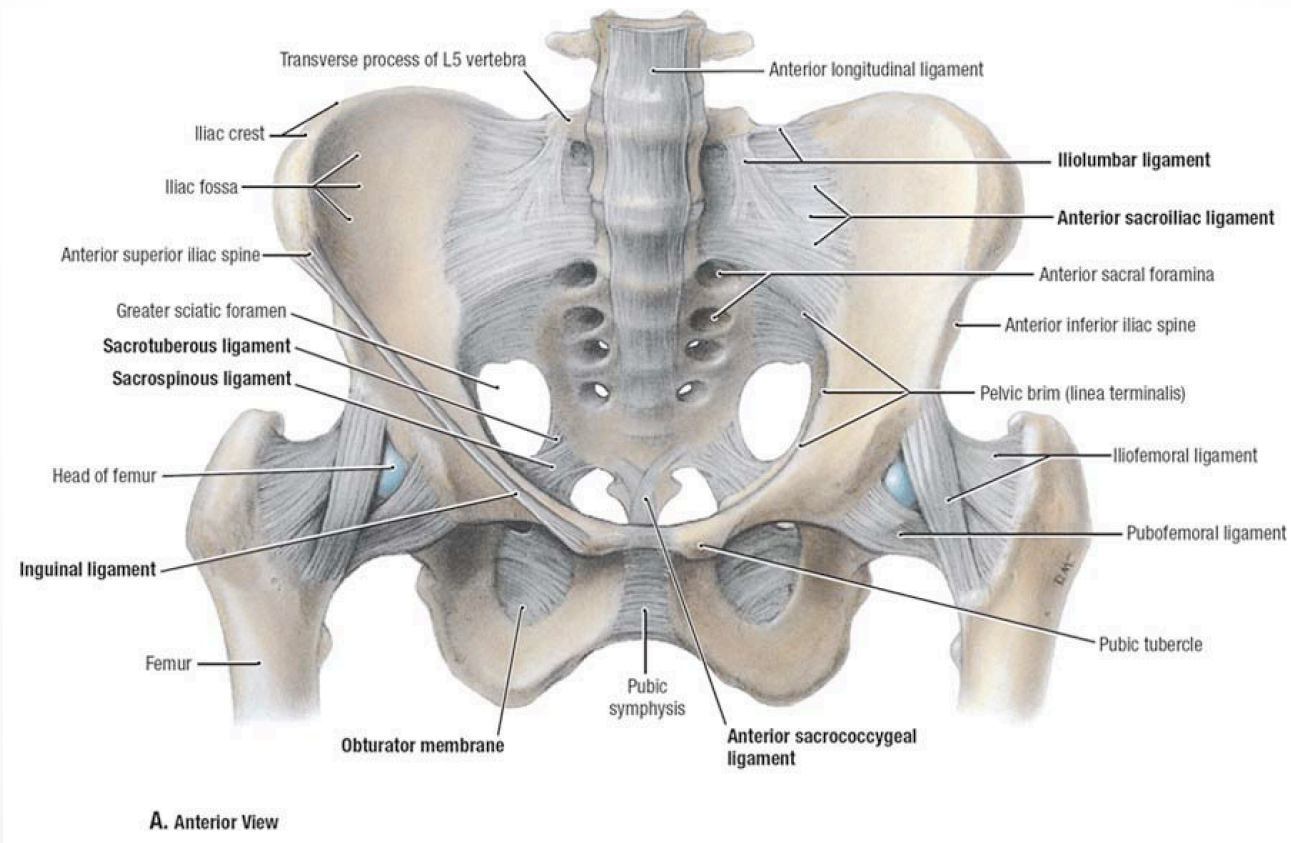
A. Anterior View



B. Posterior View

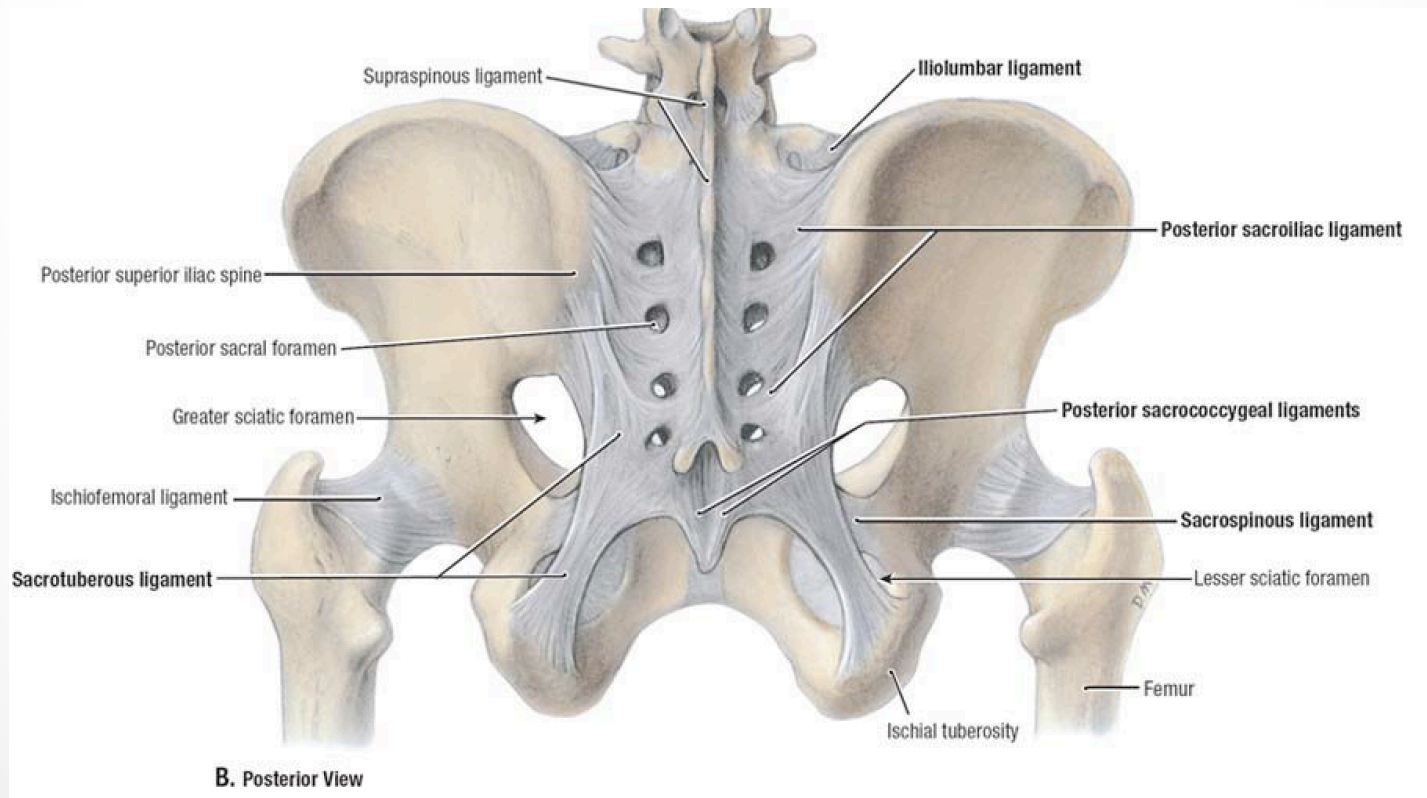
Ligamentous anatomy

- Ant. SI – resist external rotation
- Iliolumbar - augments posterior complex

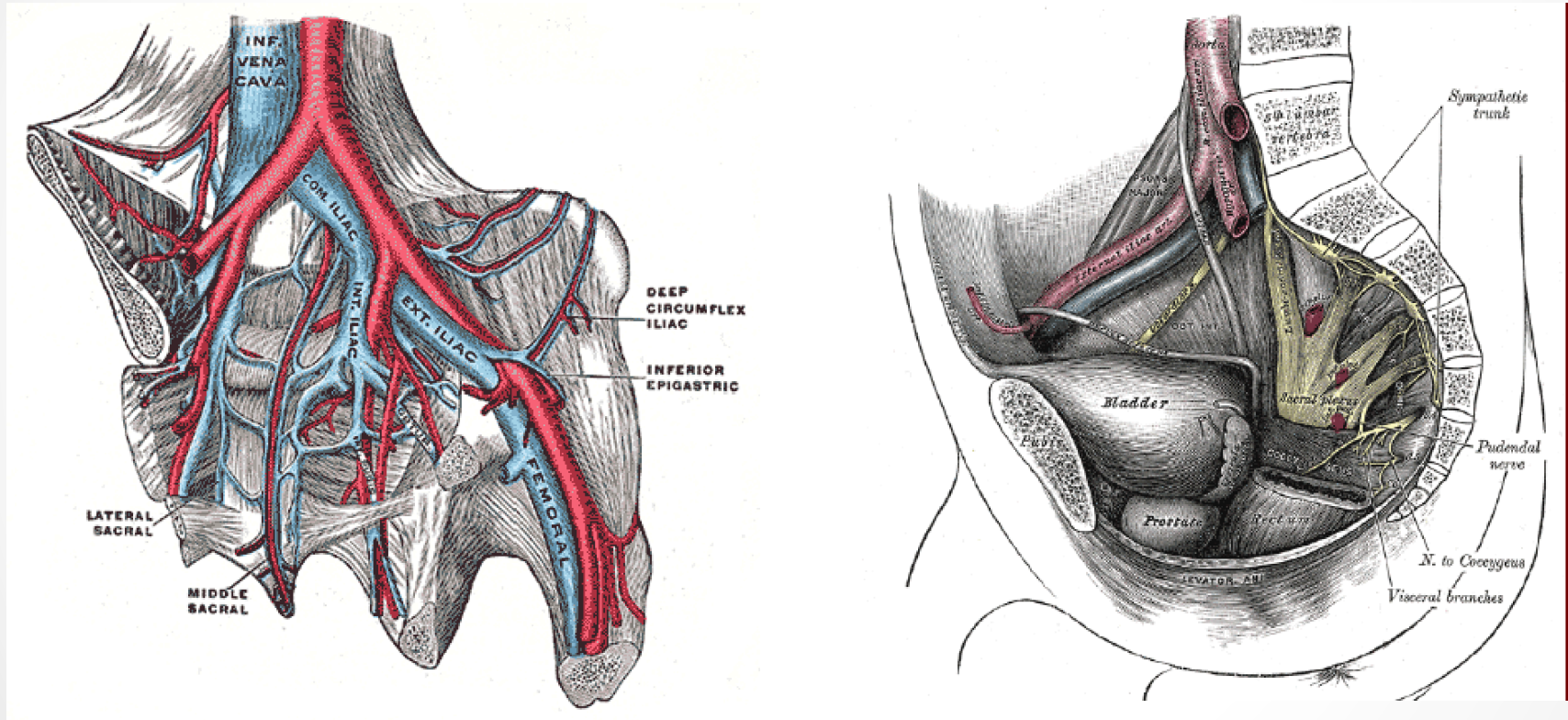


Ligamentous anatomy

- Post. SI & Interosseous-posterior stability
- Sacrotuberous - Resists shear and flexion of SI joint
- Sacrospinous -resists external rotation



Pelvic anatomy



Proximity with numerous vascular, neurological and soft tissue structures which can be injured

Pelvic Stability

- Stability – ability of pelvic ring to withstand physiologic forces without abnormal deformation

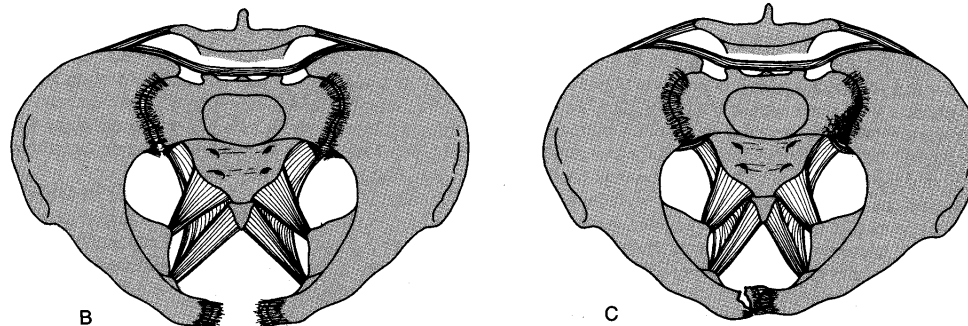
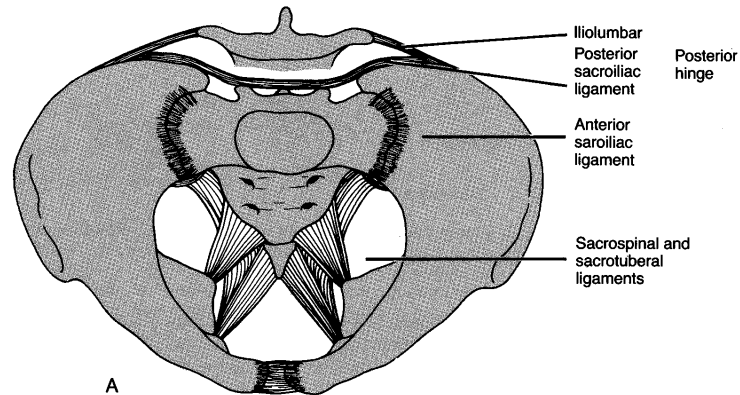


Figure 31-7

PELVIC FRACTURES

- **Types of injury:**
- Four groups
 1. Isolated fractures with an intact ring.
 2. Fracture of the acetabulum; although it is ring fracture but involvement of the joint raise a special problem.
 3. Sacrococcygeal fractures.
 4. Fractures with broken ring (stable or unstable)

Fractures of the pelvic ring

- Because of the rigidity of the pelvis, a break at one point in the ring should be associated with disruption at a second point except
 - a. Fractures due to direct blow.
 - b. Acetabular floor fractures.
 - c. Ring fractures in children.
- The second point break is usually not visible either it is reduced immediately or the sacroiliac joint is only partially disrupted.

Mechanisms of injury

The basic mechanisms of pelvic ring injury are:

1. Anteroposterior compression (APC).
2. Lateral compression (LC).
3. Vertical shear (VS).
4. Combinations of these.

Anteroposterior compression (APC)

- Usually caused by a frontal collision between pedestrian and a car. This injury may lead to:
 1. Fracture of the rami.
 2. The innominate bones are sprung apart and externally rotated with disruption of the symphysis.
 3. The anterior sacroiliac joint is partially torn.
 4. Fracture of the posterior part of the ilium.
- This is called open book injury.

Lateral compression (LC)

- Side to side compression of the pelvis causes the ring to buckle and break. This is due to a side –on impact in a road accident or a fall from a height.
- This injury may lead to
 1. Anteriorly the pubic rami on one side or both sides are fractured.
 2. Posteriorly there is severe sacroiliac strain or fracture of the sacrum or ilium, either on the same side of the pubic fracture or on the opposite side.



Vertical shear (VS)

- The innominate bone on one side is displaced vertically, fracturing the pubic rami and disrupting the sacroiliac region on the same side. This is typically occurs when falls from a height on one leg. These are severe unstable injuries with gross tearing of the soft tissues and associated with retroperitoneal hemorrhage.

Combination injuries

- In severe pelvic injuries there may be a combination of the above.

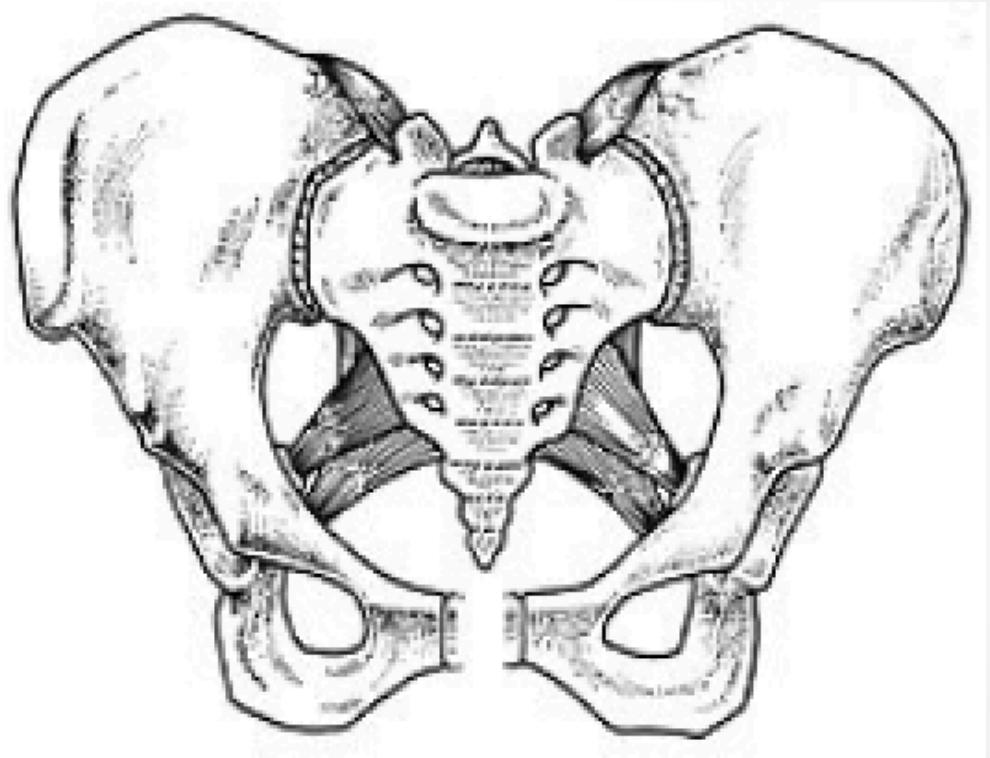
Classification

The Young-Burgess (1986; 1987) system is based on mechanism of injury:

- 1. Anterior posterior compression (APC)**
- 2. Lateral compression (LC)**
- 3. Vertical Shear (VS)**

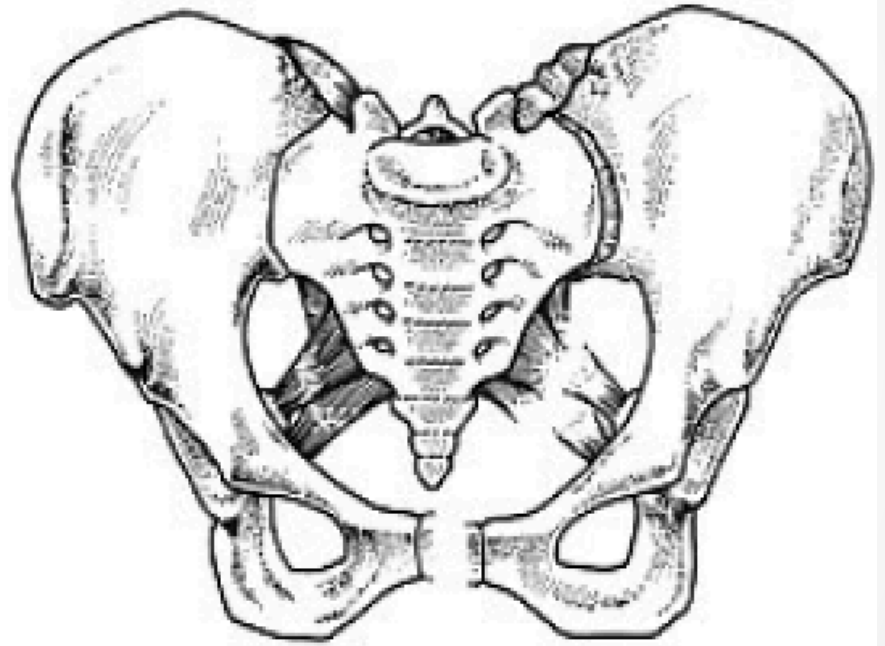
Classification

- *APC- I injuries:*
- Less than 2.5 cm pubic diastasis
- symphysis or through vertically oriented rami fractures.
- The SI joints and posterior ligaments remain intact, and stability is maintained.



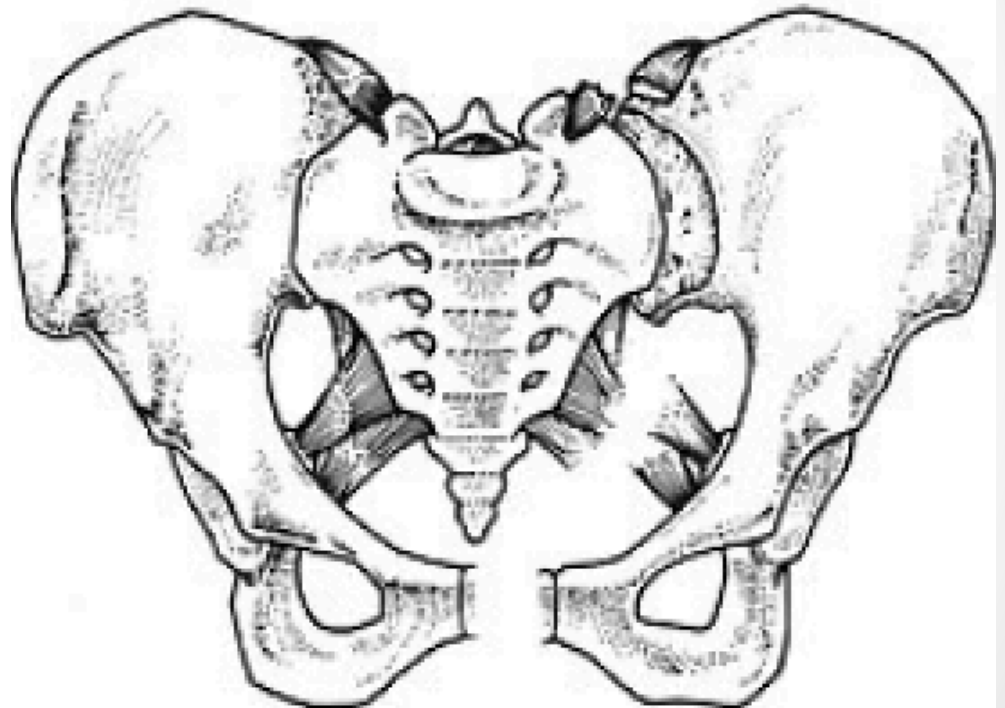
Classification

- *APC- II injuries:*
- Anterior diastasis exceeds >2.5 cm
- Diastasis occurs in 1 or both of the SI joints.
- Incomplete posterior arch disruption results in rotational instability.
- Posterior ligaments intact, vertical stability is preserved



Classification

- *APC- III injuries:*
- posterior SI ligaments, disruption
- vertically and rotationally unstable.



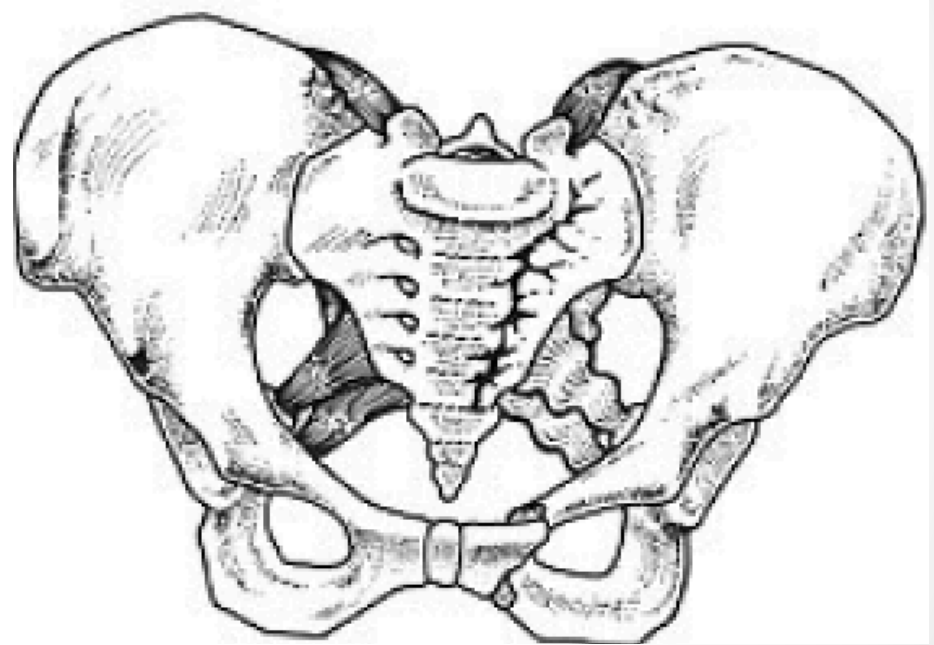
Classification

Lateral compression (LC) injury

- Internal rotation of the affected hemipelvis.
- This internal rotation decreases pelvic volume.
- pelvic vascular injuries and resulting hemorrhage are less common with this injury than with other injuries.
- Lateral compression injuries are associated with brain and intra-abdominal injuries.

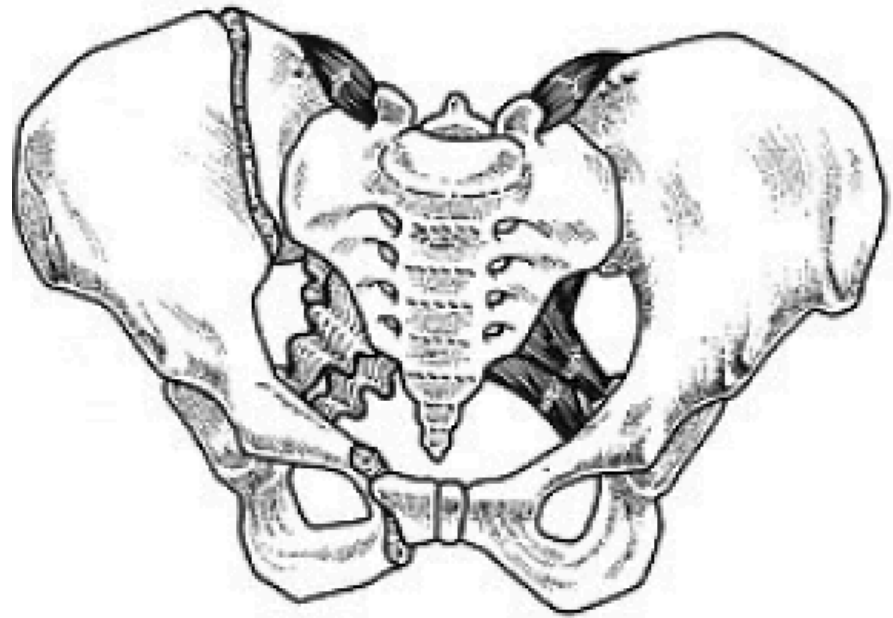
Classification

- *LC- I injuries:*
- Ipsilateral sacral buckle fractures;
- ipsilateral horizontal pubic rami fractures; less commonly, disruption of the pubic symphysis with overlap of the pubic bones.
- The posterior ligaments remain intact; stable pelvis



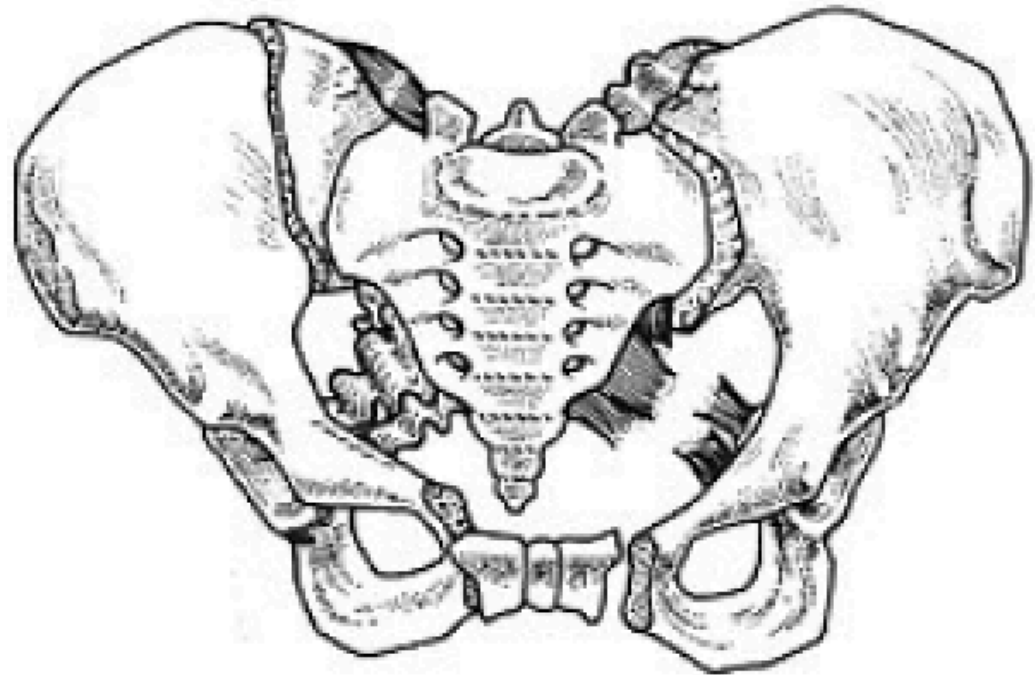
Classification

- *LC- II injuries:*
- more internal rotation of the hemipelvis.
- Fracture of the ipsilateral iliac wing or disruption of the ipsilateral posterior SI joint.
- Rotationally unstable, vertical stability is maintained.



Classification

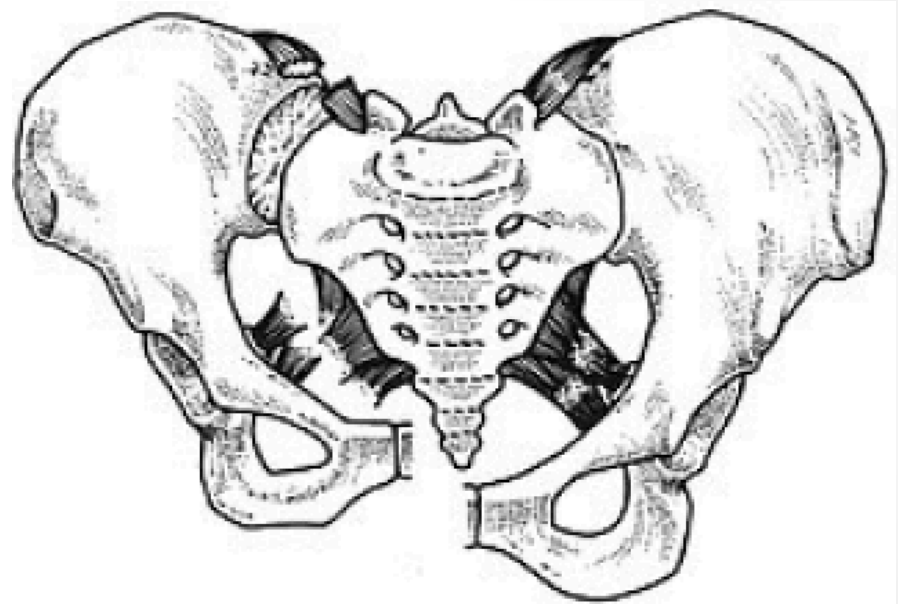
- *LC- III injuries:*
- Forces crosses midline to contralateral hemipelvis.
- Type I or type II LC injury ipsilateral injury
- External rotation in Contralateral hemipelvis.
- Pubic rami fractures or disruption of the ligaments
- Rotationally unstable but vertically stable.



Classification

Vertical shear injury

- Vertically oriented force usually by the femur
- Vertically oriented fractures of the pubic rami
- SI joint disruption
- Vertical displacement
- Rotational and vertical instability



Tile Classification

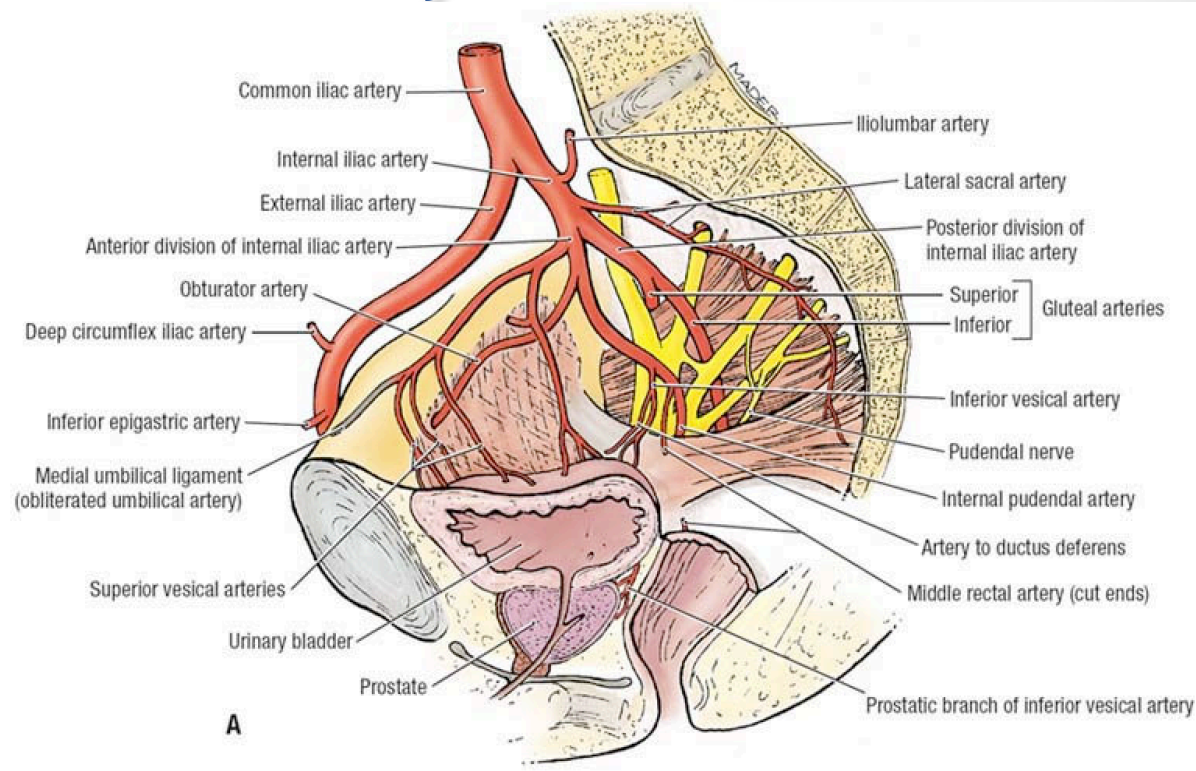
- Type A: Stable fracture.
 - A1-fractures not involving the pelvic ring; avulsion injuries
 - A2- Stable, min displacement of ring
- Type B: Rotationally unstable, but vertically stable.
 - B1- External rotation instability; open book injury
 - B2-LC injury; internal instability; ipsilateral only
 - B3- LC injury; bilateral rotational instability (bucket handle)
- Type C: Rotationally and vertically unstable.
 - C1- Unilateral injury
 - C2- Bilateral; one side with only rotational instability
 - C3- Bilateral; both sides with rotational and vertical instability

Associated injuries

- Vascular injuries
- Neurological injuries
- Bladder/urethral injuries
- Rectum injuries
- Vaginal injuries
- Open fracture

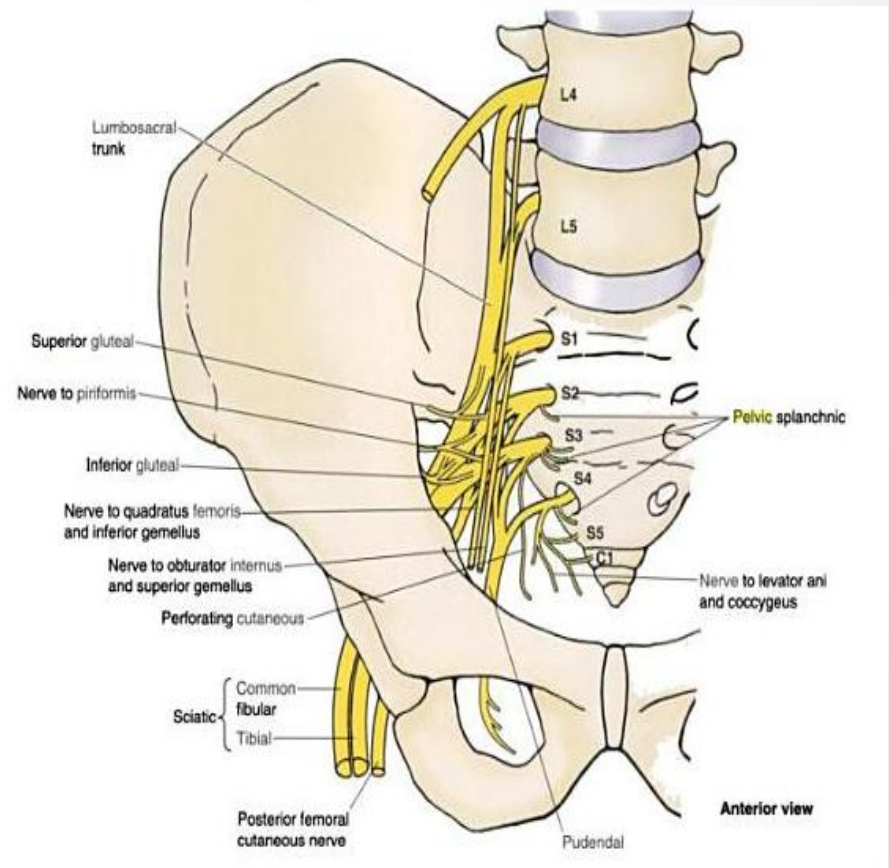
Vascular injuries

- Internal iliac artery
- Most common-SGA
- Usual bleeding is from venous plexus.
- APCIII and VS
- CT embolization if bleeding is not controlled



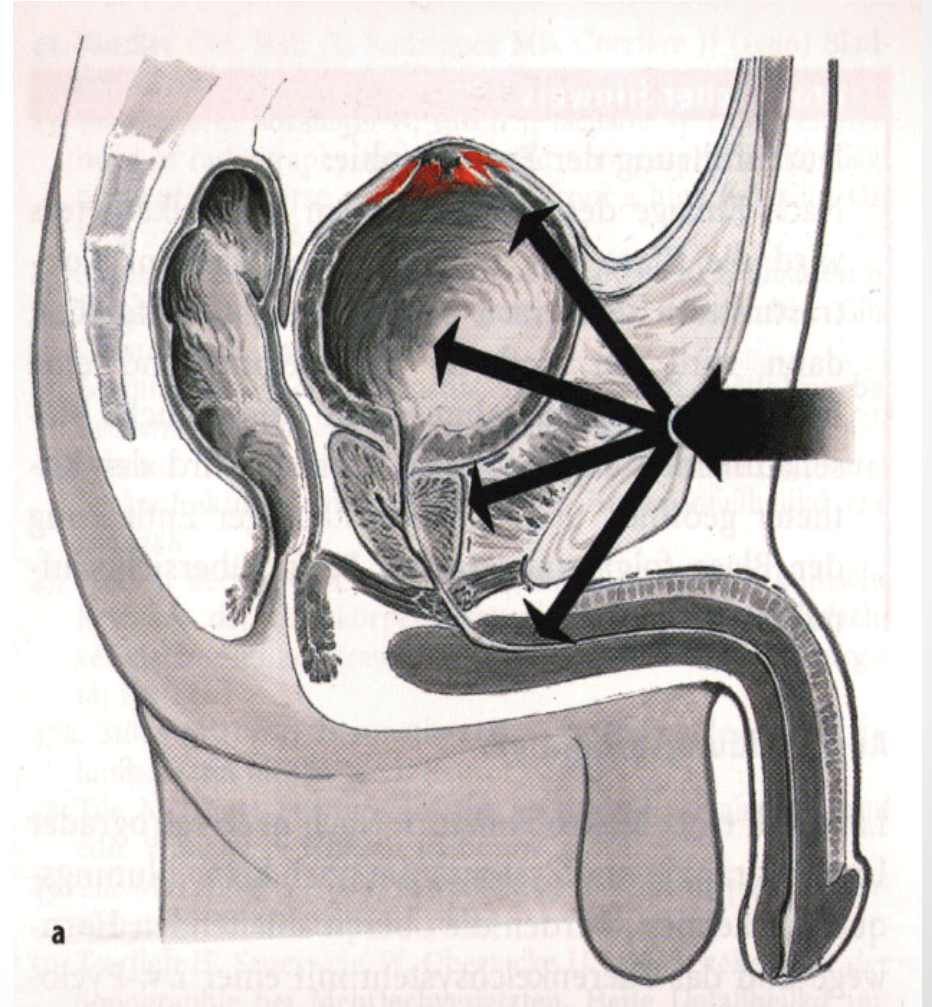
Neurological injuries

- L5, S1 are the most commonly injured plexus
- L2-L4 can be involved
- Examine for foot drop and peri-anal sensation



Potentially damaged Visceral Anatomy

- Blunt vs. impaled
by bony spike
 - Bladder
 - Urethral
 - Rectum
 - Vagina



Open fractures

- Anterior and lateral wounds generally are protected by muscle and are not contaminated by internal sources.
- Posterior and perineal wounds may be contaminated by rectal and vaginal tears and genitourinary injuries.
- Colostomy may be necessary for large bowel perforations or injuries to the anorectal region.
- Colostomy is indicated for any open injury where the fecal stream will contact the open area.



Radiography

1. Plain radiography: 5 views are necessary
 1. Anteroposterior view.
 2. Pelvic inlet view in which the tube is cephalad to the pelvis and tilted 30° downwards.
 3. Pelvic outlet view in which the tube is caudad to the pelvis and tilted 40° upwards.
 4. Right oblique view. (Judet)
 5. Left oblique view. (Judet)
2. CT
3. Urethrography if indicated

Inlet View

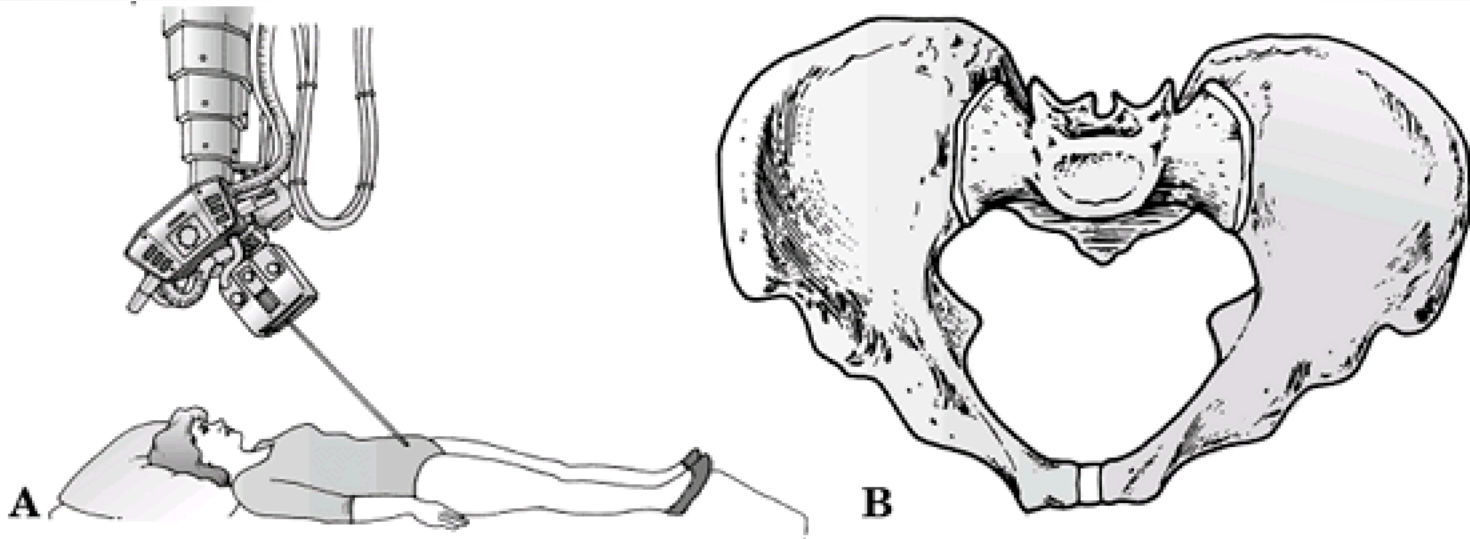


Figure 25.4. Inlet view of the pelvis: technique (A) and artist's sketch (B).
(Modified from Tile M. Fractures of the Pelvis and Acetabulum, 2nd ed. Baltimore: Williams & Wilkins; 1995.)

- Posterior displacement of pelvic ring
- Diastasis of Pubic symphysis

Outlet view

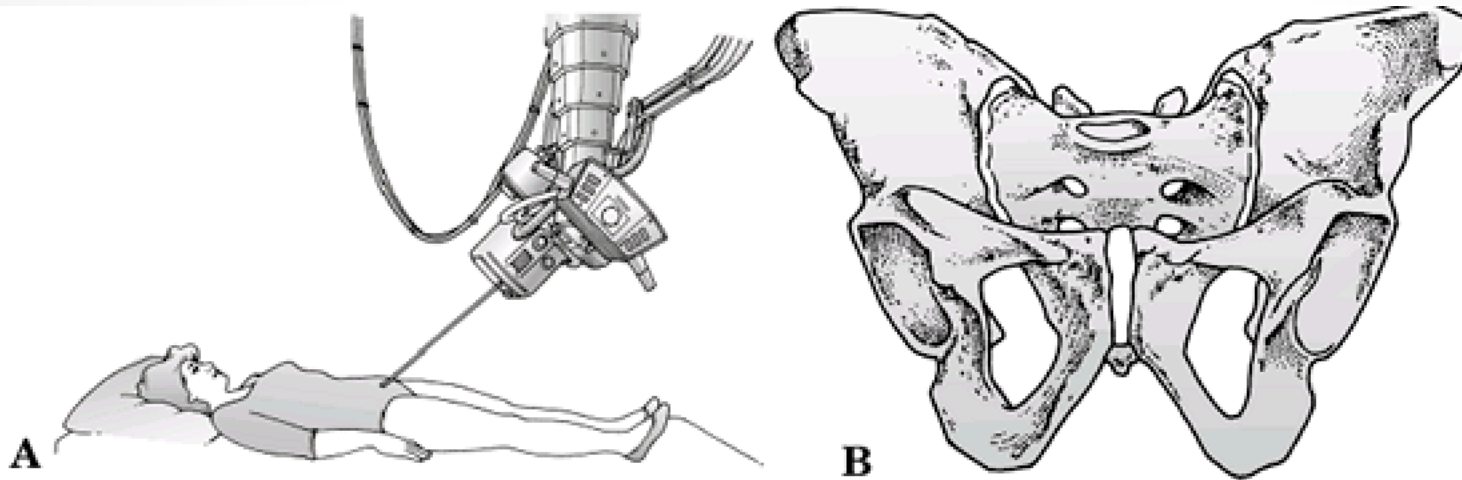


Figure 25.5. Outlet view of the pelvis: technique (A) and artist's sketch (B).
(Modified from Tile M. Fractures of the Pelvis and Acetabulum, 2nd ed. Baltimore: Williams & Wilkins; 1995.)

- Vertical shift of pelvis

Clinical features and clinical assessment

1. Fracture of the pelvis should be suspected in every patient with serious abdominal injury or lower limb injury.
2. H\O road traffic accident, fall from a height or crush injury.
3. Severe pain, swelling and bruises in the lower abdomen, perineum, thighs, scrotum or valva.
4. Extravasations of urine.
5. Symptoms and signs of bleeding and hemorrhagic shock.

Clinical features and clinical assessment

6. Tenderness all over the pelvic bone especially when attempt to compress or distract the pelvis.
7. Tender abdomen due to bleeding or intrapelvic structure injuries.
8. Rectal examination should be done in every case.
9. Bleeding in external meatus indicates urethral injury. If no bleeding ask the patient to void and give direct look to the urine, if the patient able to void this indicates either no urethral injury or there is only minimal damage to the urethra.
10. Neurological examination should be done to exclude sacral and lumbar plexus injury.



Management

1. Initial management

- ABC
- Assessment of injuries
- Early blood transfusion/ MTP

Management

2. *Management of severe bleeding*

1. Treatment of shock.
2. Laparotomy.
3. External fixation to close the book.

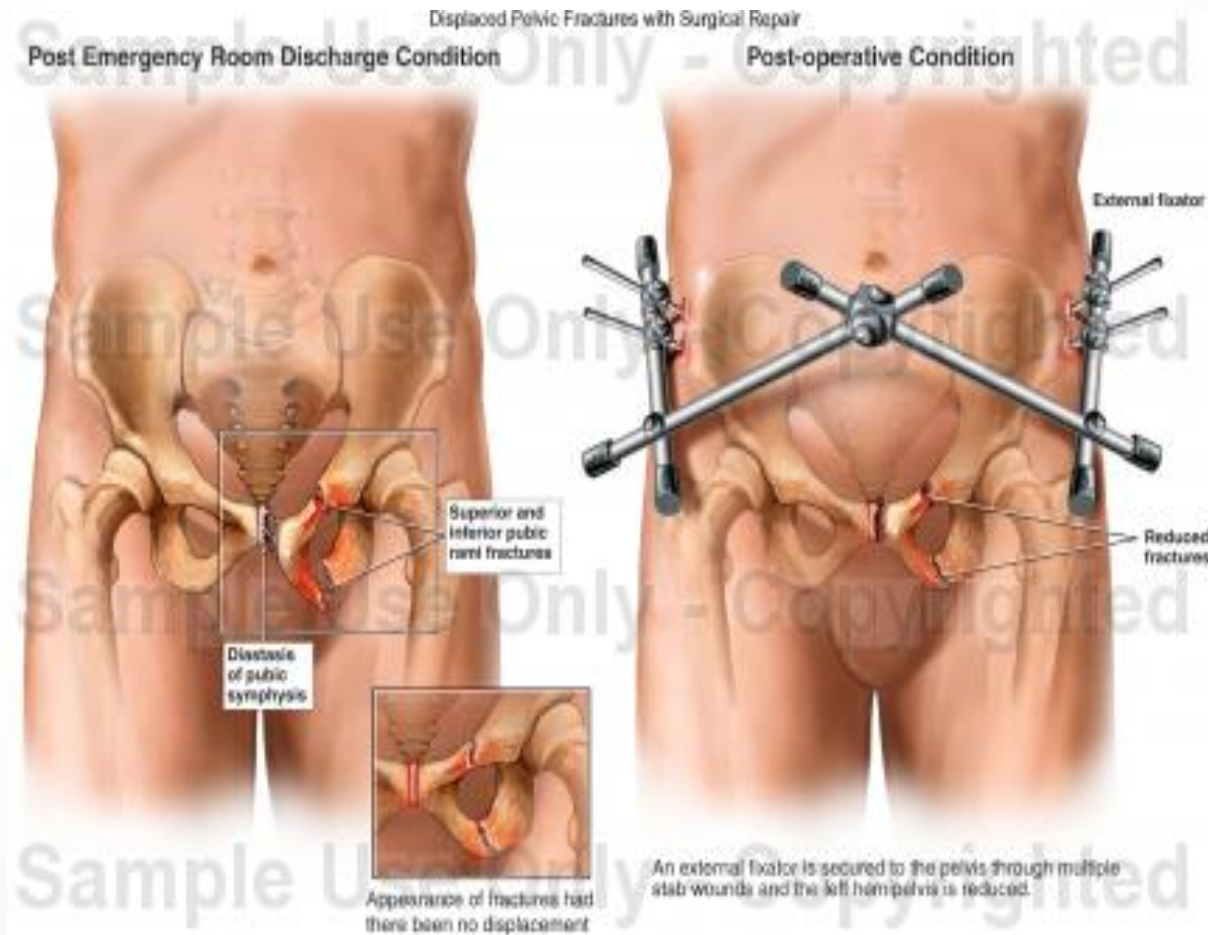
3. *Management of urethral and bladder injury.*

Management

4. *Treatment of the fracture*

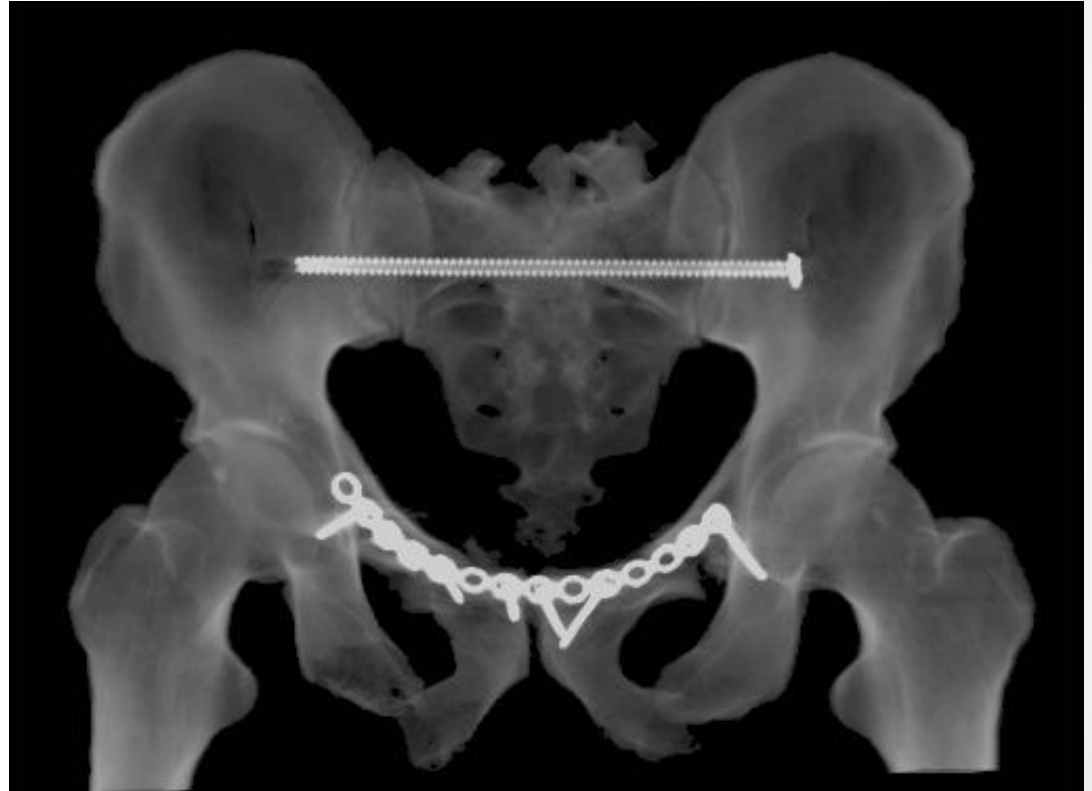
1. Isolated fractures and minimally displaced fractures- protected weight bearing with serial Xrays
2. Open fractures are treated with external fixation initially
3. Unstable fractures are treated with ORIF

External fixation



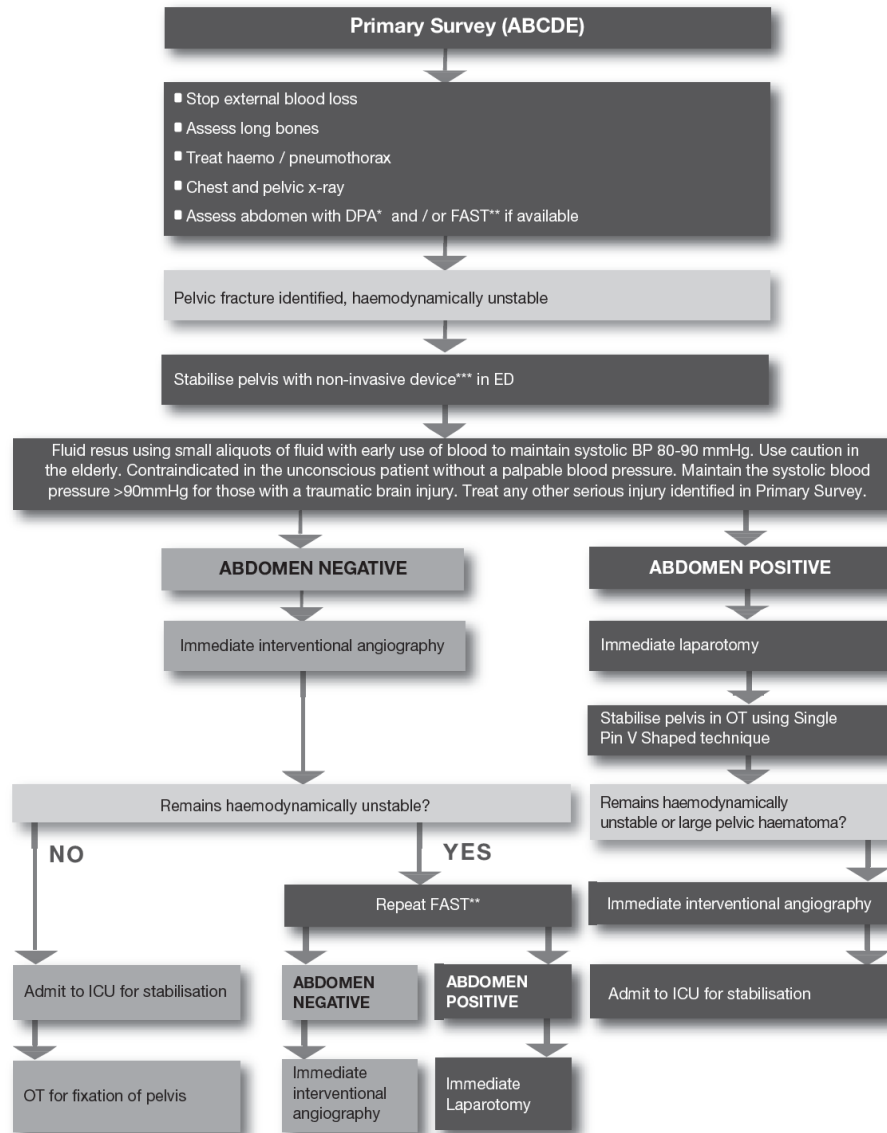
Open reduction internal fixation

- Anterior- Pelvic reconstruction plate
- Posterior/ SI joint dislocation – cannulated screw fixation



Algorithm 1 :: Management of the Haemodynamically Unstable Patient with a Pelvic Fracture with Angiography Services available

Management of the Haemodynamically Unstable Patient with a Pelvic Fracture **with** Angiography Services available



PELVIC FRACTURE GUIDELINE

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Conclusions

- High mortality in pelvic fracture (10-25%)
- APCIII and VS are most dangerous fracture patterns
- Multiple associated injuries with pelvic fracture
- Early resuscitation with blood transfusion
- Consider CT embolization
- Operative measures if hemorrhage uncontrolled
- Unstable pelvis needs to be fixed

Bibliography

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- Jones AL, Powell JN, Kellam JF, et al. Open pelvic fractures. A multicenter retrospective analysis. *Orthop Clin North Am.* 1997;28(3):345-50.