Pelvic Ring Injuries: Definitive Management

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Seattle, WA Revised 2009

Created by Steven A. Olson, MD in 2004
First revised by Rafael Neiman, MD in 2007
Second Revision by James C. Krieg, MD in 2009

Goals

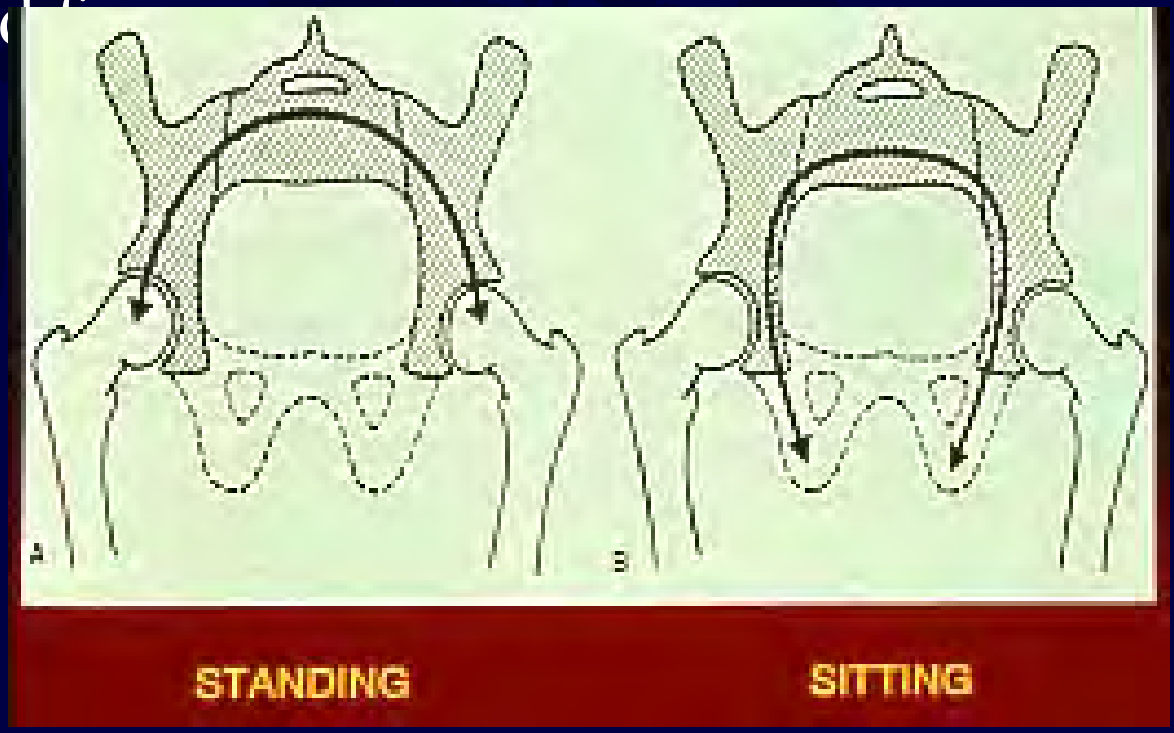
- Define pelvic ring instability
- Decision process: operate or not?
- Non-operative treatment
- Principles of operative treatment
- Preoperative planning
- Surgical approaches
- Techniques of pelvic reduction and fixation
- Biomechanics of fixation techniques
- Outcomes of pelvic ring injury

Introduction:
Pelvic Ring Stability

- Stability defined as ability to support physiologic load
- Physiologic load may be sitting, side lying, or standing, as dictated by patient needs

Introduction:
Pelvic Ring Stability

- Posterior ring integrity is important in transferring load from torso to lower extremities



Defining Instability

- Loss of posterior ring integrity often leads to instability
- Loss of anterior ring integrity may contribute to instability, and may be a marker to posterior ring injury
- Tile classification scheme based on instability patterns

Is it stable?

- Is there deformity?
  - Deformity on presentation predicts instabilitly

Is it stable?

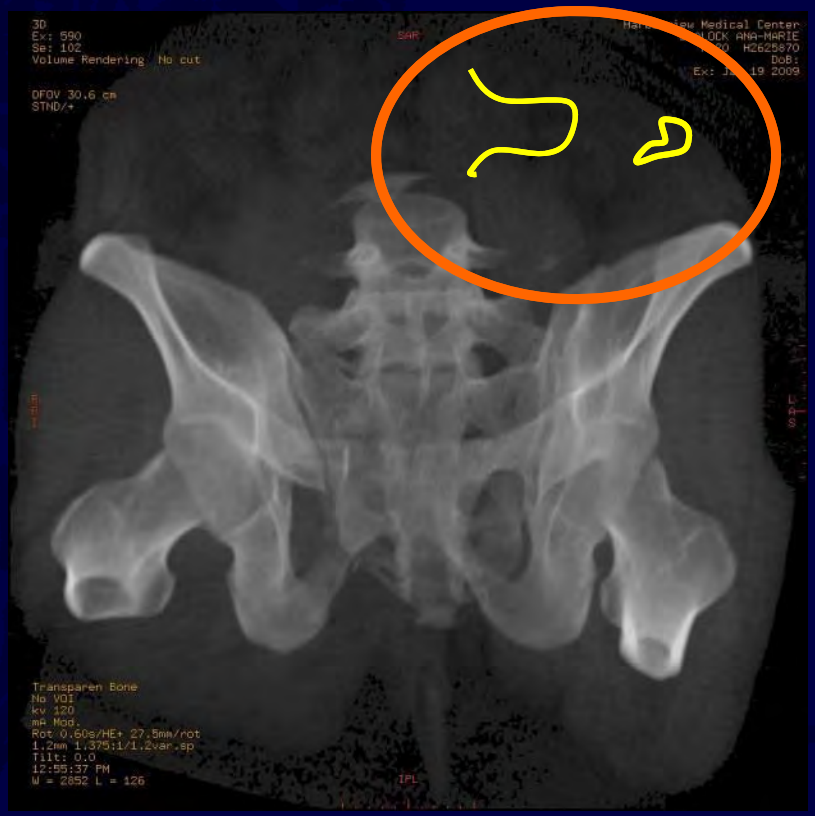
- Is there deformity?
- Is the posterior pelvic ring intact?
  - CT scan

Is it stable?

- Is there deformity?
- Is the posterior pelvic ring intact
- Stress radiographs

Is it stable?

- Is there deformity?
- Is the posterior pelvic ring intact
- Stress radiographs
- Are there clues to soft tissue injury?
  - LS transverse process fx
  - Ischial spine avulsion
  - Lateral sacral avulsion



Describing Instability

- Refer to previous lecture on Classification
- Tile Classification
  - A stable
  - B partially stable
  - C unstable

Operative Indications

- Resuscitation
  - See previous lecture on Acute Management
- Assist in mobilization
  - Just as stabilizing long bones helps in mobilization of polytrauma patients
- Prevent long term functional impairment
  - Deformity of pelvic ring can impact function

Non-Operative Management

- Lateral impaction type injuries with minimal (< 1.5 cm) displacement
- Pubic rami fractures with no posterior displacement
- Minimal gapping of pubic symphysis
  - Without associated SI injury
  - 2.5 cm or less, assuming no motion with stress or mobilization
  - This number is not absolute, so other evidence of instability (like SI injury) must be ruled out

Non-Operative Management

- X-rays are static picture of dynamic situation
  - It may be that the deformity is worse than seen on X-rays taken
  - Stress radiographs may be helpful
  - Post-mobilization radiographs should be taken in all cases of non-operative treatment
  - Other evidence of instability should be sought
    - Lumbar transverse process fractures
    - Avulsions of sacrotuberous/sacrospinous ligaments

Non-Operative Treatment

- Tile A (stable) injuries can generally bear weight as tolerated
- Walker/crutches/cane often helpful in early mobilization
- Serial radiographs followed during healing
- Displacement requires reassessment of stability and consideration given to operative treatment

Non-Operative Treatment

- Tile B (partially stable) injuries can be treated non-operatively if deformity is minimal
- Weight bearing should be restricted (toe-touch only) on side of posterior ring injury
- Serial radiographs followed during healing
- Displacement requires reassessment of stability and consideration given to operative treatment

Non-Operative Treatment

- Failure of non-operative treatment may be due to displacement after mobilization
- Excessive pain which precludes early mobilization may also be failure of non-operative treatment

Principles of Operative Treatment

- Posterior ring structure is important
- Goal is restoration of anatomy and enough stability to maintain reduction during healing
- Most injuries involve multiple sites of injury
  - In general, more points of fixation lead to greater stability
  - This does NOT mean that all sites of injury need fixation

Principles of Operative Treatment

- Anterior ring fixation may provide structural protection of posterior fixation
- If combined open and percutaneus techniques are used, the open portion is often done first to aid in reduction of the percutaneusly treated injury

Surgical Treatment: Preoperative Planning

- Consider patient related factors
  - Surgical clearance, resuscitation
  - Coordination of care
    - Trauma surgeon, intensivist, neurosurgeon

Surgical Treatment: Preoperative Planning

- Consider patient related factors
  - Associated injuries
    - May need general surgeon, genitourinary surgeon, gynecologist, plastic surgeon

Preoperative Planning

- Timing of surgery
  - Reduction may be easiest in first 24-48 hours
    - May aid in percutaneus reduction
  - Patients often not adequately resuscitated in first 24 hours
  - Potential for surgical “secondary hit” on post-injury days 2-5
    - May be a significant issue in open procedures

Preoperative Planning

- Intraoperative imaging
  - Radiolucent table
  - Fluoroscopy
  - Radiologic Technician and Surgeon understand C-arm views necessary

Preoperative Planning

- Reduction tools
  - Traction
  - Pelvic manipulator (e.g. femoral distractor)
  - Specialized clamps

Preoperative Planning

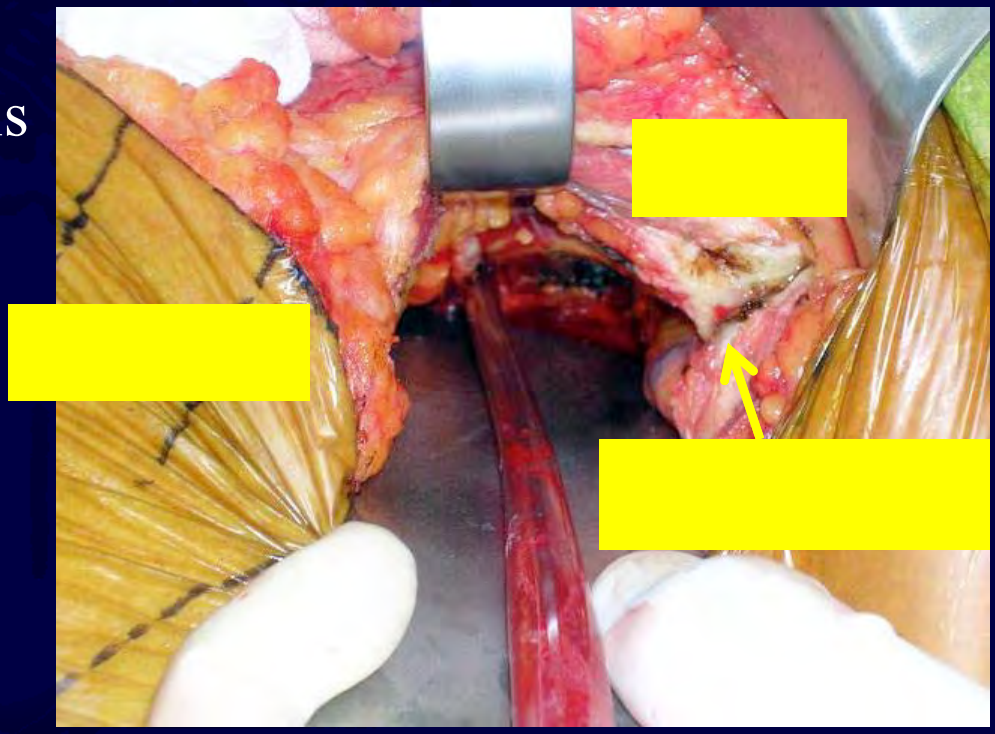
- Implants needed
  - Extra-long screws
  - Cannulated screws, often extra-long with appropriate instruments
  - Specialized plates for contourability (reconstruction plates)
  - External fixation

Preoperative Planning

- Surgical approaches planned
  - Soft tissues examined
  - Patient positioning planned
    - Is it safe to prone patient?
    - Equipment/padding for safe prone positioning

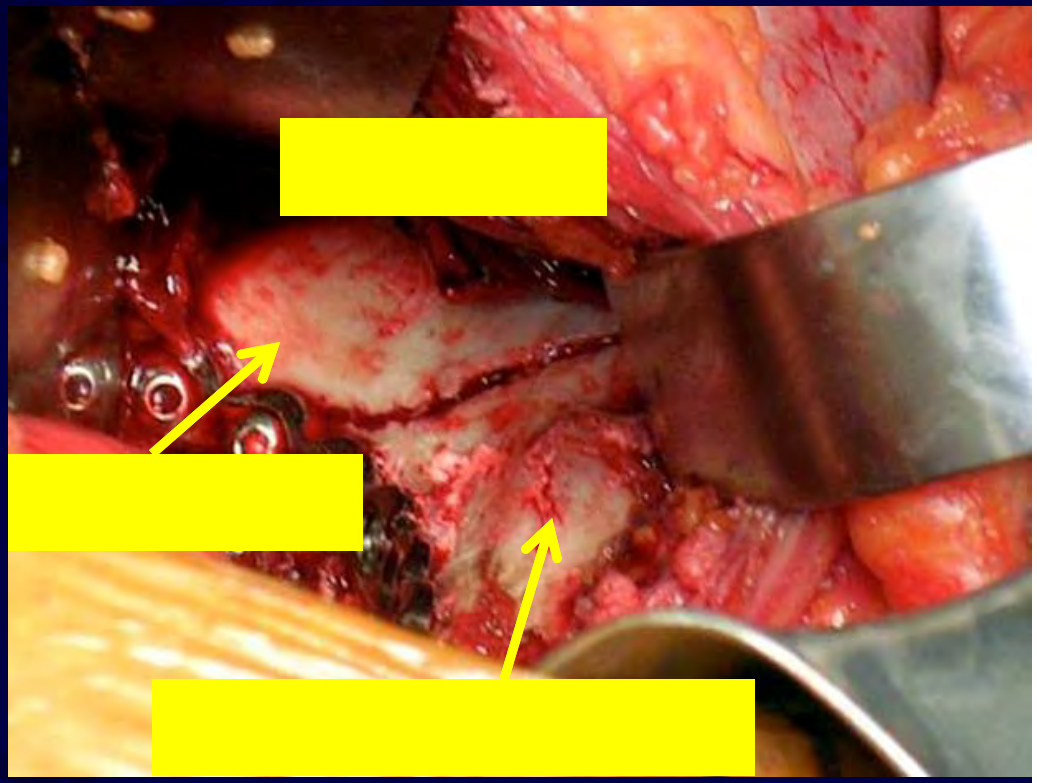
Surgical Approaches: Anterior Pelvic Ring

- Pfannenstiel
  - Exposure of symphysis pubis and pubic bones
  - Avoid transection of rectus tendons
  - Elevate rectus subperiosteally



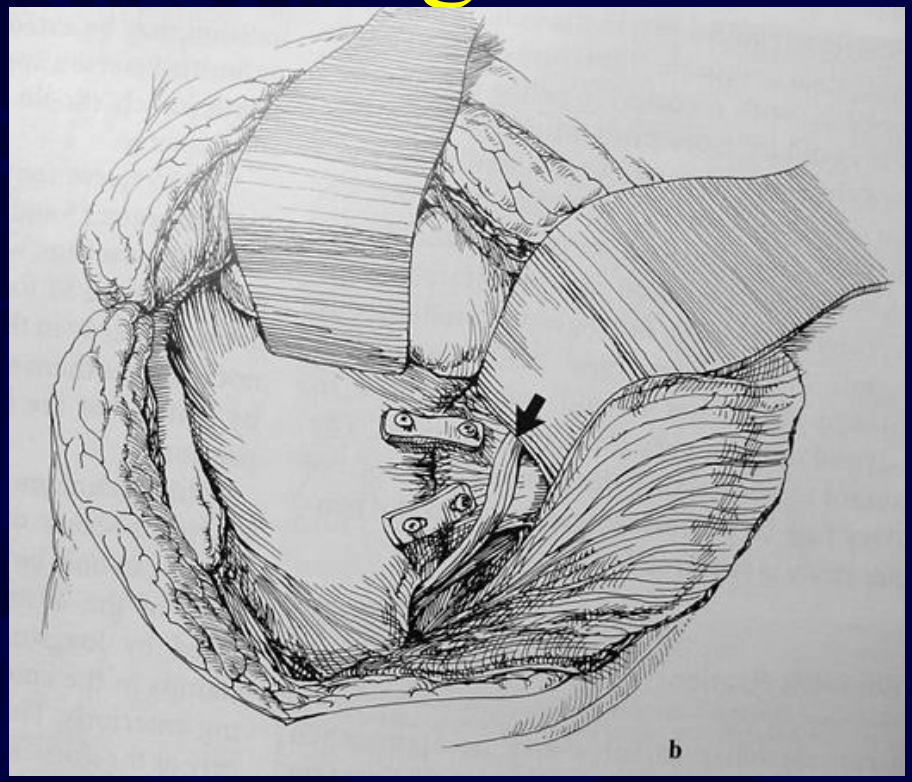
Surgical Approaches: Anterior Pelvic Ring

- Stoppa extension
  - Exposes symphysis to SI joint along pelvic brim



Surgical Approaches: Posterior Pelvic Ring

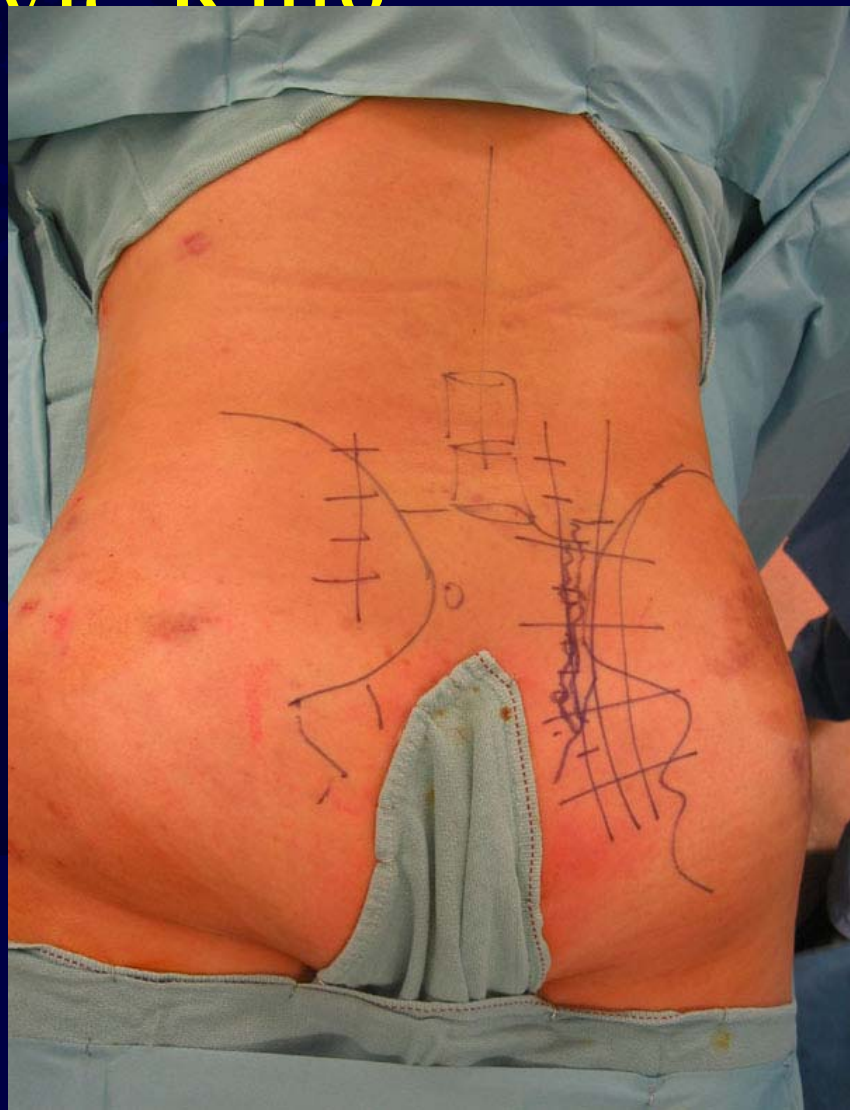
- Anterior approach
  - Iliac window of the ilioinguinal
  - Exposure of SI joint



M Tile in Schatzker, Tile (eds). Rationale of Operative Fracture Care, Springer, Berlin, 1996, p221-270

Surgical Approaches: Posterior Pelvic Ring

- Posterior approach
  - Exposure of sacrum and posterior ilium
  - Sacral fractures
  - Iliac fracture dislocations of the SI joint (crescent fracture)



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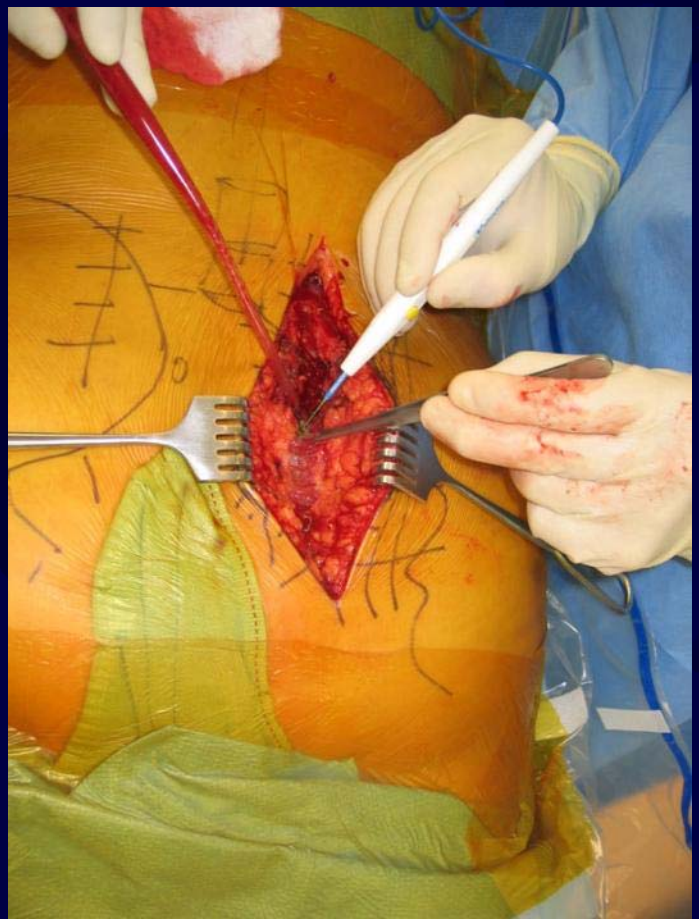
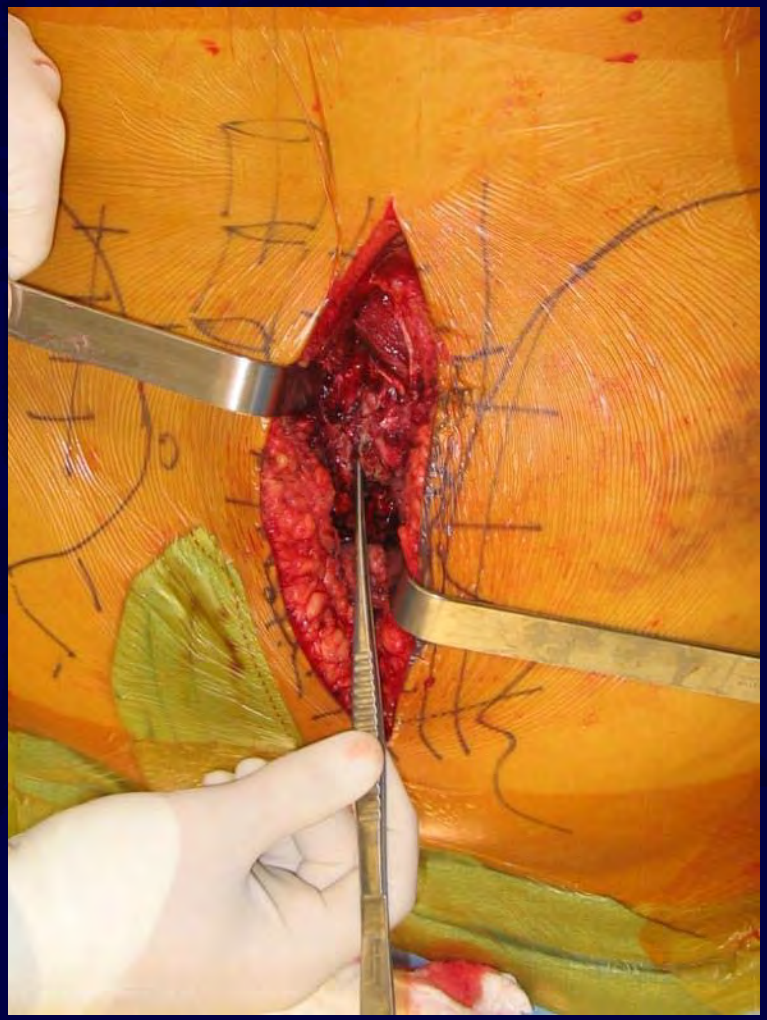
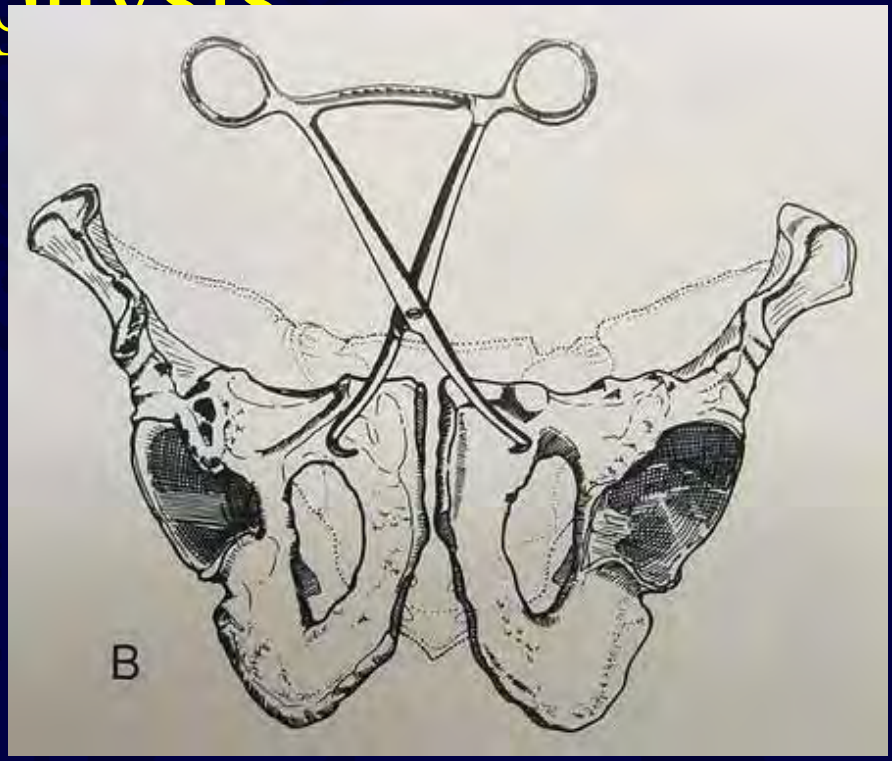




Reduction and Fixation: Symphysis

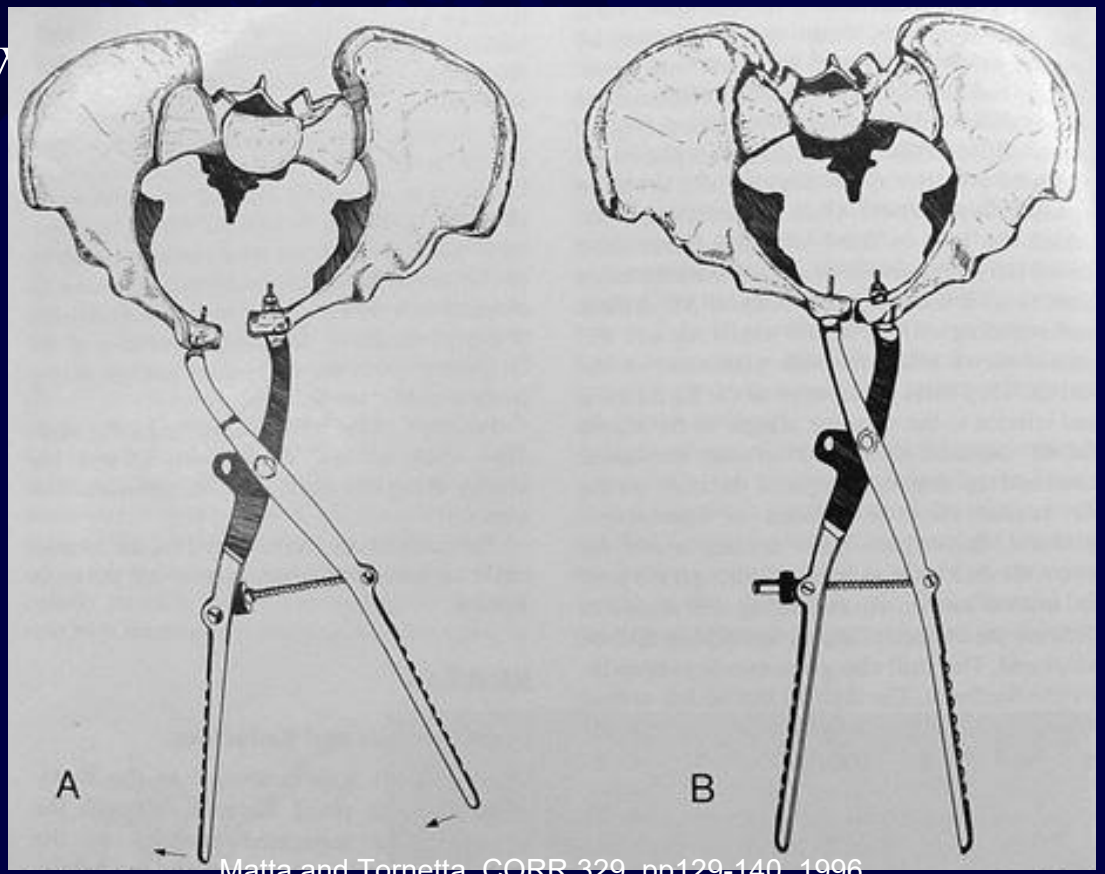
- Reduction with clamp
  - Weber clamp on pectineal eminences



Matta and Tornetta, CORR 329, pp129-140, 1996

Reduction and Fixation: Symphysis

- Reduction with clamp
  - Jungbluth clamp w
    screws



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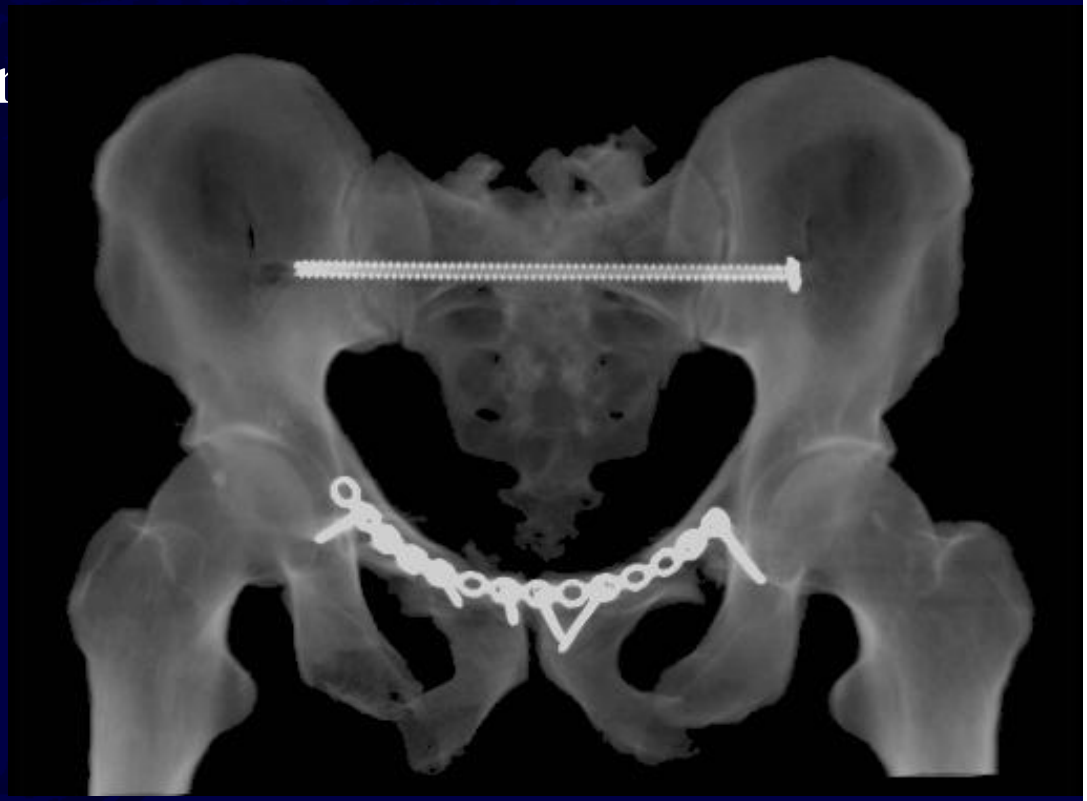
Reduction and Fixation: Symphysis

- Pelvic reconstruction plate
  - Commonly 6 hole plate
  - Variable directions of screws

Reduction and Fixation: Ramus Fractures

- Pelvic reconstruction plate
- Medullary screw fixation
  - Retrograde
  - Antegrade



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Reduction and Fixation: Ramus Fractures

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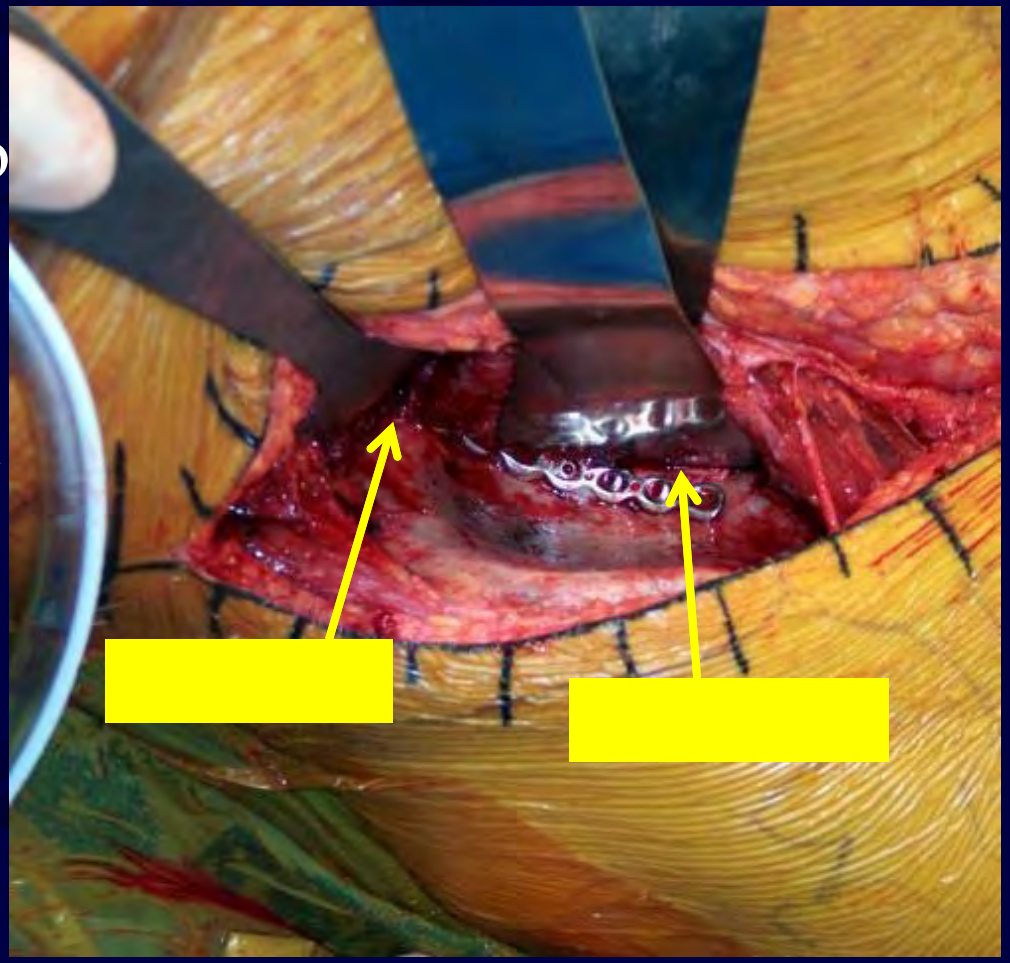
Reduction and Fixation: Ramus Fractures

- Anterior External Fixation
  - Controls rotation only
  - Pins in gluteus medius pillar of ilium
  - Alternative placement in Anterior Inferior Iliac Spine

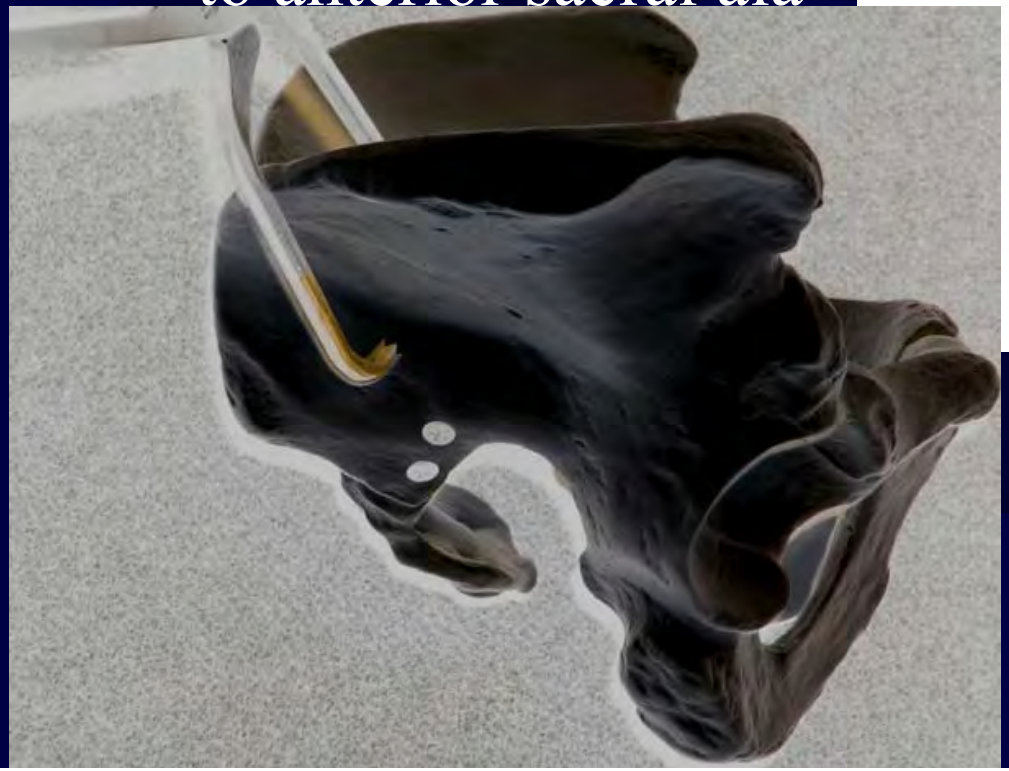
Reduction and Fixation: SI Joint Dislocation

- Anterior exposure facilitates reduction o dislocation
- Iliac window of ilioinguinal approach



Reduction and Fixation: SI Joint Dislocation

- Clamp applied from lateral, posterior ilium to anterior sacral ala

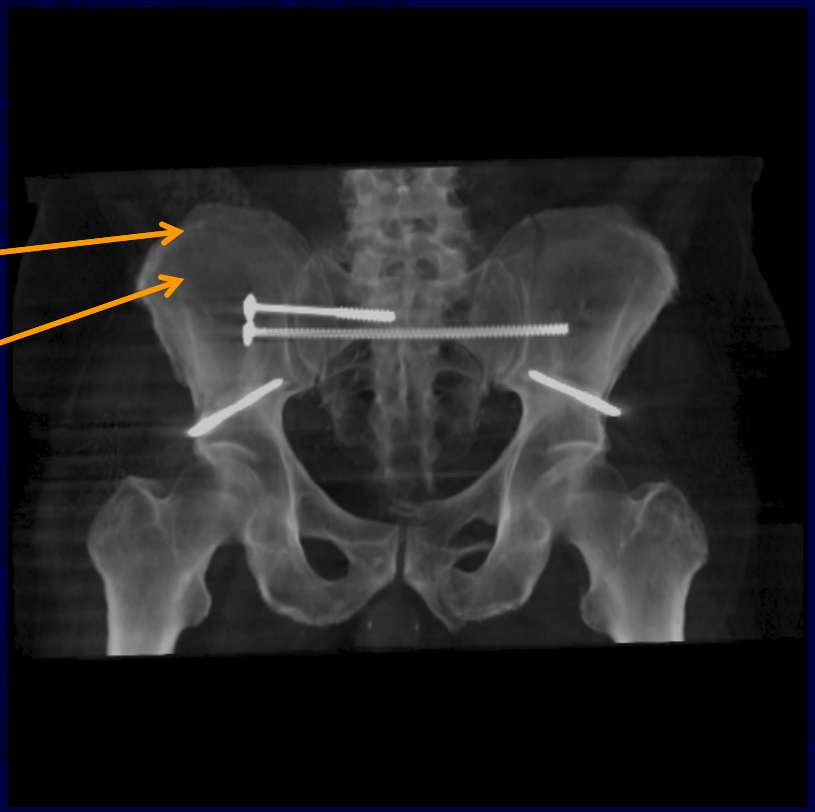


Reduction and Fixation: SI Joint Dislocation

- Plating
  - Need more than one plate to avoid linkage displacement
  - Can be used in tandem or with SI screw

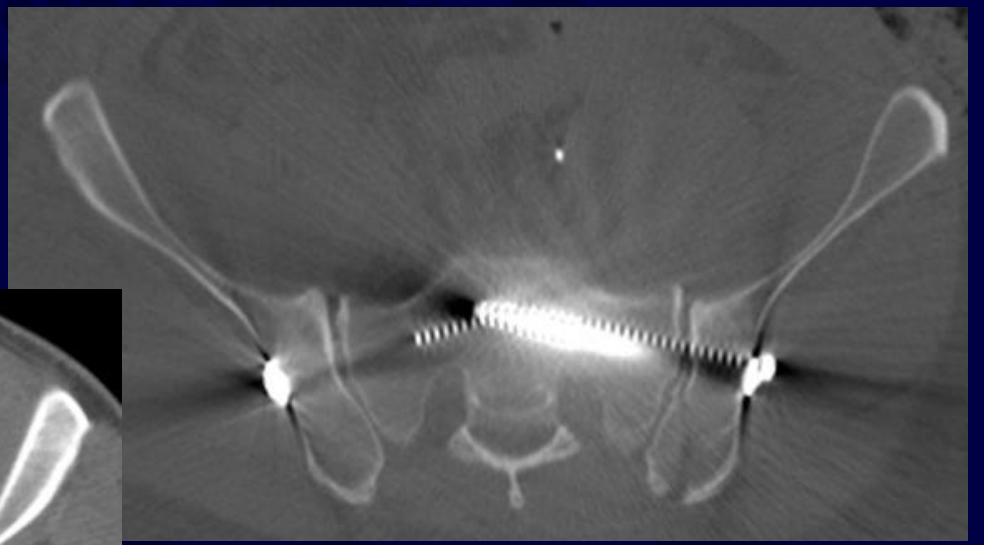
Reduction and Fixation: SI Joint Dislocation

- SI screw
  - Cannulated for ease of placement
  - Partially threaded for reduction
  - Fully threaded for improved fixation
  - Knowledge of anatomy and imaging is essential
  - Be aware of sacral dysmorphism



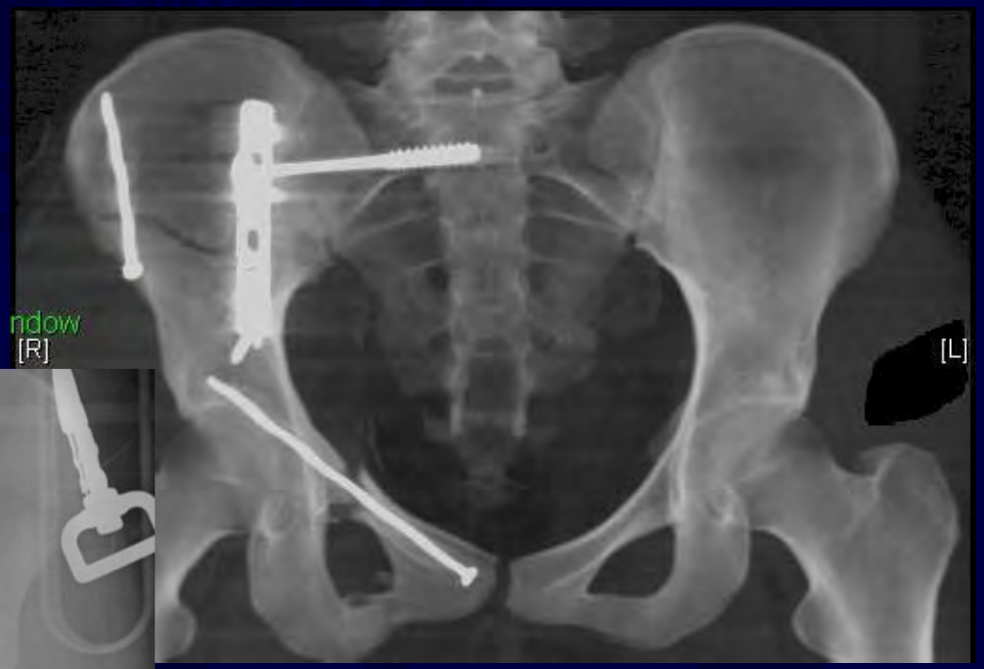
Reduction and Fixation: SI Joint Fracture/Dislocation "Crescent Fracture"

- SI screw
  - If caudal segment is in the path of fixation screw
  - Opportunity for percutaneus treatment



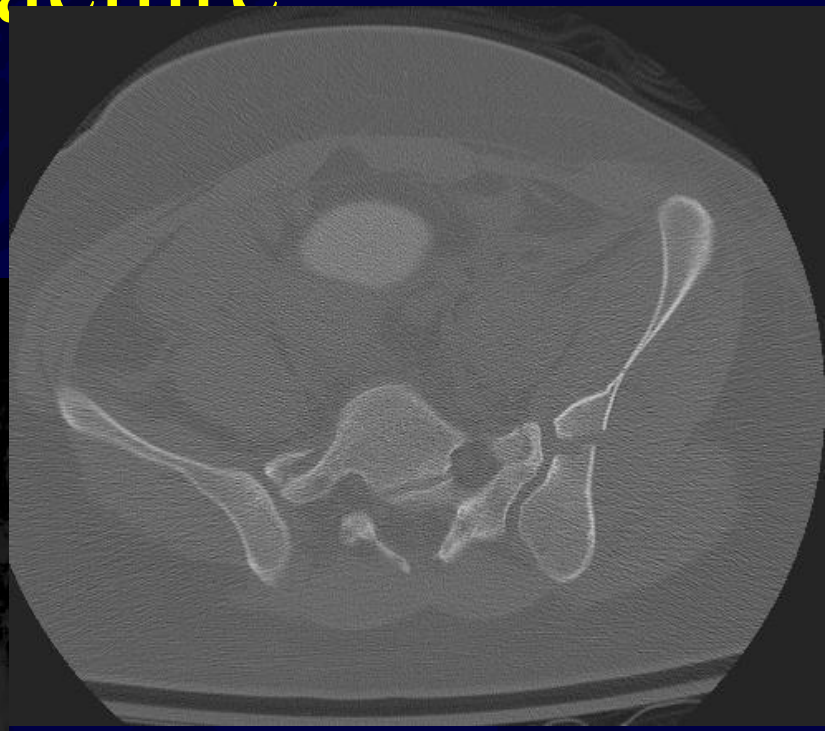
Reduction and Fixation: SI Joint Fracture/Dislocation "Crescent Fracture"

- SI screw and plate
  - Anterior ORIF if large fragment
  - Supplement as needed with SI screw



Reduction and Fixation: SI Joint Fracture/Dislocation "Crescent Fracture"

- ORIF with plate
  - Posterior approach



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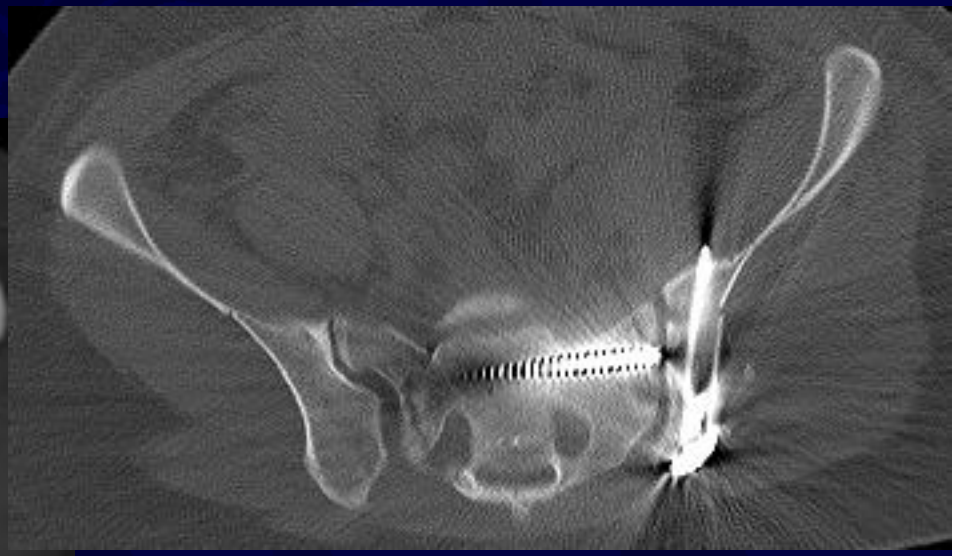

Reduction : Sacral Fracture

- Indirect reduction
  - Anterior ring reduction

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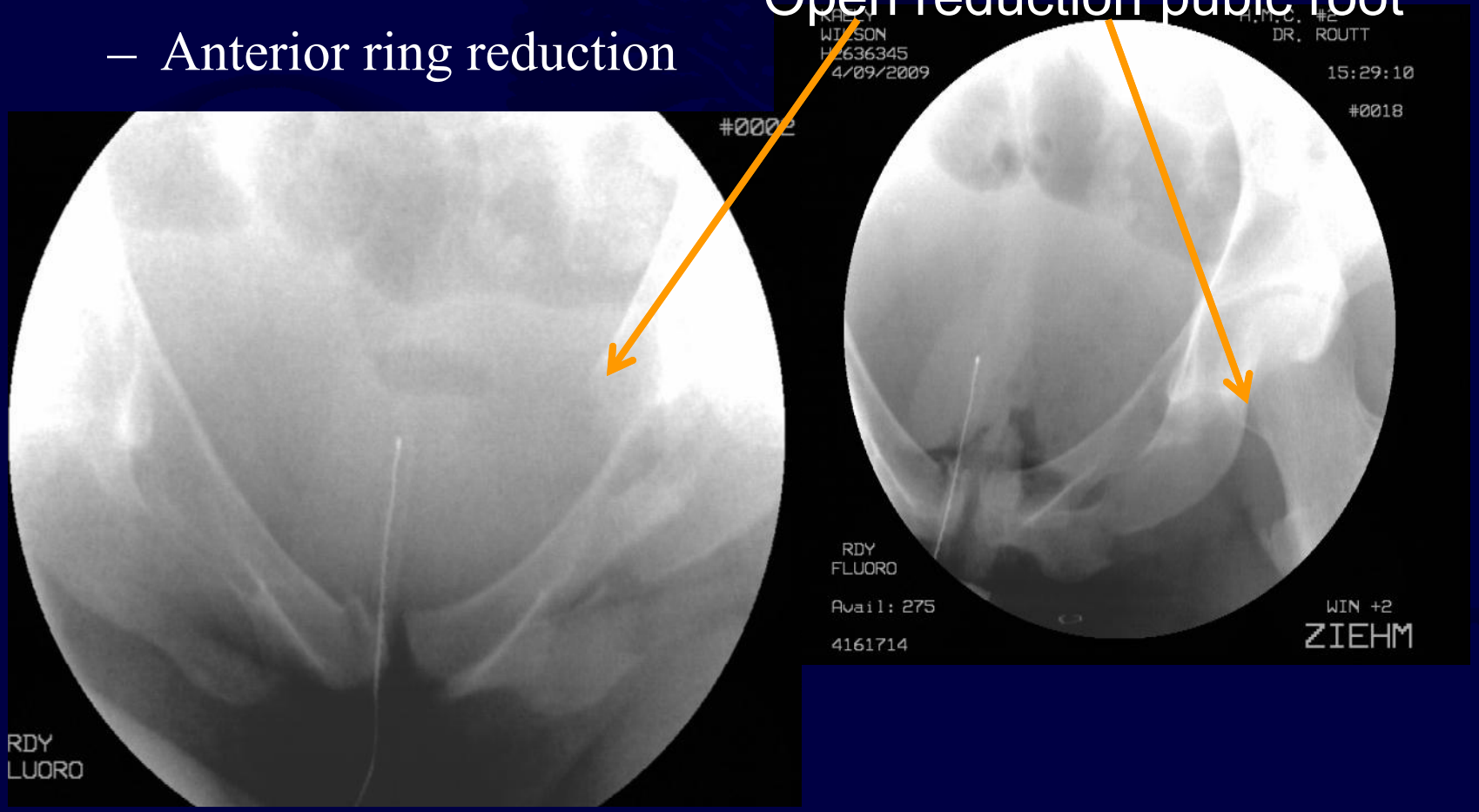
  - Anterior ring reduction

Open reduction pubic root



Reduction : Sacral Fracture

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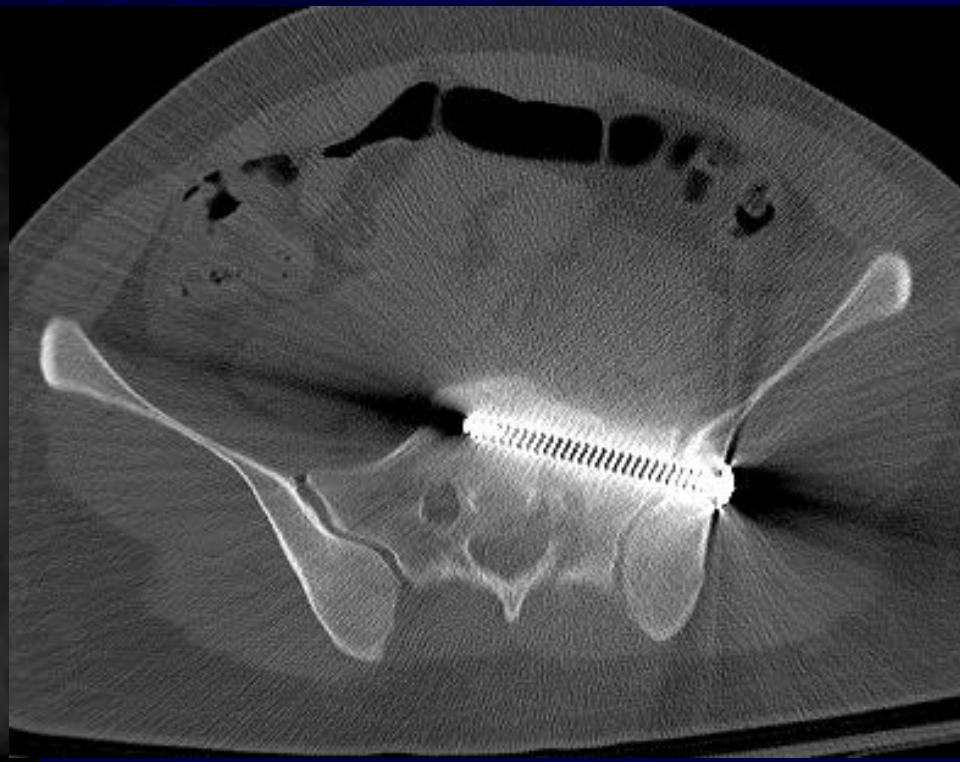
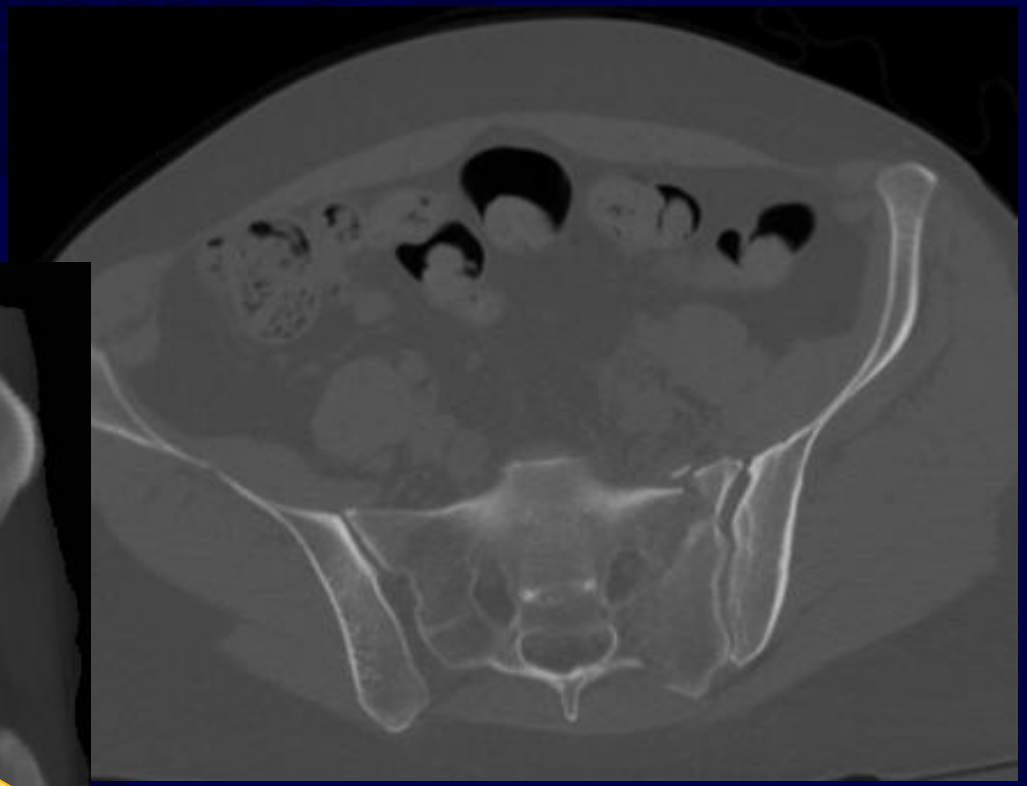


Reduction : Sacral Fracture

- Indirect reduction
  - Distractor
  - Traction



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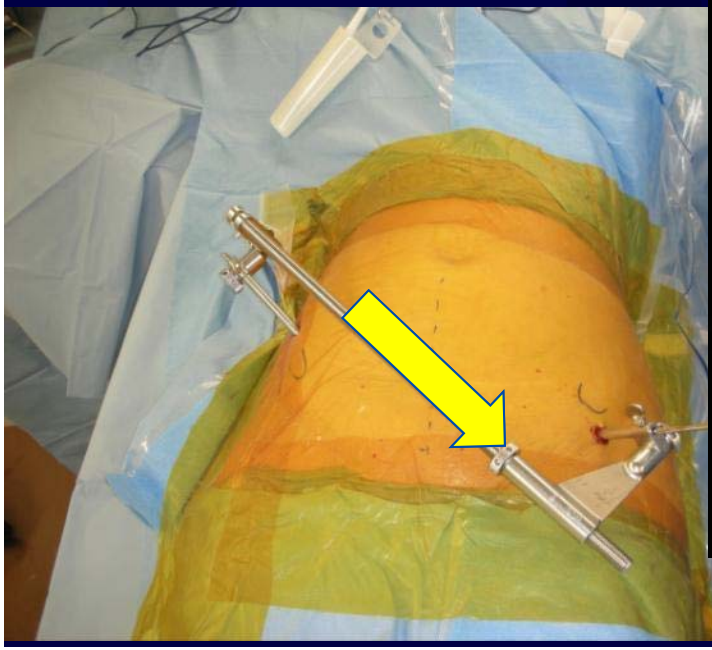
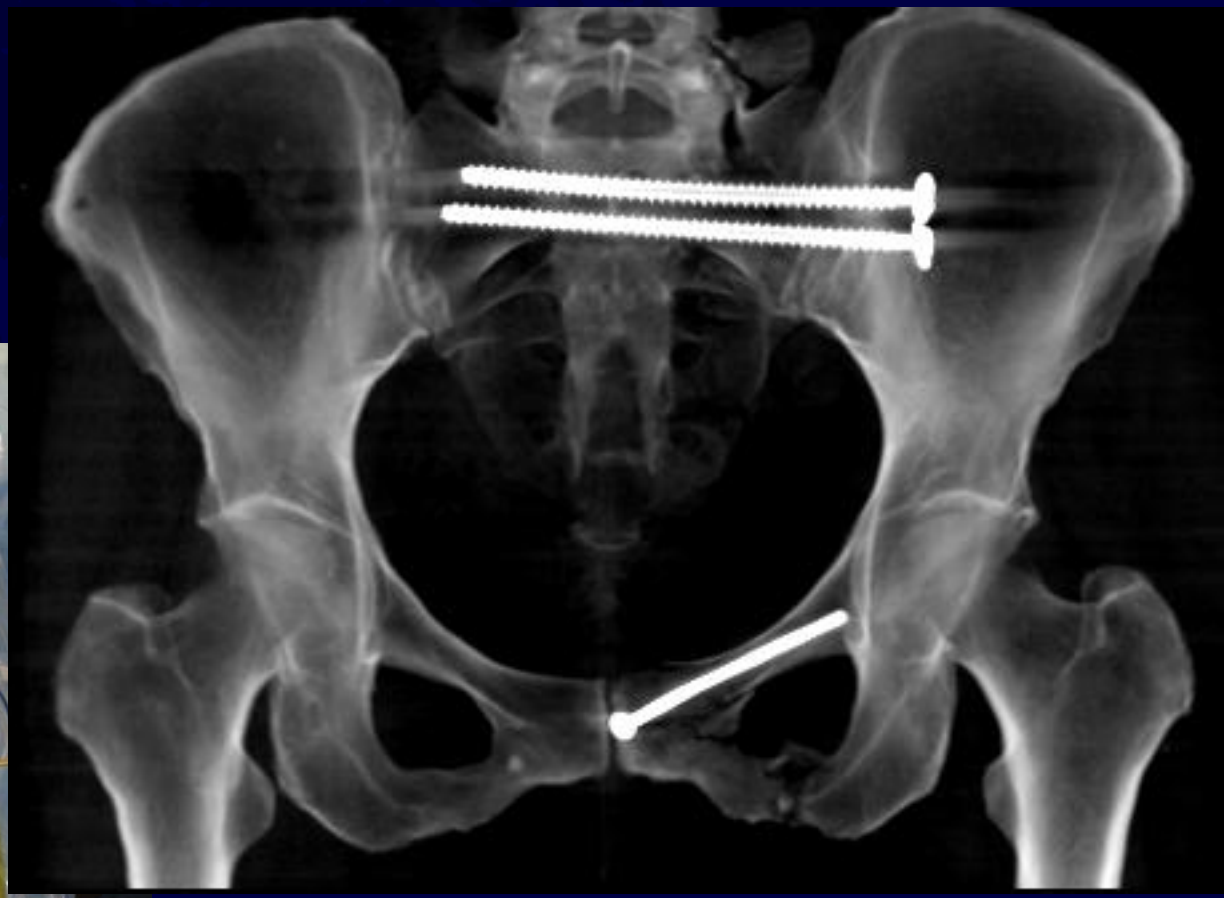
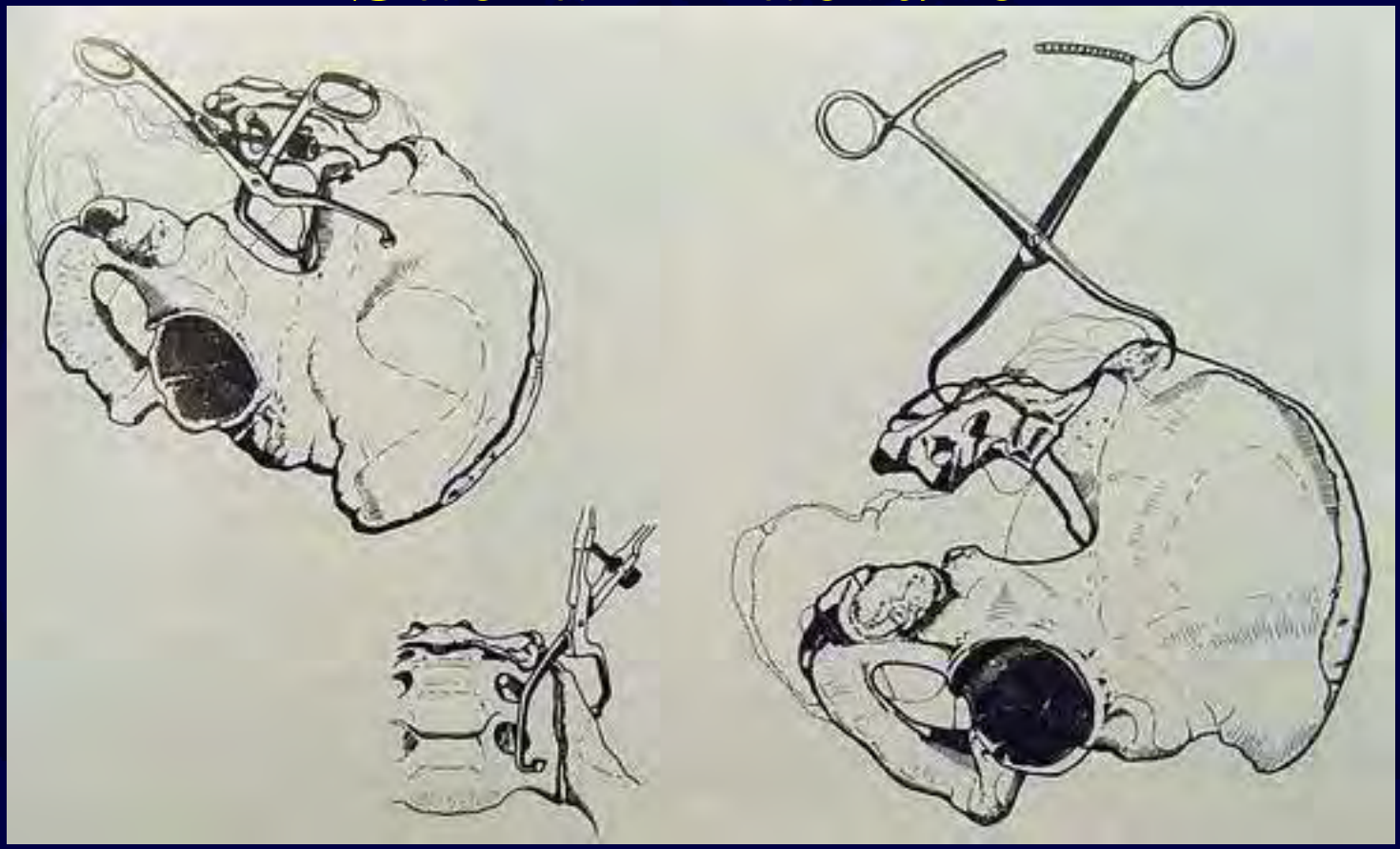




Reduction : Sacral Fracture

- Direct reduction
  - Posterior exposure
  - Clamp application
    - Pointed Weber clamps
  - Can decompress as well if needed

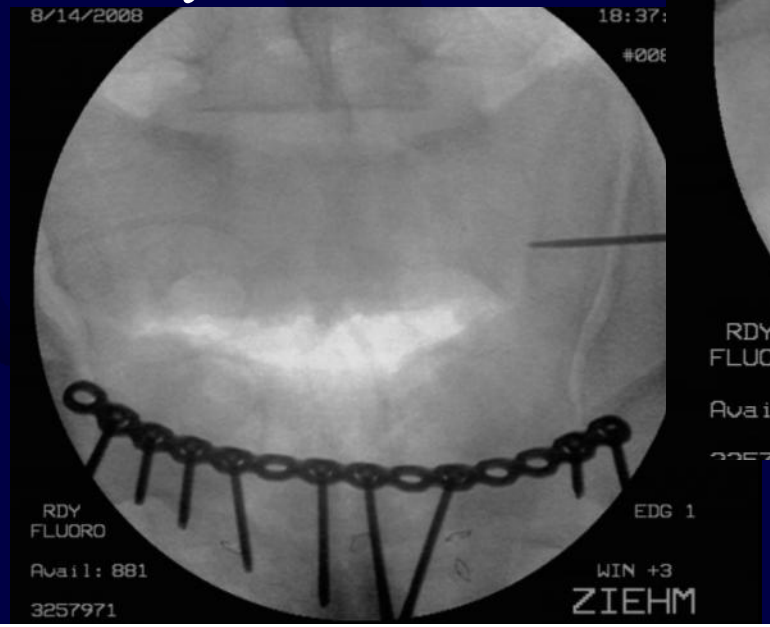
Reduction : Sacral Fracture

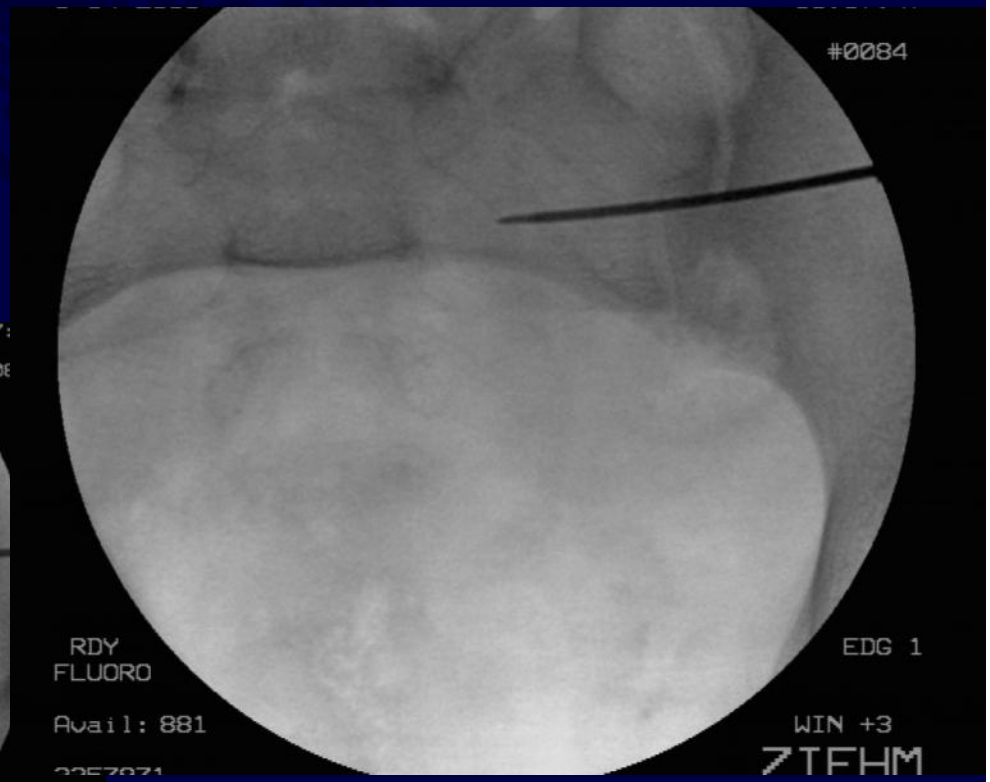


Matta and Tornetta, CORR 329, pp129-140, 1996

Fixation:
Sacral Fracture

- Iliosacral screws
  - Upper 2 sacral segments
  - Fully threaded screws
  - Know morphology, anatomy





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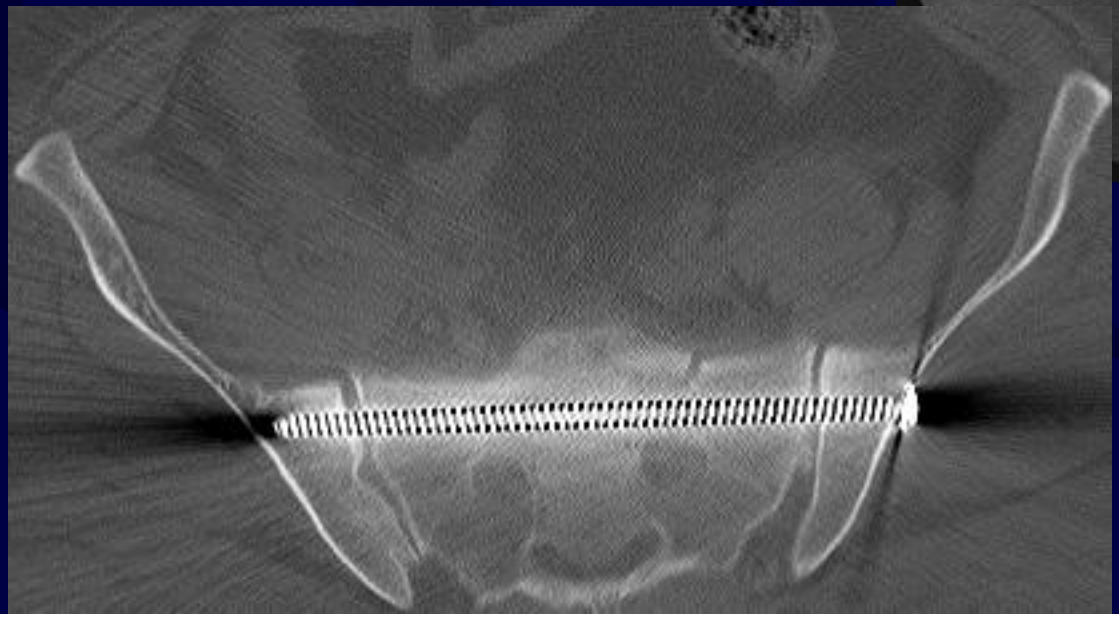
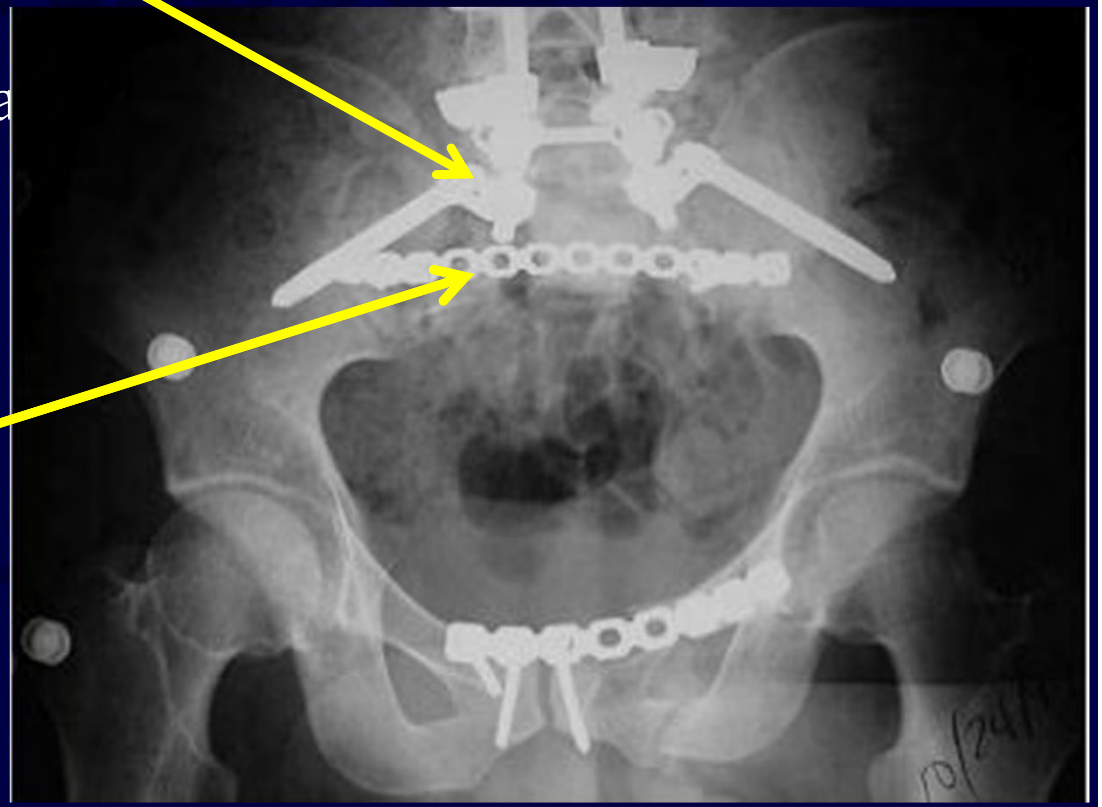


Fixation:
Sacral Fractures

- Lumbopelvic fixation
  - Vertical control
  - Can be useful in unsta
    H or Y type sacral
    fracture
- Transiliac plating



Biomechanics of Pelvic Fixation:

- No clinical comparison studies exist
- Experimental biomechanical data exist
- In general, it seems that more points/planes of fixation provide better stability
- How much stability is enough is injury dependant

Biomechanics of Pelvic Fixation: Anterior Fixation

- Anterior plating superior to external fixation in internal/external rotation
- Neither technique very effective at control of vertical displacement
- Anterior fixation can “protect” posterior fixation from failure

Biomechanics of Pelvic Fixation: Anterior Fixation

- Two hole symphyseal plate inadequate
- Retrograde pubic screw higher failure rate than antegrade

Biomechanics of Pelvic Fixation: Posterior Fixation

- Options include single SI screw, multiple SI screws, double plating of SI joint, transiliac plate of sacral fracture, or plate plus SI screw for sacral fracture or SI dislocation
- Any of the above are more stable than single SI screw in unstable injuries

Biomechanics of Pelvic Fixation: Posterior Fixation

- Lumbopelvic fixation
  - Lumbopelvic dissociation (unstable Y, H, or U type sacral fractures)
  - Sacral fractures with significant instability
  - Can provide axial (vertical) stability that is not as dependant on fracture reduction/stability

Outcomes

- Pain common
- Improvement occurs for at least a year in most patients
- Neurologic injury most common predictor of poor outcome

Outcomes

- SI dislocations have poor tolerance for residual displacement
- Sacral fractures have more tolerance for displacement, but parameters poorly understood
- Injury Severity Score and fracture type do not correlate with functional outcome

Conclusions: Pelvic Ring Injury

- Complex constellation of injuries
- Treatment based on comprehensive understanding of potential pelvic ring instability, displacement, and associated injuries
- Surgical techniques for reduction and stabilization continue to evolve

Acknowledgment

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