



PG Residency Pelvic Ring Fractures

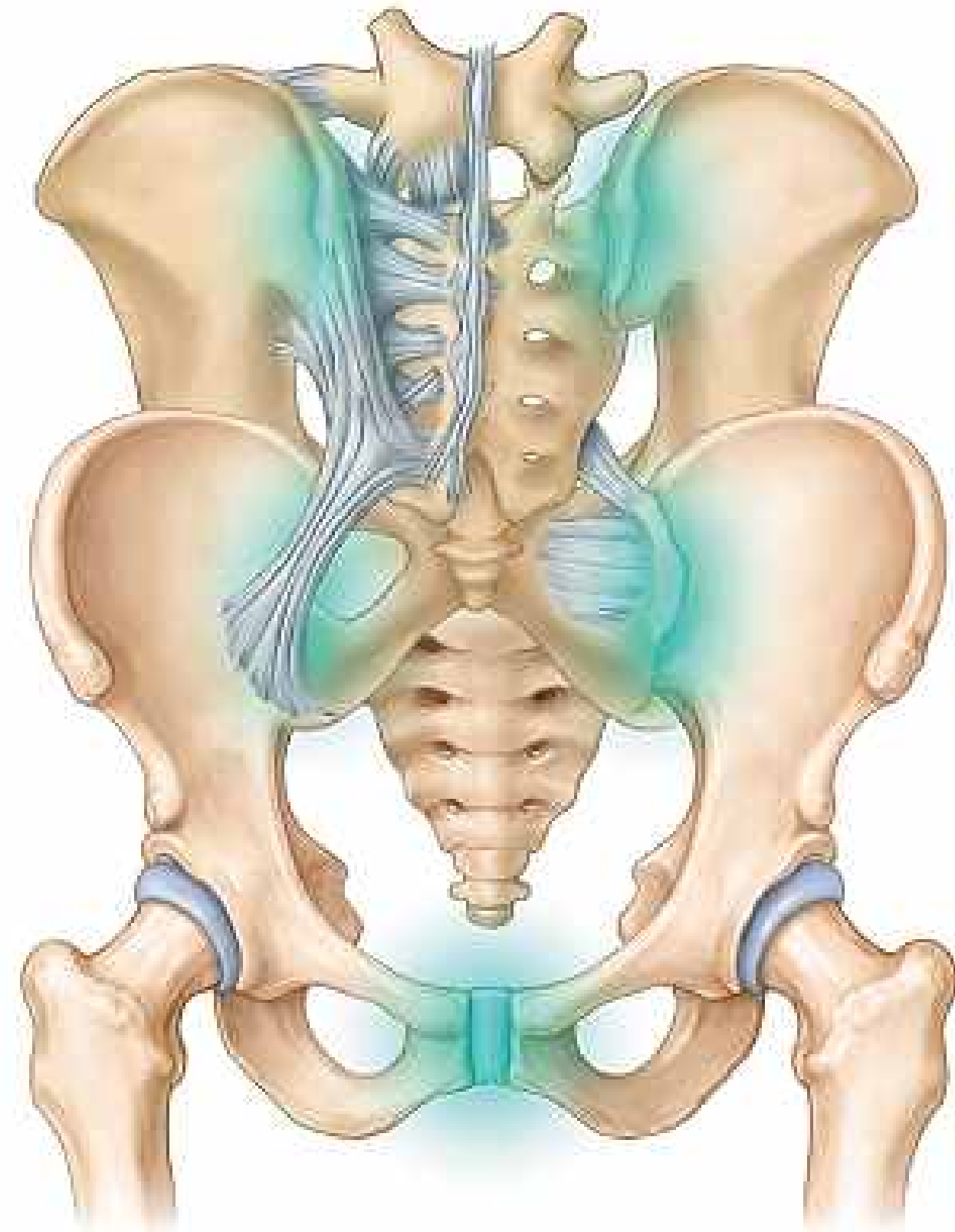
Smart Notes. Better Scores.



Rapid Revision: Pelvic Ring Fractures

- Anatomy, Biomechanics & Stability
- Trauma Resuscitation & Management Algorithms
- Classifications & Surgical Fixation Techniques

EXAM PEARL: The pelvic ring relies entirely on ligamentous integrity for stability; the SI joint lacks inherent bony stability.



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Pelvic Ring Anatomy & Biomechanics

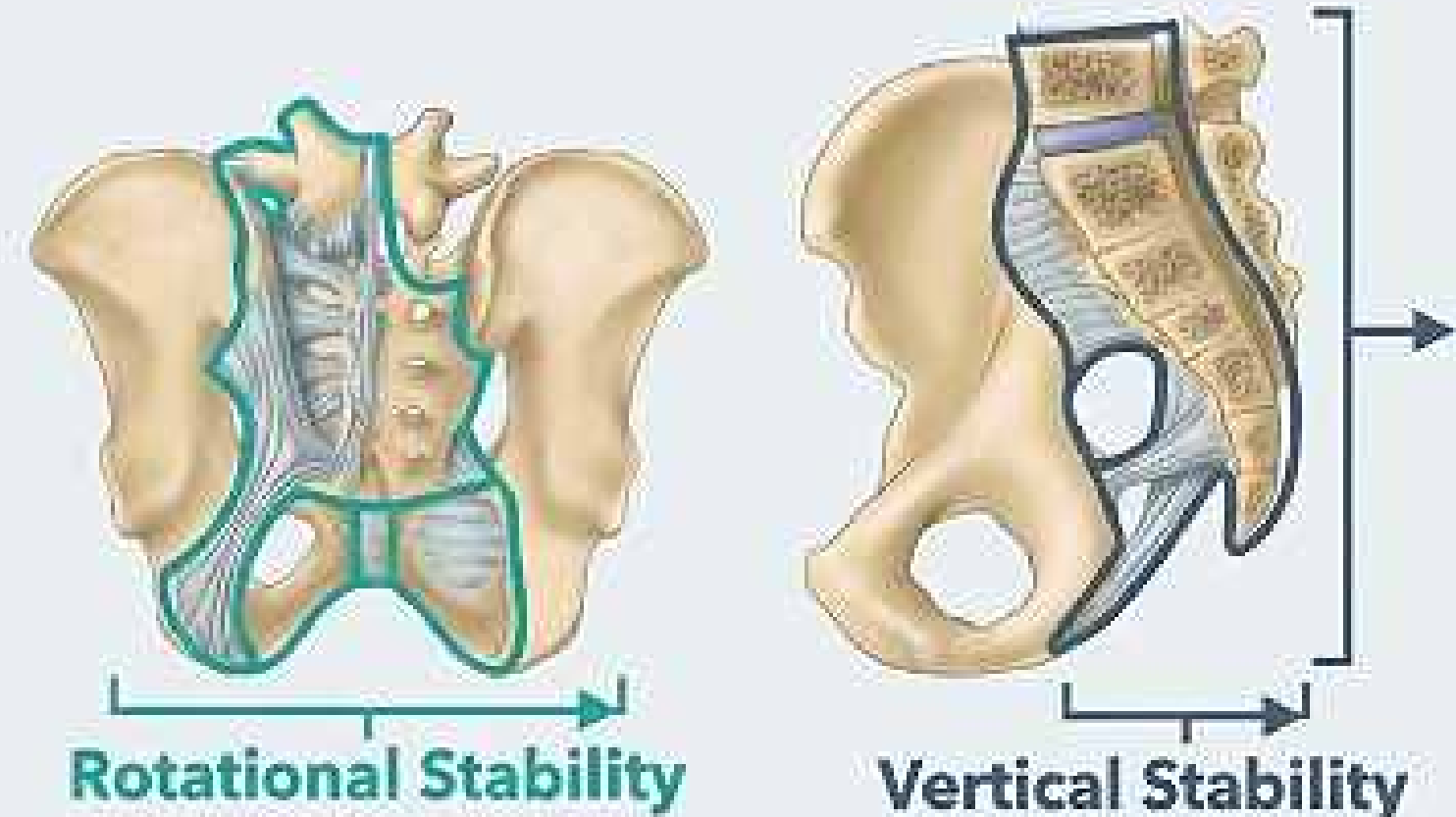
Distinguishing Rotational vs. Vertical Support Structures

Rotational Stability

- Symphysis ligaments
- Sacrospinous ligament
- Anterior sacroiliac ligament

Vertical Stability

- Posterior sacroiliac ligament
- Interosseous ligament
- Iliolumbar ligament



KEY CONCEPT: A pelvis can be rotationally unstable yet vertically stable.

EXAM PEARL:

If rotation fails, the anterior side and anterior SI ligaments fail. If vertical stability fails, the posterior interosseous and iliolumbar ligaments have ruptured.



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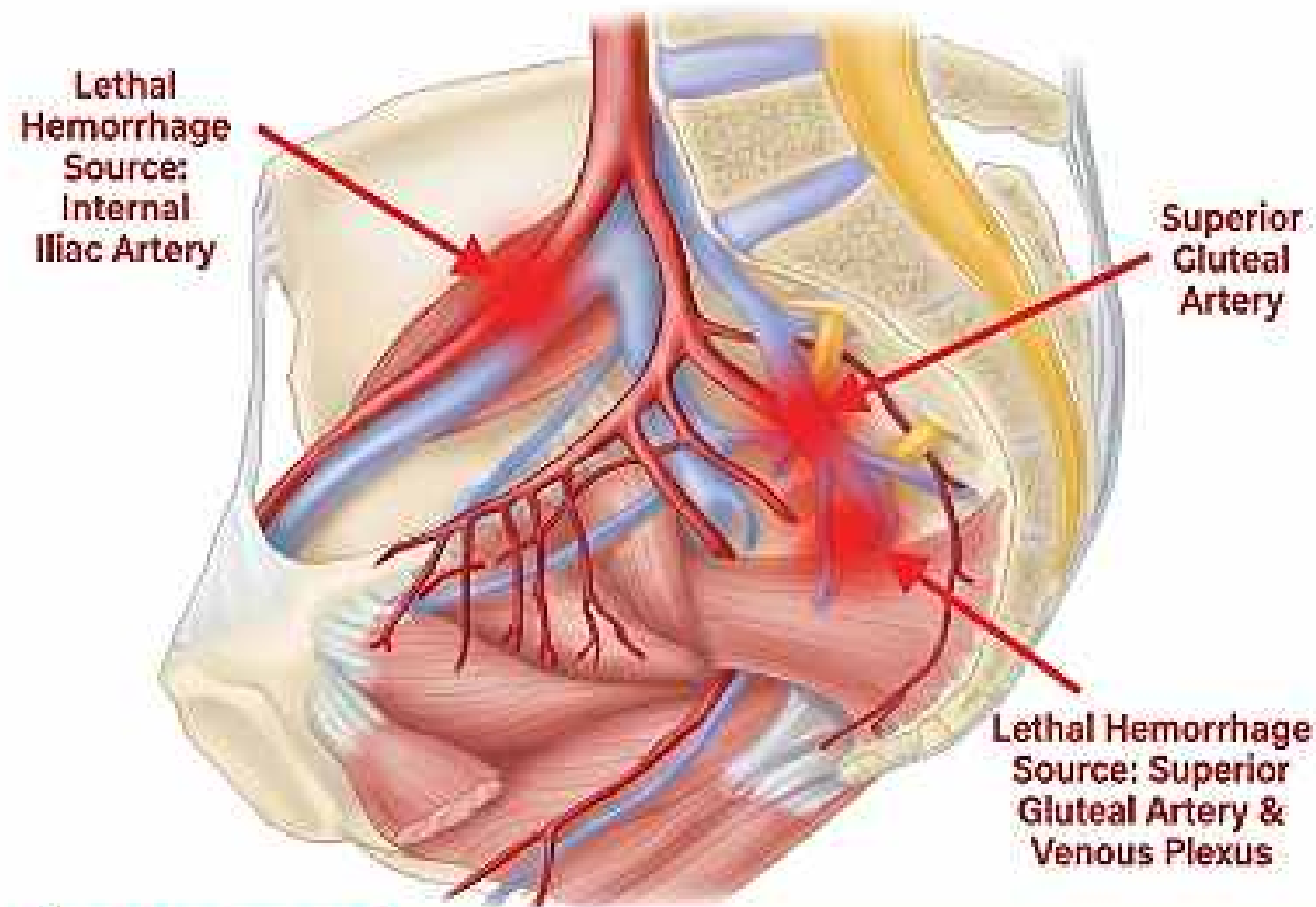
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Hemorrhage & Trauma Characteristics

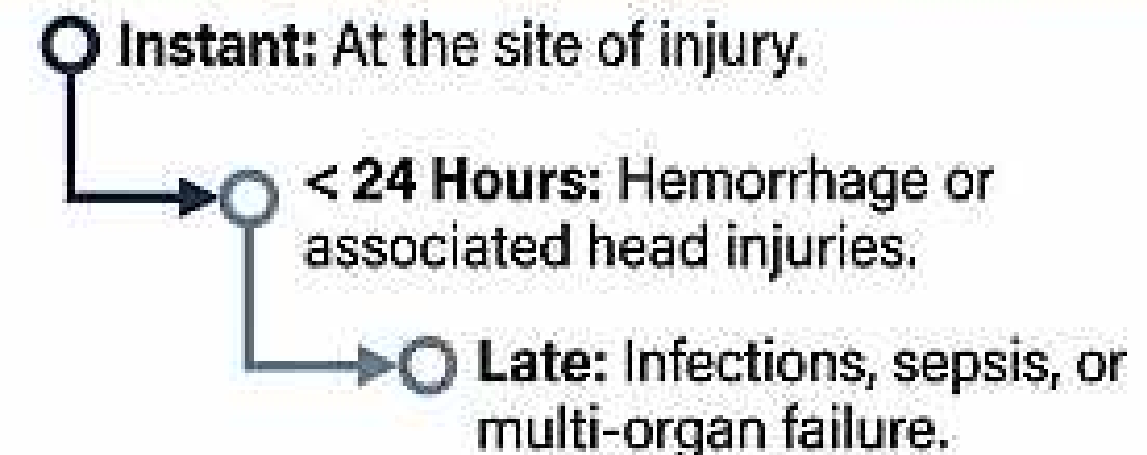


The Crisis Metric

- High-velocity trauma primarily in young patients.

Max Blood Loss: 1.5 to 2 Liters
→ Hypovolemic Shock

Trimodal Mortality Distribution



EXAM PEARL:

Most pelvic injuries are stable and non-surgical, but catastrophic blood loss is the primary immediate threat to life.

Prognosis:

Mortality is heavily linked to patient age and Injury Severity Score (ISS).



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Acute Resuscitation & Management Protocol

Immediate Action

ATLS (ABCs) in 'golden hour' |
Proximal IV access | Early transfusion

Hemodynamically Unstable?

Apply circumferential pelvic binder
strictly at greater trochanters.

FAST Positive

Immediate Laparotomy
(intra-peritoneal packing,
temporary ex-fix).

FAST Negative

Angiography to embolize
bleeding vessels.

**STRICT BINDER
PLACEMENT LEVEL**



Open Fractures:

Vaginal/rectal exams
mandatory; immediate
diverting colostomy for
perineal wounds.

EXAM PEARL:

A pelvic binder **MUST** be centered over the greater trochanters, not the iliac crests, to effectively reduce pelvic volume.



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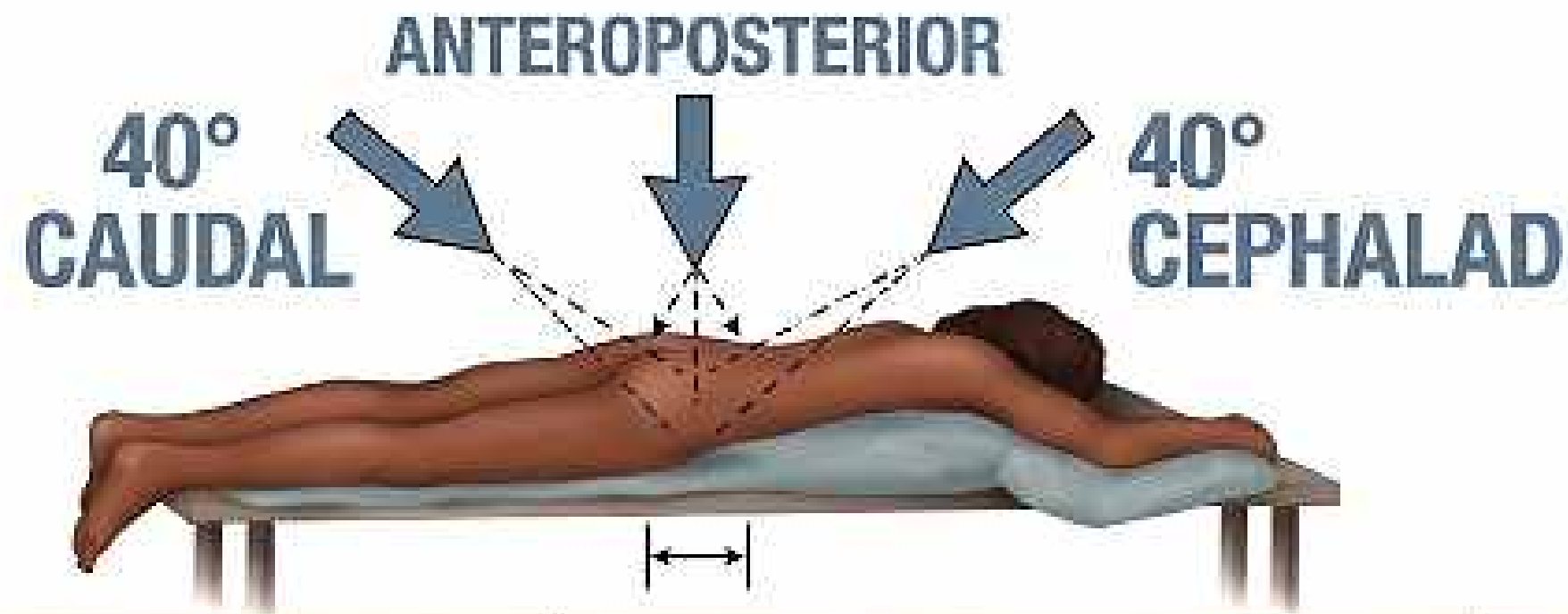
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Standard Radiographic Trauma Series



Standard AP View	Inlet View (40° Caudal)	Outlet View (40° Cephalad)
- Initial screening for suspected trauma. - CT Scan is the best overall evaluation for any bony fracture of the pelvis.	- Shows inward/outward rotation of anterior pelvis. - Shows AP displacement of hemi-pelvis.	- Shows vertical displacement (superior/inferior). - Shows flexion/extension rotation.

EXAM PEARL: Use the Inlet view for **ROTATIONAL** displacement (front-to-back); use the Outlet view for **VERTICAL** displacement (up-and-down).

Instability Recognition & Radiographic Signs

Rotational Instability

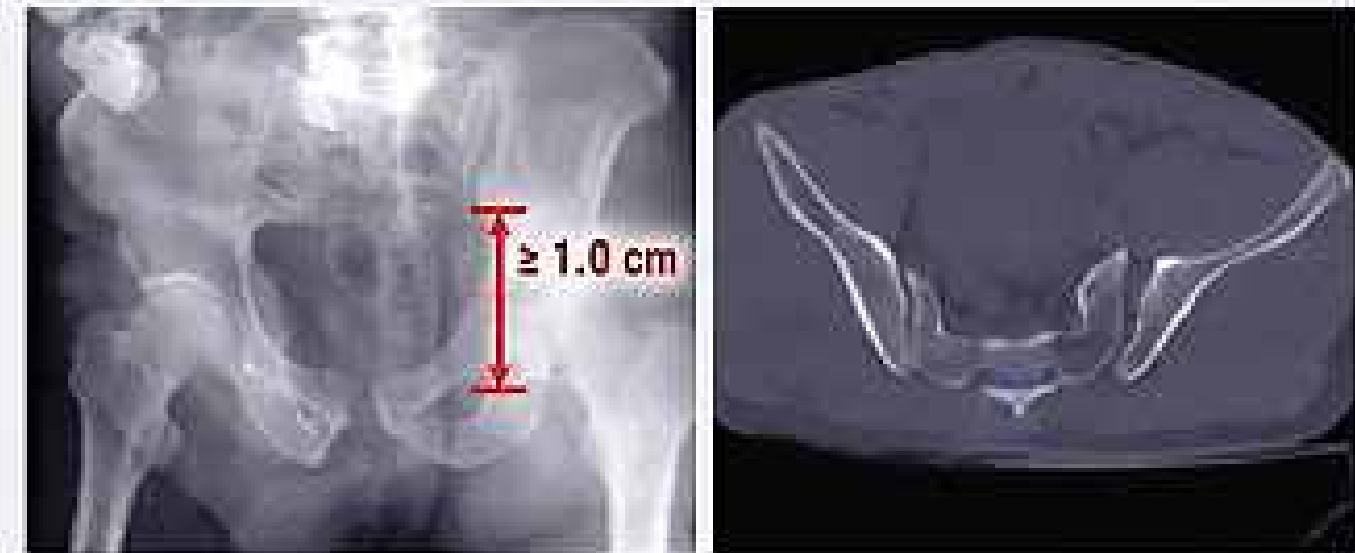


- Symphysis widening **> 2.5 cm**.
- Indicates sacrospinous/anterior SI ligament rupture.

Clinical Notes:

- **Lateral Compression (LC):** Impacted fracture of anterior sacral cortex (typically stable).
- **Stress Examination:** Perform ONLY ONCE (under sedation in OT or when hemodynamically stable).

Vertical Instability



- Superior migration of one hemipelvis **≥ 1 cm**.
- Sacral fracture with visible gap.

EXAM PEARL: Symphysis diastasis > 2.5 cm is the absolute threshold distinguishing a stable open-book injury (APC I) from an unstable one (APC II).



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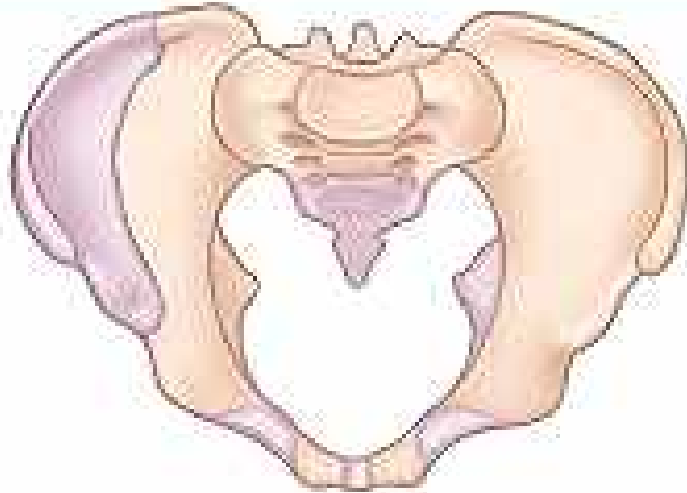
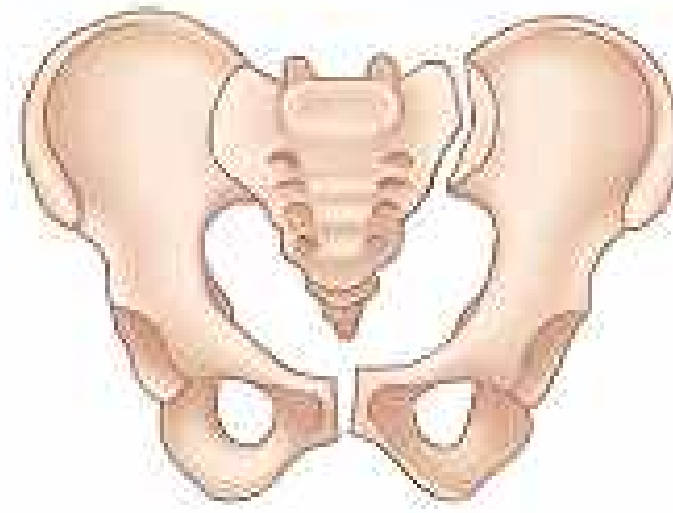
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Tile Classification System (AO/OTA 61)

Type A (Stable)	Type B (Rotationally Unstable, Vertically Stable)	Type C (Rotationally & Vertically Unstable)
		
• A1: Avulsion • A2: Direct blow / Duverney's • A3: Transverse sacrococcygeal	• B1: Open Book • B2: Lateral Compression / Internal Rotation • B3: Bilateral B-type	• C1: Unilateral • C2: Bilateral mixed • C3: Bilateral complete disruption

EXAM PEARL:

Tile A3 fractures (transverse sacrum or coccyx) are technically considered spinal injuries rather than true pelvic ring disruptions.



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Anatomical Classifications: Denis & Nakatani



Denis Classification (Sacral Fractures)

- **Zone 1:** Lateral to neural foramina (L5 nerve risk).
- **Zone 2 (CRITICAL):** Transforaminal (**L5 to S2 root risk – 30% neurological compromise**).
- **Zone 3:** Central/medial to neural foramina (Severe bowel/bladder/sexual dysfunction risk).

Nakatani Classification (Pubic Ramus Fractures)

Zone 1	Zone 2	Zone 3
Zone 1: Medial to obturator foramen.	Zone 2: In between zones 1 and 3.	Zone 3: Lateral to obturator foramen (pubic root fracture)

EXAM PEARL: Denis Zone 2 fractures mandate ORIF over percutaneous techniques due to the 30% risk of neurological injury requiring decompression.



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Trauma Bay to OR Pathway

Surgical Timing: EAC vs. DCO

EAC (Early Appropriate Care)

Proceed with Definitive Fixation (< 36 hours).

- Venous lactate < **4.0 mmol/L**
- Base Excess **-2 to -5.5 mmol/L**
- pH ≥ **7.25**

Preferred over Early Total Care (ETC).

DCO (Damage Control Orthopedics)

Delay Fixation. Stabilize & Resuscitate.

- Hemodynamically unstable
- Venous lactate > **4.0 mmol/L**
- Temporary stabilization (binder/ex-fix)
- Hemorrhage/contamination control
- Resuscitate in ICU until lactate drops

EXAM PEARL: Operating for definitive fixation when a patient's lactate is > **4.0 mmol/L** significantly increases mortality; employ DCO instead.



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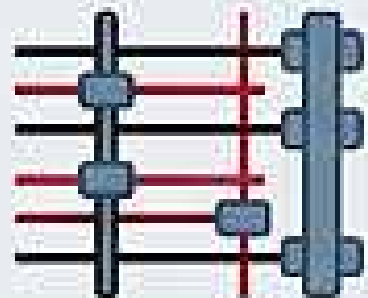
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Anterior Fixation Strategies



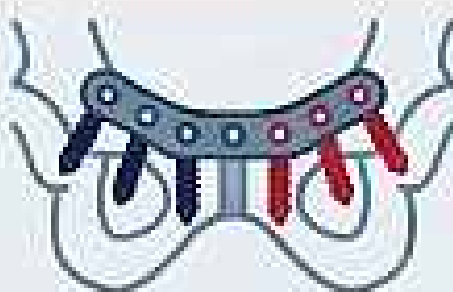
External Fixation

- Anterior placement (cranial-to-caudal). Gives rotational control.
- Left in place 6-12 weeks.



ASIF (Anterior Subcutaneous Internal Fixation)

- Minimal dissection, rigid, low-profile.
- Allows early mobilization.
- Disadvantage: Requires future hardware removal.



Internal Fixation (Plating)

- Multi-hole plate used for pubic symphysis.
- Best for B1 (Open Book) injuries.
- Caveat: Often requires posterior screw fixation to prevent implant breakage.

EXAM PEARL: Due to continued physiological motion at the symphysis during healing, anterior plates will frequently break if posterior instability is not concurrently addressed.



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Posterior Fixation Strategies

Indications for Posterior ORIF

- Grossly displaced posterior injuries.
- Bilateral injuries.
- Denis Zone 2 to decompress neural foramina.

Closed percutaneous techniques are preferred for unilateral injuries without neural compromise.

ABSOLUTE CONTRAINDICATIONS for Open Posterior Approach

- Recent internal iliac artery embolization.
- Large Morel-Lavallée lesion.

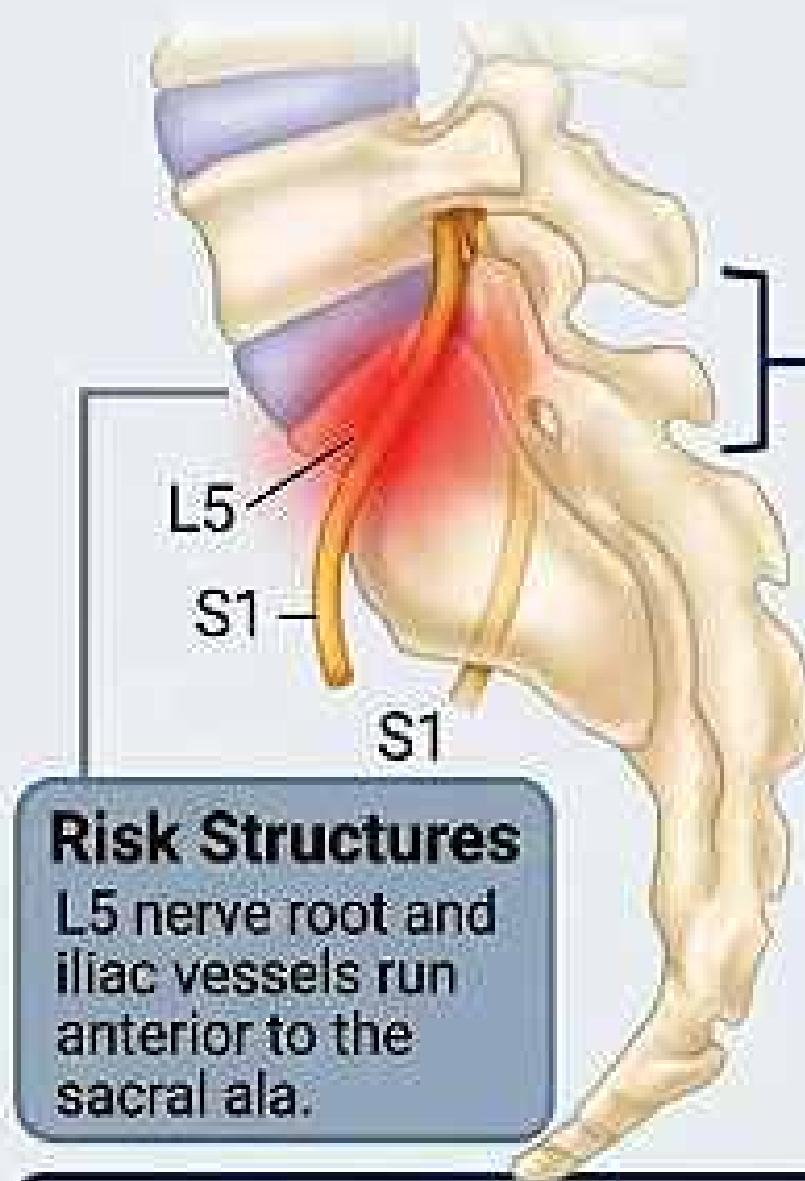
Result: *Extreme risk of catastrophic soft tissue failure.*

Alternative Techniques: Transiliac rod fixation (risk of sacral compression) or Tension band plating.



EXAM PEARL: Do not perform an open posterior approach if the patient has a Morel-Lavallée lesion or recent arterial embolization; the soft tissue will fail.

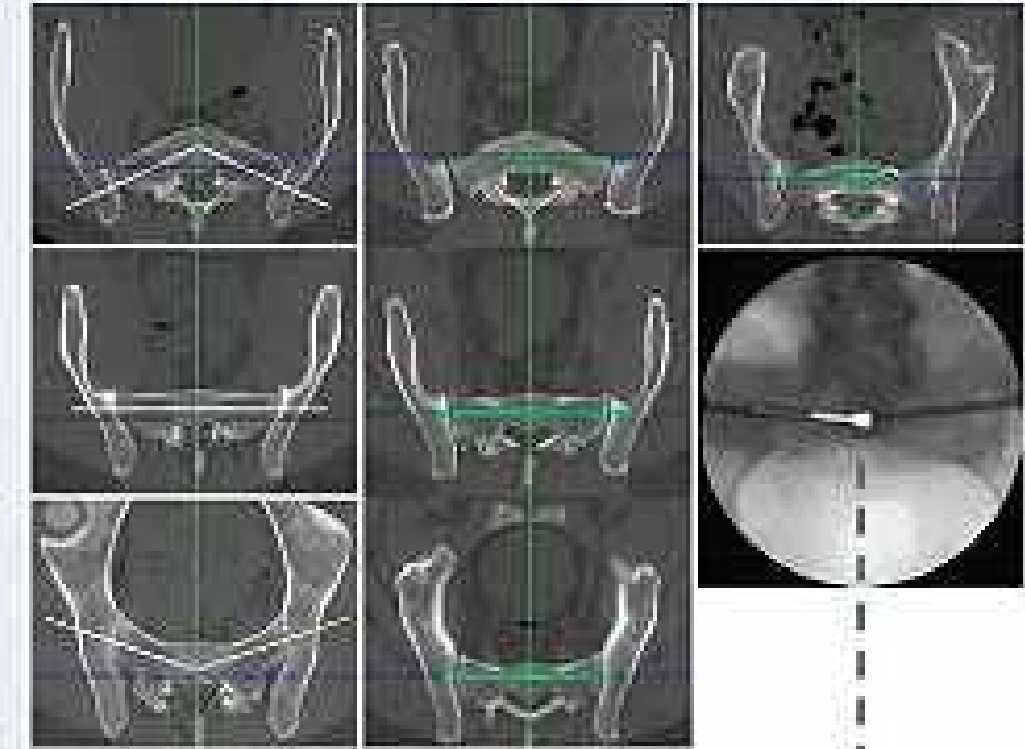
Percutaneous Iliosacral Screw Fixation



Risk Structures
L5 nerve root and iliac vessels run anterior to the sacral ala.

Transsacral-Transiliac Advantage:

- ➔ Traverses **entire** sacrum
- ➔ Engages contralateral cortices
- ➔ Trajectory **parallel** to foramen



Target: Safe zone in the body of S1 (cortex of alar slope forms superior aspect).

Imaging Marker: Iliac Cortical Density (ICD) on lateral fluoroscopy demarcates anterior cortical thickening.

EXAM PEARL: A recessed sacral ala allows for “in-out-in” screw trajectories, but this places the L5 nerve root at extreme risk. Pre-op CT is mandatory.



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Rapid Revision Summary

The 5 Non-Negotiable Clinical Rules

1. Stable vs Unstable Thresholds

Symphysis $> 2.5\text{cm}$ = **Rotational**.
Superior shift $\geq 1.0\text{cm}$ = **Vertical**.

2. Tile Classification Core

A = Stable,
B = Rotationally Unstable,
C = Vertically + Rotationally Unstable.

3. Hemorrhage Resuscitation

Unstable + FAST Positive = Laparotomy.
Unstable + FAST Negative = Angiography.

4. Surgical Timing (Lactate Rule)

Lactate $< 4 \text{ mmol/L}$ = **EAC (Fix)**.
Lactate $> 4 \text{ mmol/L}$ = **DCO (Stabilize)**.

5. Mechanical Tamponade

Pelvic **binder** must be **centered** strictly over the **Greater Trochanters**.

EXAM PEARL: Always correlate the **specific injury mechanism** (APC vs LC vs VS) directly with the **specific failed ligaments** (Anterior vs Sacrospinous vs Posterior).



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Must-Remember Classifications & Values

2.5 cm

Symphysis Diastasis Critical Value
(Distinguishes APC I vs APC II)

250 Cm

Typical Maximum Blood Loss in
Pelvic Trauma

1.0 cm

Vertical Migration Critical Value

1.5 - 2.0 L

Typical **Maximum Blood Loss** in Pelvic
Trauma

30%

Risk of **neurological injury**
in Denis Zone II fractures

4.0 mmol/L

EAC Venous Lactate
Threshold

40°

Standard Inlet (Caudal) /
Outlet (Cephalad) Angles

LC-1 Fracture Scoring Criteria	
PARAMETER	POINTS
SACRAL DISPLACEMENT	
<2 mm	1
≥2 mm	2
DENIS CLASSIFICATION	
Zone 1	1
Zone 2	2
Zone 3	3
SACRAL COLUMNS	
1 column	1
2 columns	2
3 columns	3
INFERIOR RAMUS DISPLACEMENT	
Minimal	1
>50%	2
Complete	3
SUPERIOR RAMUS LOCATION	
Root	1
Mid-ramus	2
Parasymphseal	3

EXAM PEARL: Denis Zone 3 fractures (Central) are specifically linked to **severe** bowel, bladder, and sexual **dysfunction**.



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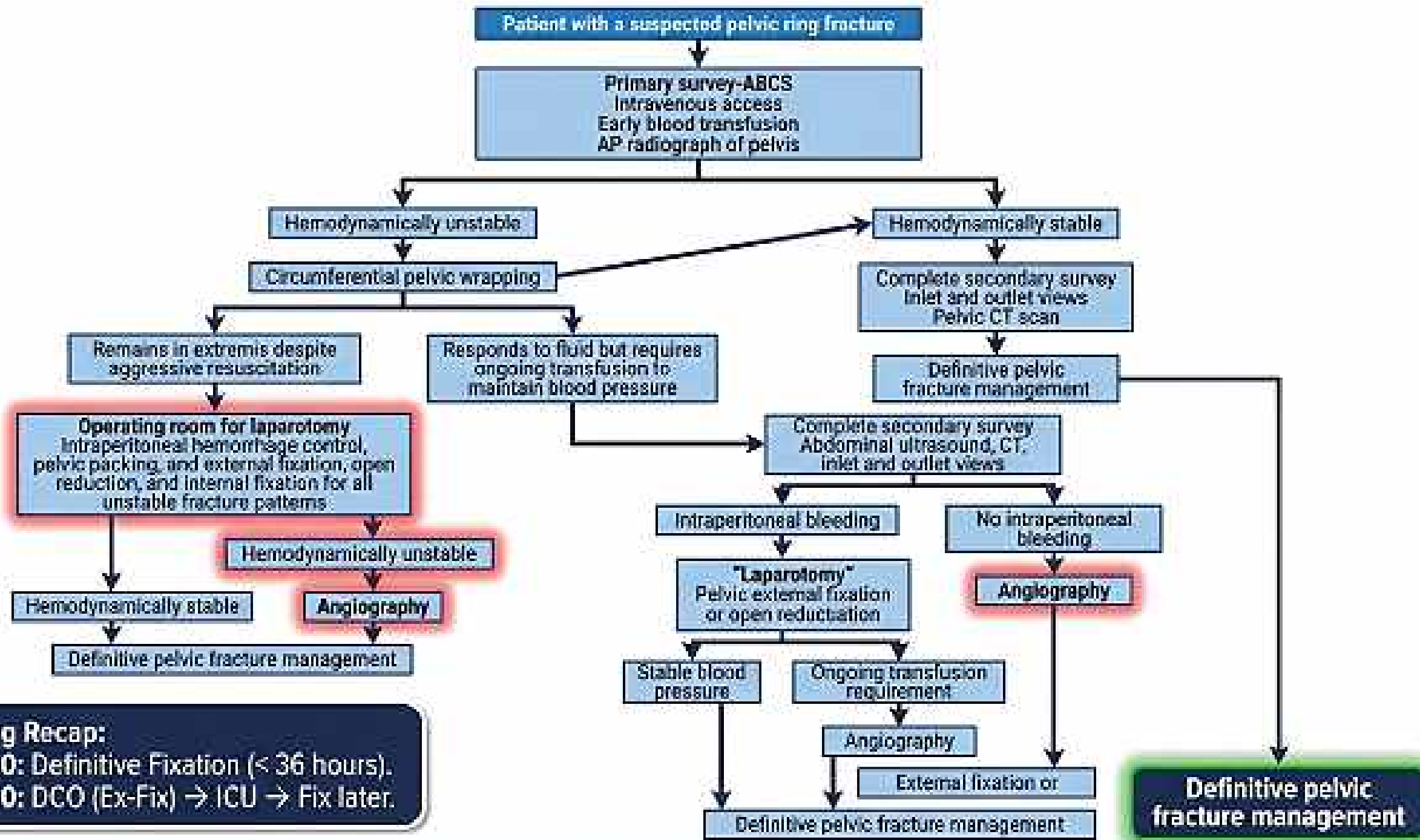
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One-Page Management Algorithm



Surgical Timing Recap:

- Lactate < 4.0: Definitive Fixation (< 36 hours).
- Lactate > 4.0: DCO (Ex-Fix) → ICU → Fix later.

EXAM PEARL: The primary goal in the first 24 hours of a hemodynamically unstable pelvic fracture is hemorrhage control, not anatomical bony reduction.



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