The Acute Management of Pelvic Ring Injuries

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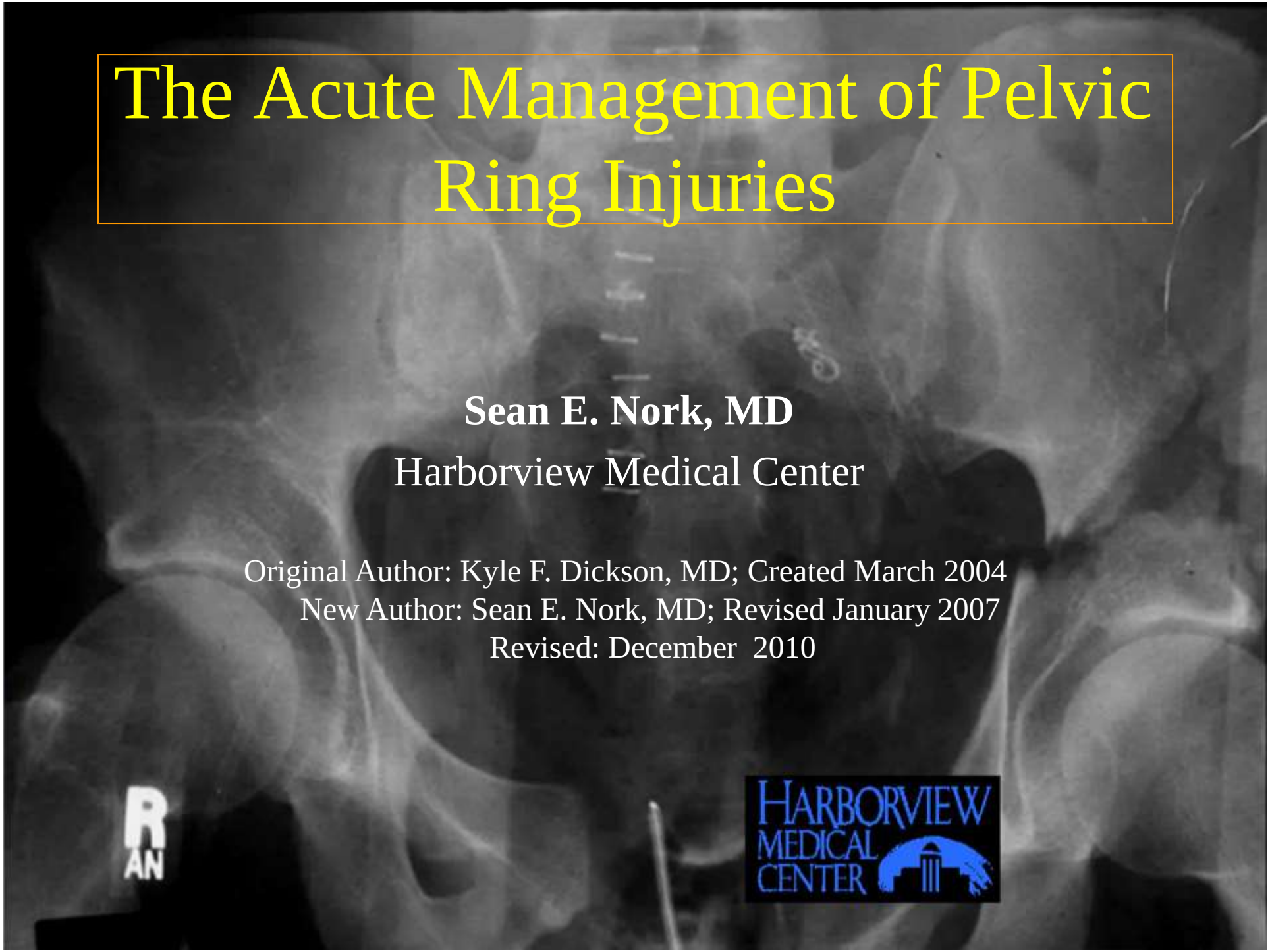
New Author: Sean E. Nork, MD; Revised January 2007
Revised: December 2010



Pelvic Ring Injuries

High energy

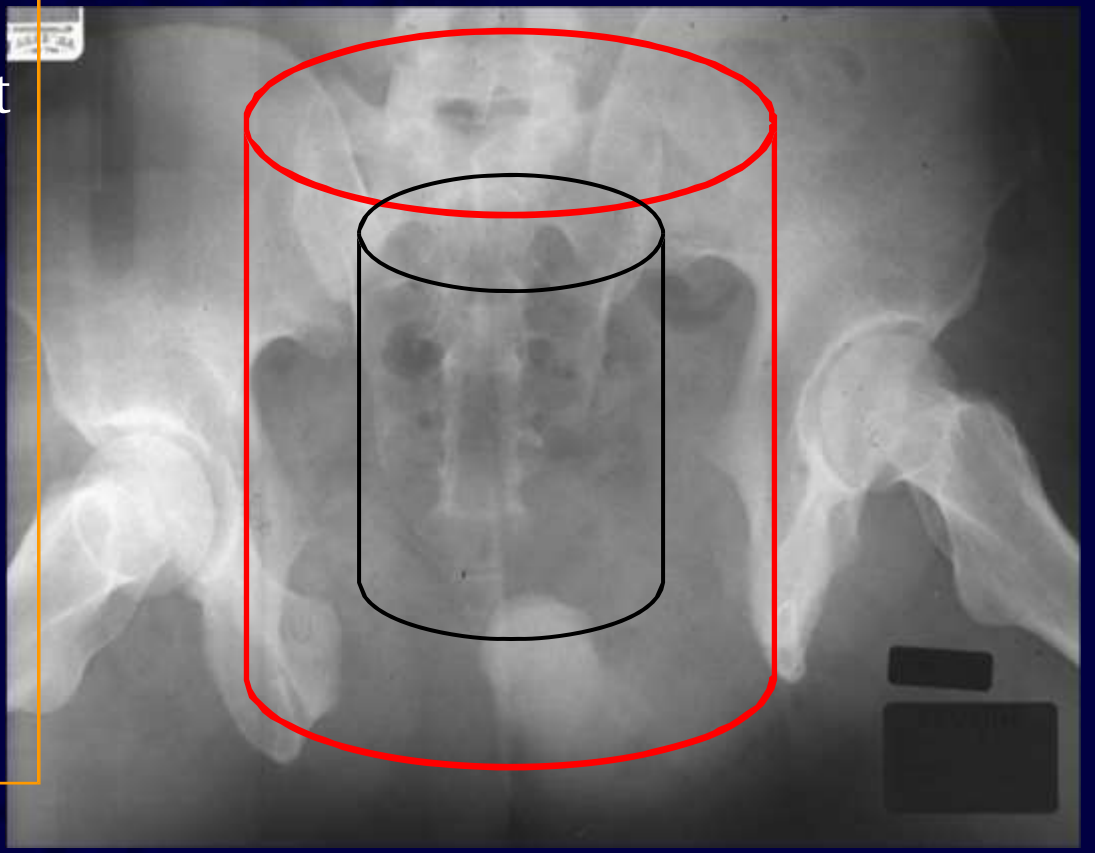
Morbidity/Mortality

Hemorrhage

Pelvic Ring Injuries

An unstable pelvic injury may allow hemorrhage to collect in the true pelvis as there is no longer a constraint which allows tamponade.

The volume was traditionally assume to be a cylinder with a volume of $\mathbf{4/3\pi\ r^3}$, However…



Best estimated by a hemi-elliptical sphere
(Stover et al, J Trauma, 2006)

Primary survey: ABC's

Airway maintenance with cervical spine protection

Breathing and ventilation

Circulation with hemorrhage control

Disability: Neurologic status

Exposure/environment control: undress patient but prevent hypothemia

Considerations for Transfer or Care at a Specialized Center: Pelvic Fractures

- Significant posterior pelvis instability/displacement on the initial AP X-ray (indicates potential need for ORIF)
- Bladder/urethra injury
- Open pelvic fractures
- Lateral directed force with fractures through iliac wing, sacral ala or foramina
- Open book with anterior displacement > 2.5 cm (value of 2.5 centimeters somewhat arbitrary and controversial with regards to reliability)

Physical Exam

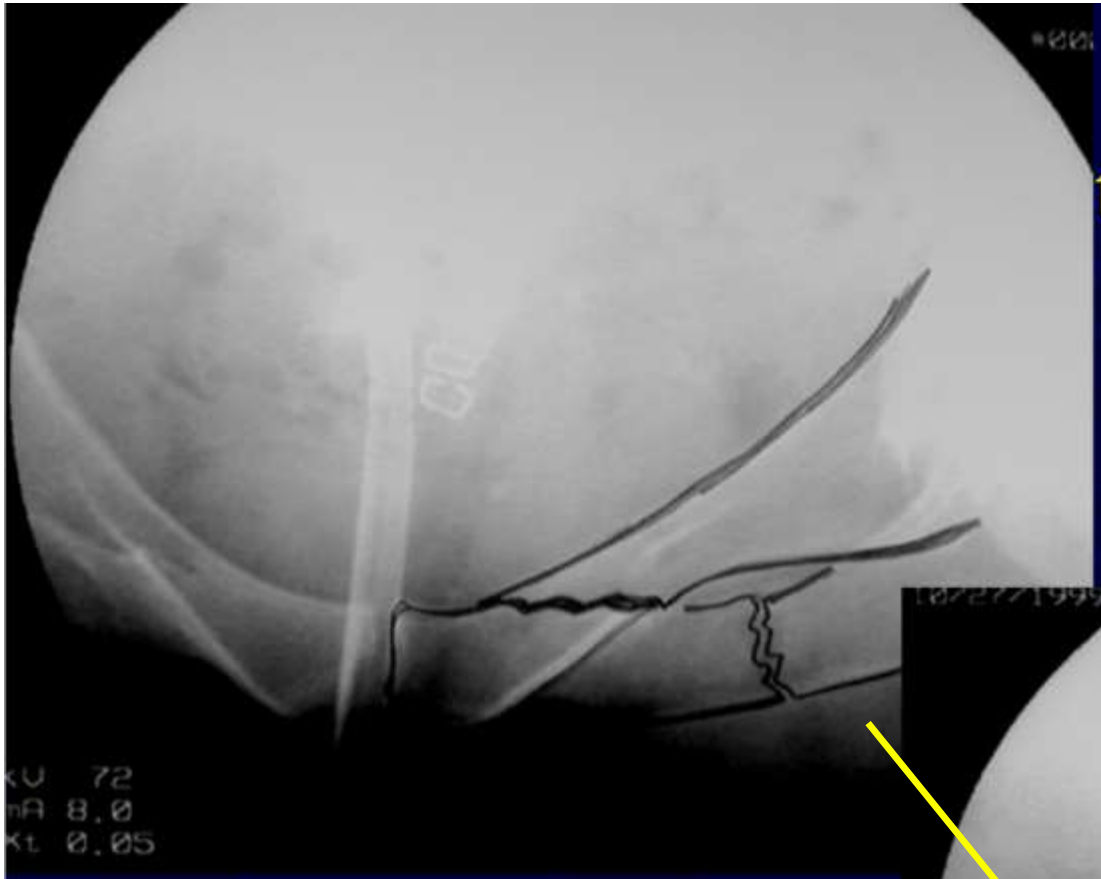
- Degloving injuries
- Limb shortening
- Limb rotation
- Open wounds
- Swelling &

Defining Pelvic Stability???

- Radiographic
- Hemodynamic
- Biomechanical (Tile & Hearn)
- Mechanical

"Able to withstand normal physiological forces without abnormal deformation"

table?



- Single examiner
- Use fluoro if available
- Best in experienced hands

Radiographic Signs of Instability

- Sacroiliac displacement of 5 mm in any plane
- Posterior fracture gap (rather than impaction)
- Avulsion of fifth lumbar transverse process, lateral border of sacrum (sacrotuberous ligament), or ischial spine (sacrospinous ligament)

Open Pelvic Injuries

- Open wounds extending to the colon, rectum, or perineum: strongly consider early diverting colostomy
- Soft-tissue wounds should be aggressively debrided
- Early repair of vaginal lacerations to minimize subsequent pelvic abscess

Urologic Injuries

- 15% incidence
- Blood at meatus or high riding prostate
- Eventual swelling of scrotum and labia (occasional arterial bleeder requiring surgery)
- Retrograde urethrogram indicated in pelvic injured patients

Urologic Injuries

- Intraperitoneal & extraperitoneal bladder ruptures are usually repaired
- A foley catheter is preferred
- If a supra-pubic catheter it used, it should be tunneled to prevent anterior wound contamination
- Urethral injuries are usually repaired on a delayed basis

Sources of H

- External (open wounds)
- Internal: Chest
- Long bones
- Abdomina
- Retroperitoneal

Sources of Hemorrhage

- External (open wounds)
- Internal: Chest
- Long bones
- Abdominal
- Retroperitoneal

Chest x-ray
Physical exam, swelling
DPL, ultrasound, FAST
CT scan, direct look

Shock vs Hemodynamic Instability

- Definitions Confusing
- Potentially based on multiple factors & measures

- Lactate
- Base Deficit
- SBP < 90 mmHg

- Ongoing drop in Hematrocrit

Pelvic Fractures & Hemorrhage

- Fracture pattern associated with risk of vascular injury (Young & Burgess)
  - External rotation and vertical shear injury patterns at higher risk for a vascular injury that internal rotation patterns
  - APC & VS (antero-posterior compression and vertical shear) at increased risk of hemorrhage
  - Injury patterns that are tensile to N-V structures at increased risk
    - (eg iliac wing fractures with GSN extension

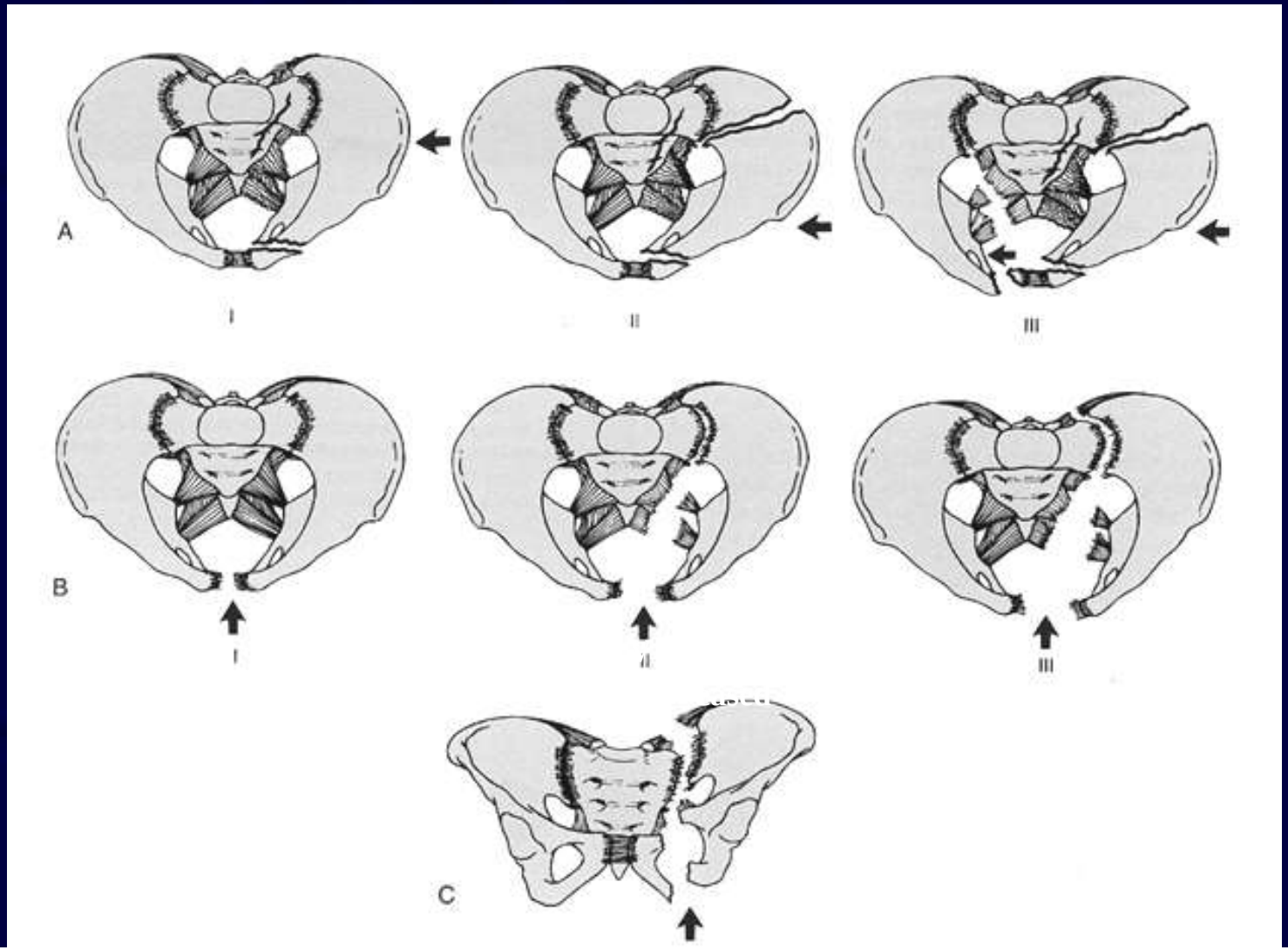
Dalal et al, JT, 1989
Burgess et al, JT, 1990
Whitbeck et al, JOT, 1997
Switzer et al, JOT, 2000
Eastridge et al, JT, 2002

Pelvic Fractures & Hemorrhage: Young and Burgess Classification

Lateral Compression (LC)

Anteroposterior Compression (APC)

Vertical Shear (VS)

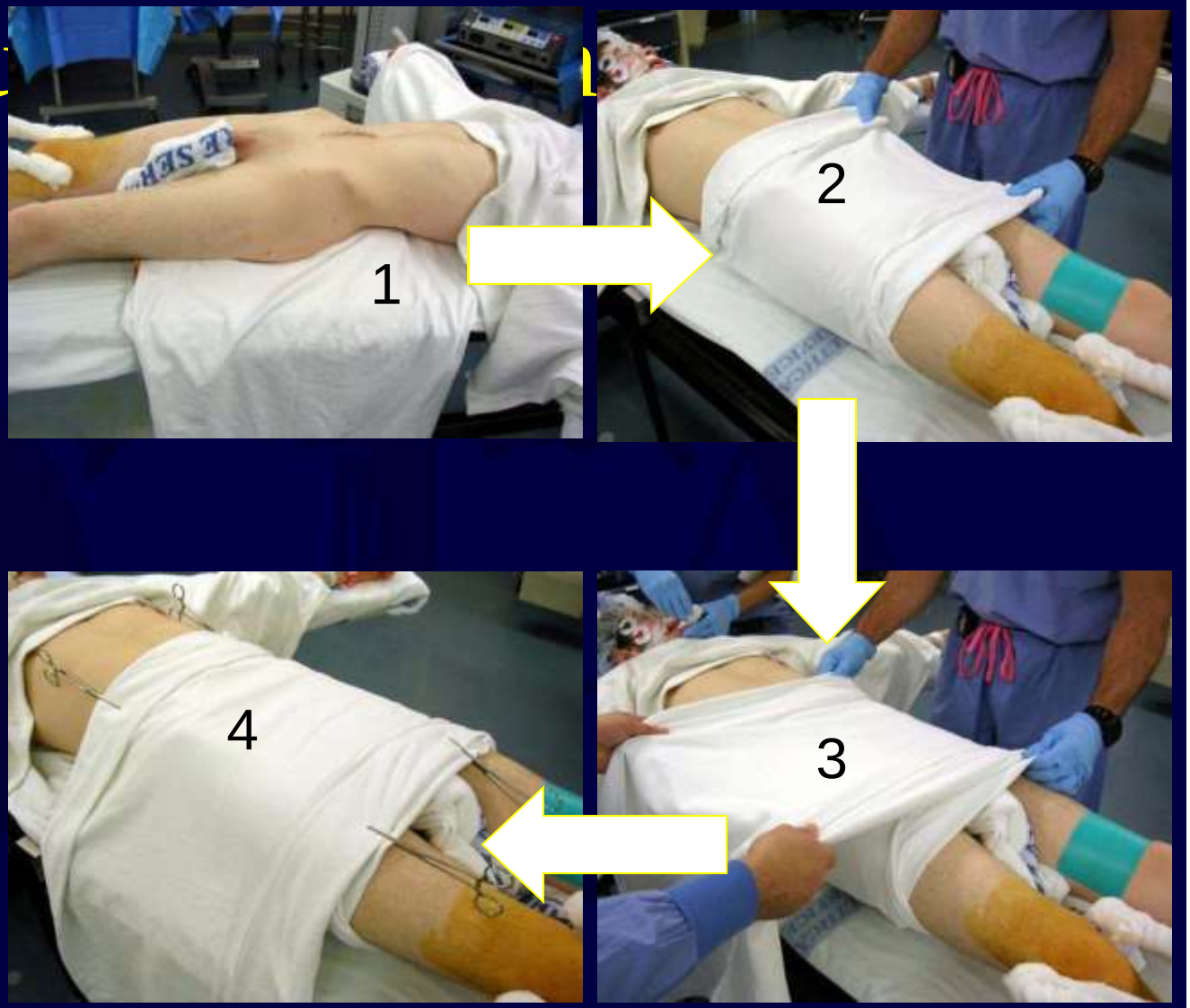


Hemorrhage Control: Methods

- Pelvic Containment
  - *Sheet*
  - *Pelvic Binder*
  - *External Fixation*
- Angiography
- Laparotomy

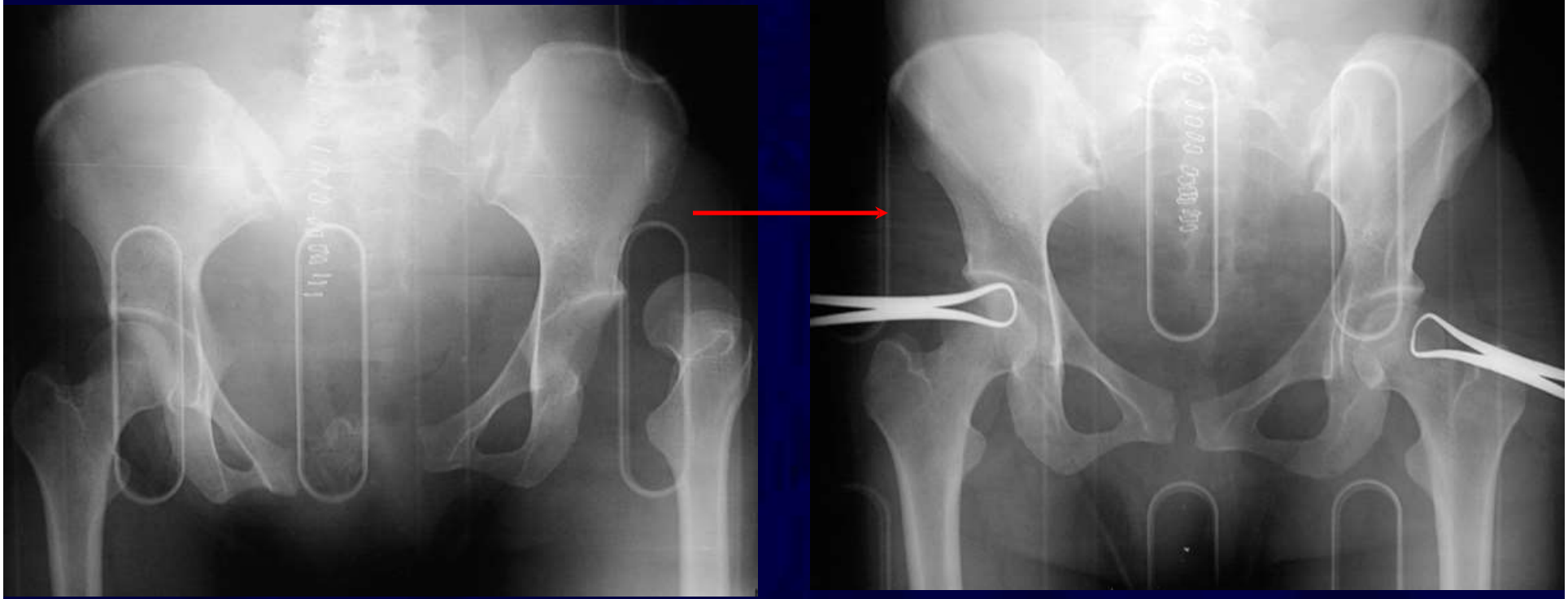
Circu

- Supine
- 2 “Wrappers”
- Placement
- Apply
- “Clamper”
- 30 Seconds

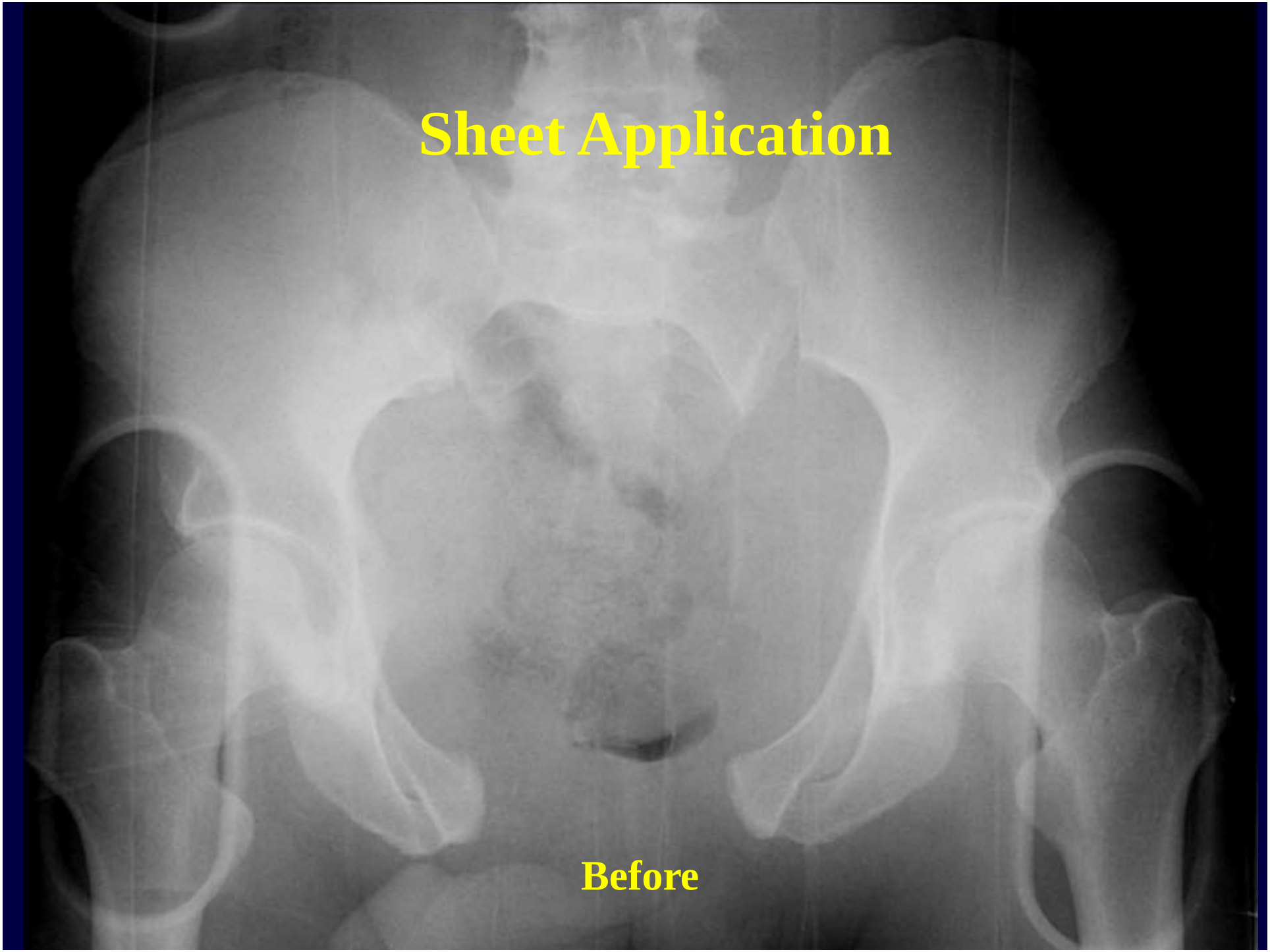


Routt et al, JOT, 2002

Sheet Application



Sheet Application



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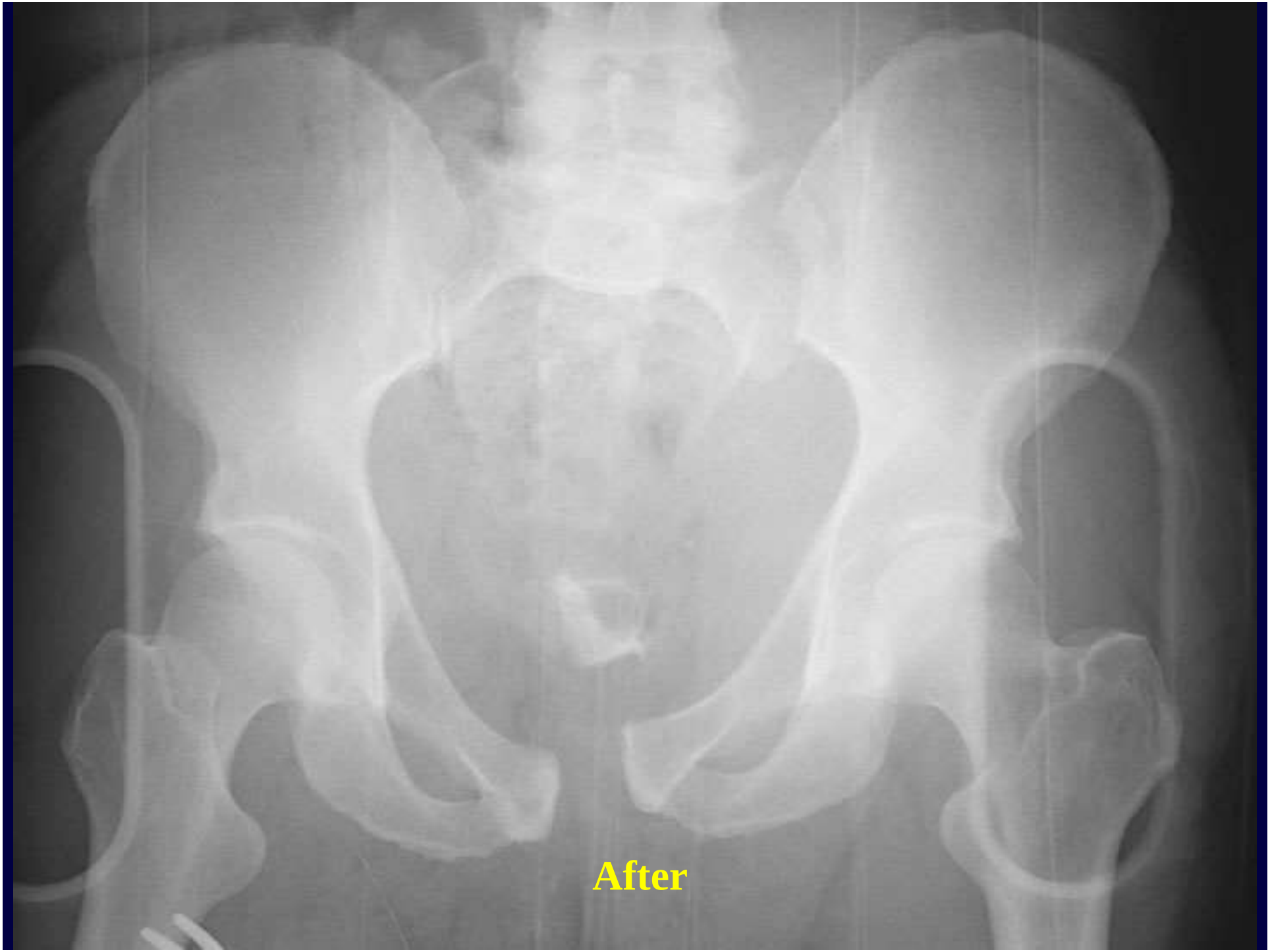
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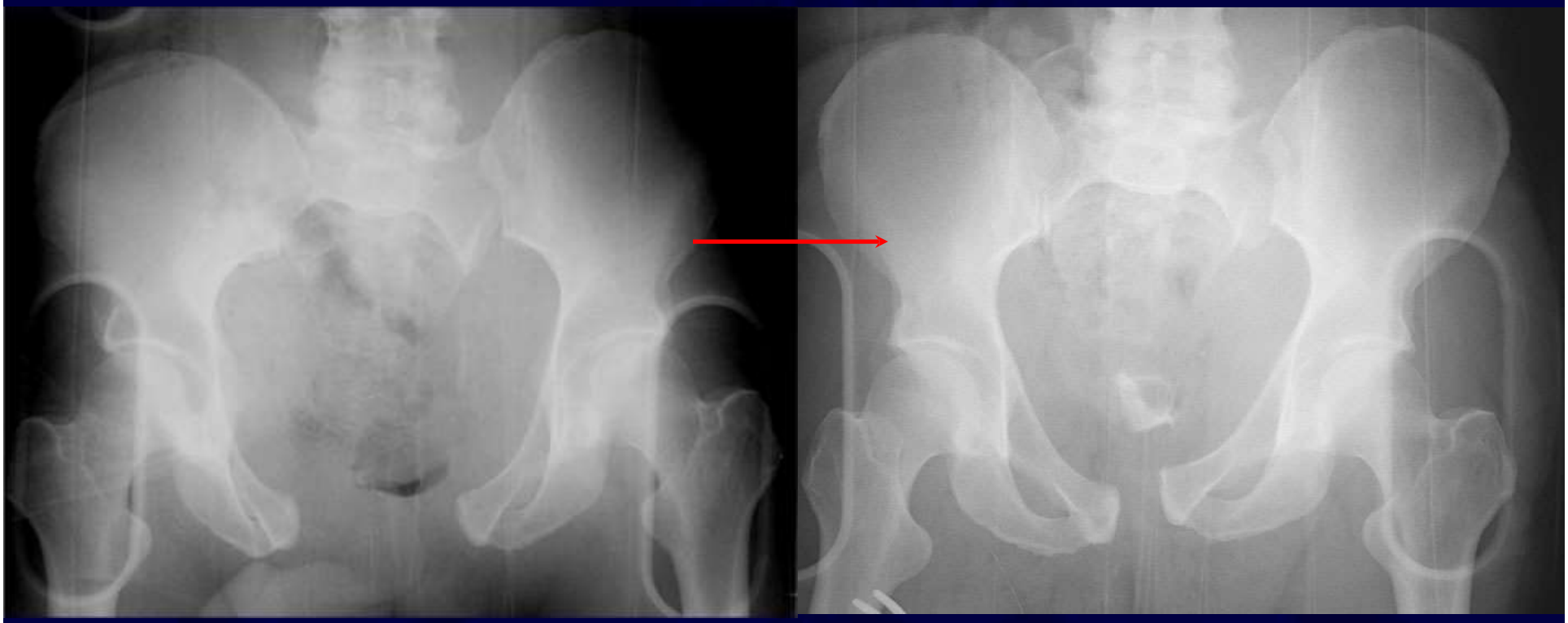
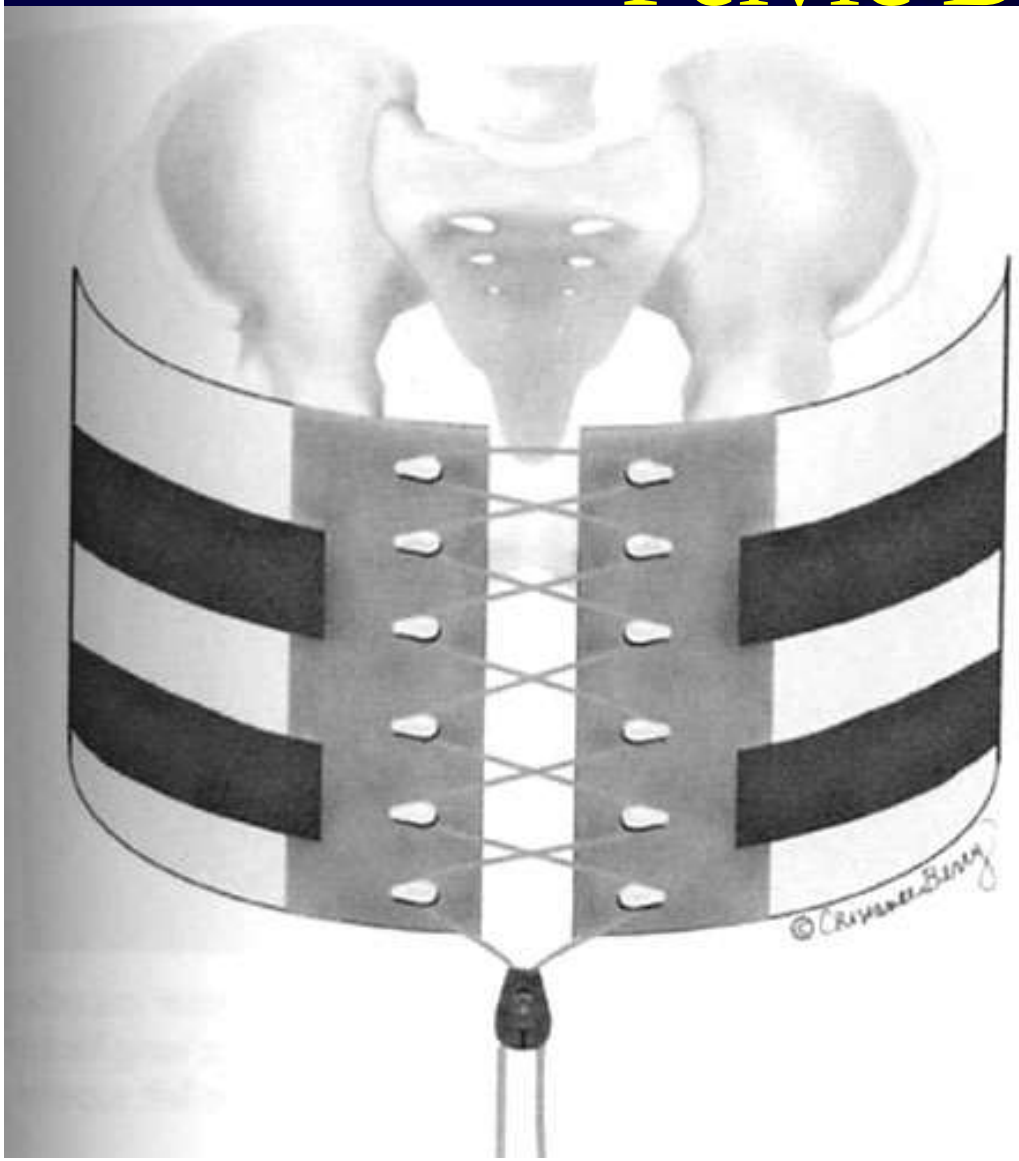


Pelvic Binders



Commercially available.
Placed over the TROCHANTERS and not over the abdomen.

External Fixation

- *Location*

AIIS

ASIS

C-clamp

Clinical Application

Resuscitative

Augmentative

Definitive

Biomechanics of External Fixation: Anterior External Fixation

- Open book injuries with posterior ligaments (hinge) intact:
-
- *All designs work*

C-type injury patterns

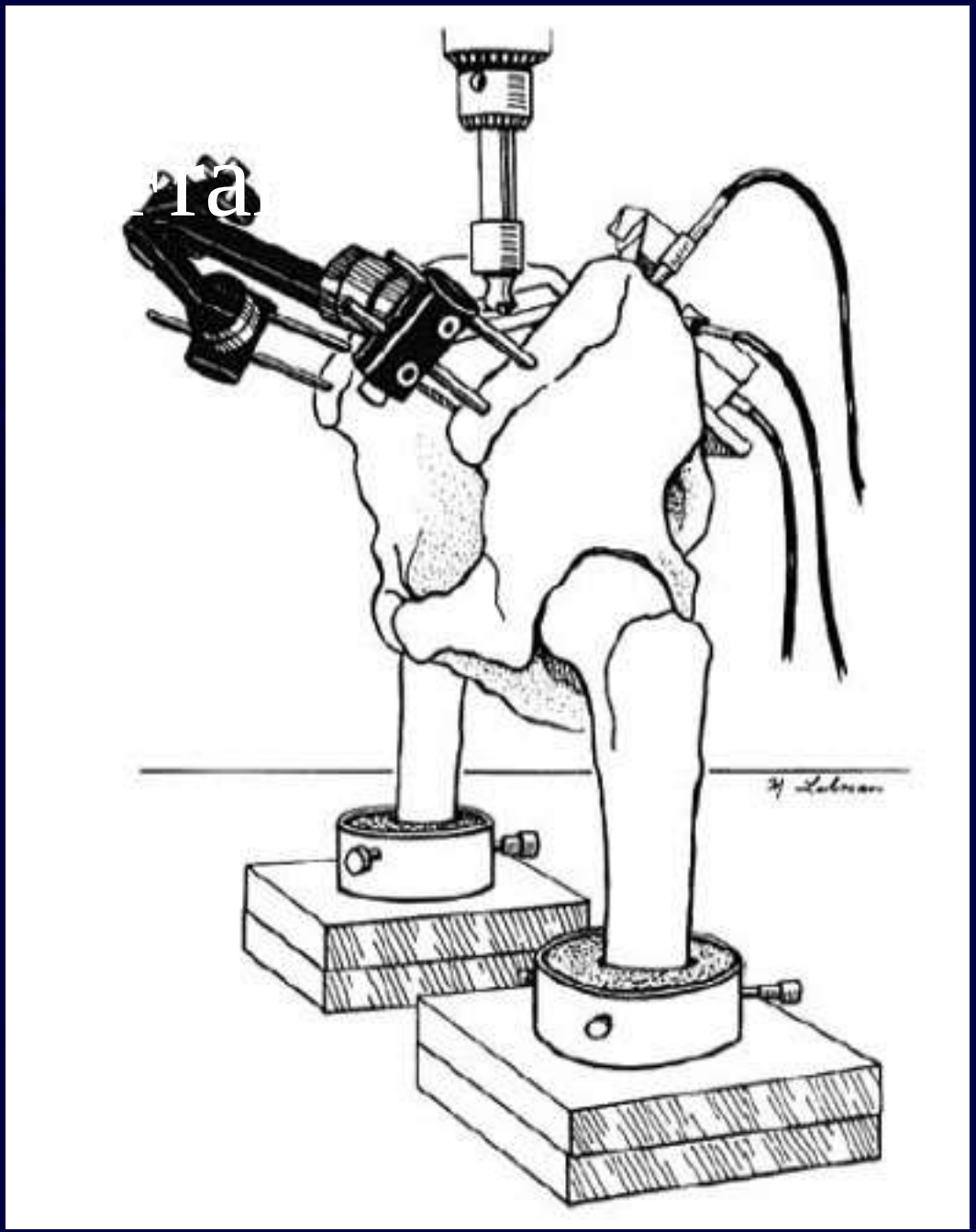
No designs work well (but AIIS frames help more than ASIS frames)

Biomechanics of External Fixation: Considerations

- Pin size
- Number of pins
- Frame design
- Frame location

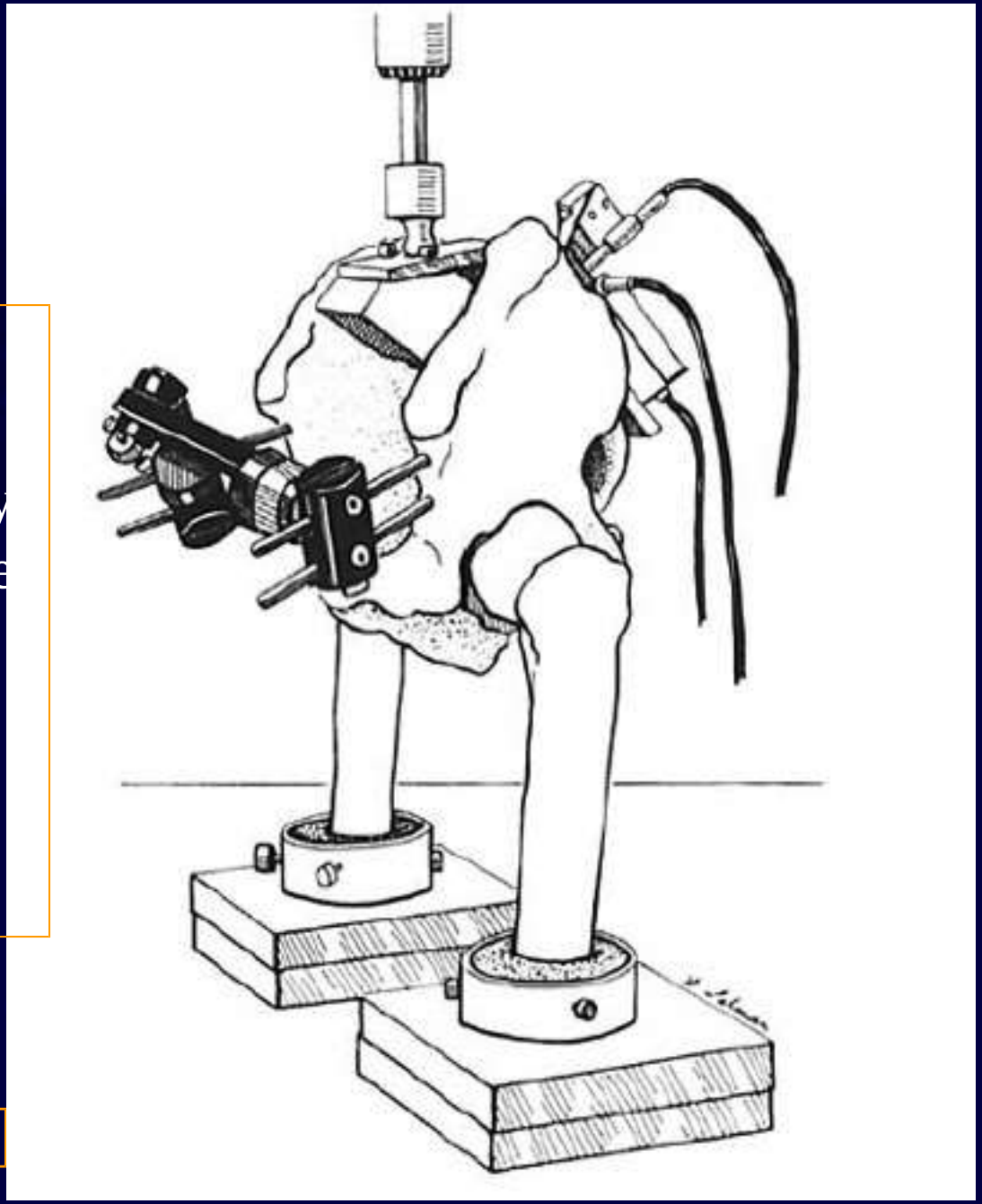
AS ra

- Placed at the iliac crests bilaterally
- Not a good vector for controlling the pelvis



AI

- Placed at the AIIS bilaterally
- At least biomechanically equivalent, thought to be superior to ASIS frames
- Patients can sit



Kim et al, CORR, 1999

AIIS Frames

- **Placed at the AIIS bilaterally**
- **At least biomechanically equivalent, thought to be superior to ASIS frames**
- **Patients can sit**

Kim et al, CORR, 1999

Indications for External Fixation

- Resuscitative (hemorrhage control, stability)
- To decrease pain in polytraumatized patients?
- As an adjunct to ORIF
- Definitive treatment (Rare!)
- Distraction frame
- Can’t ORIF the pelvis

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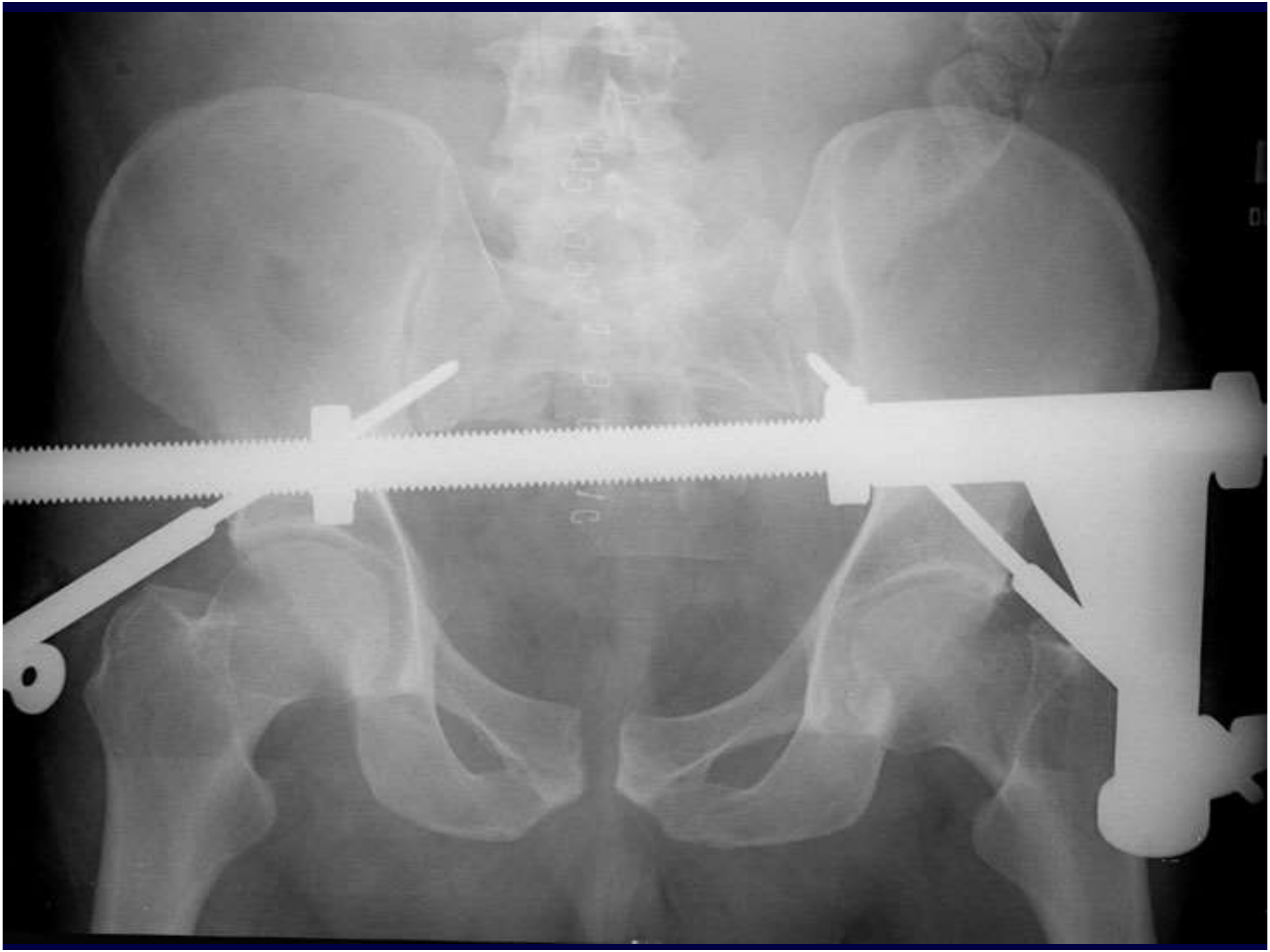

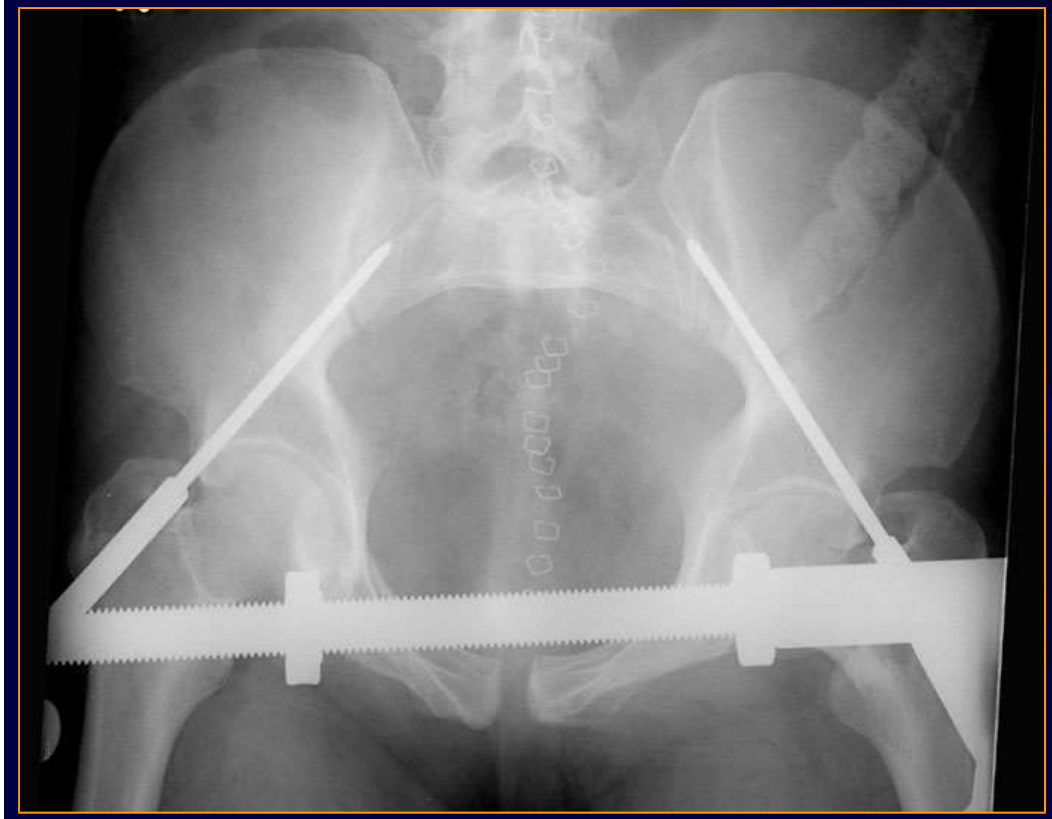

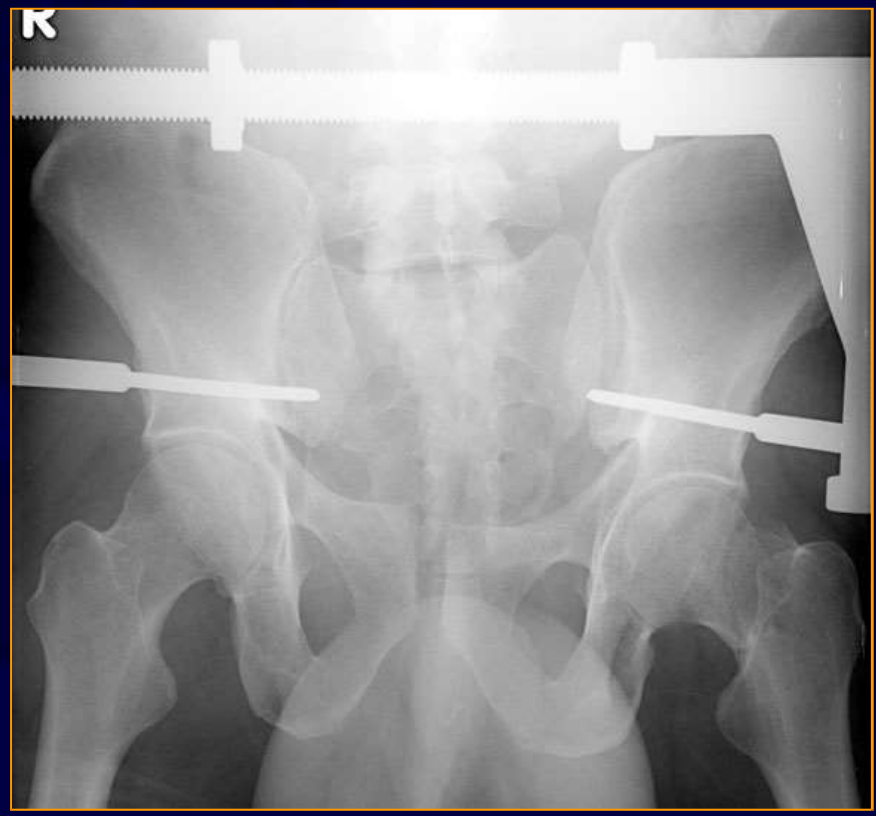
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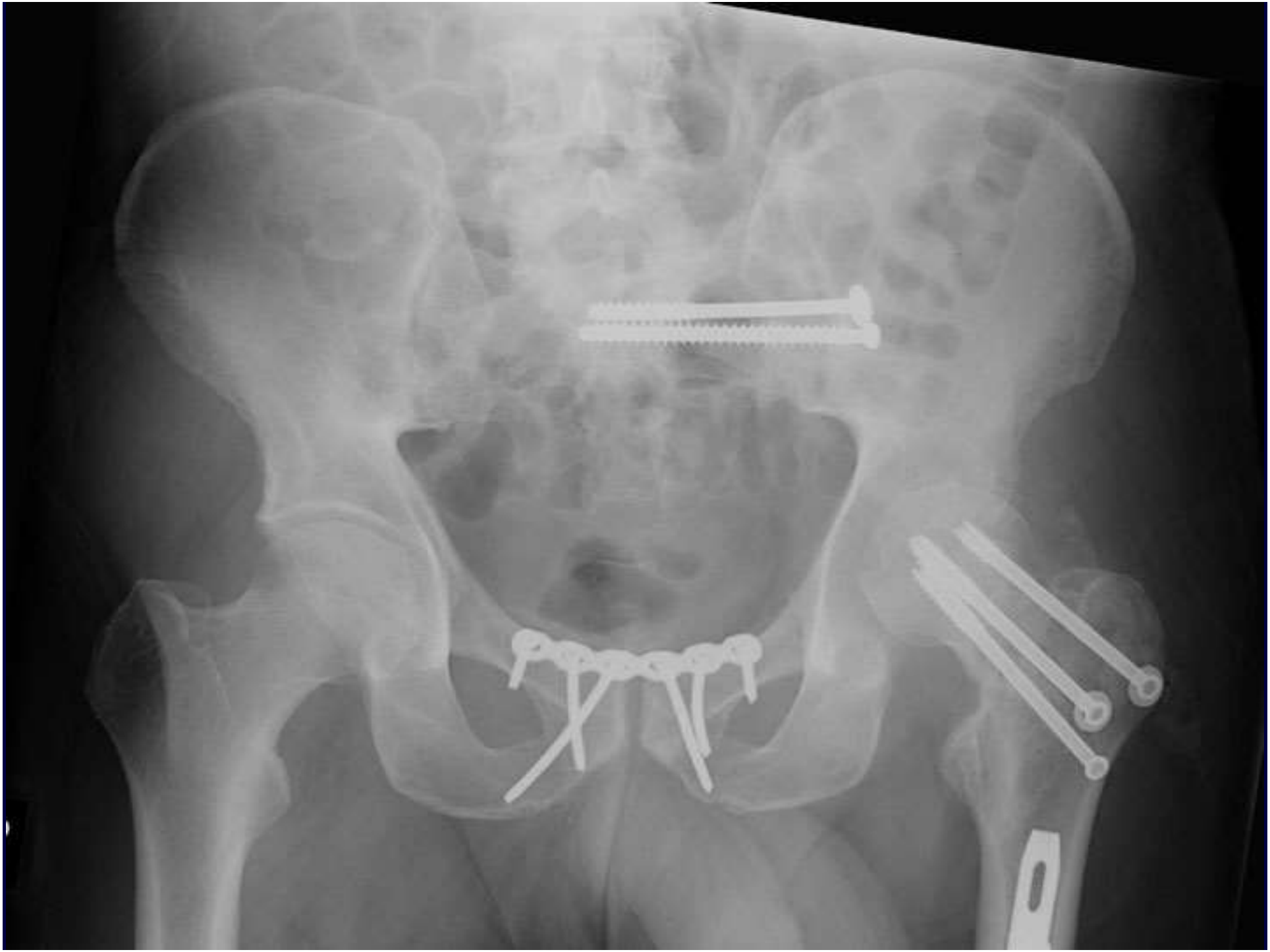

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  - Distraction frame
  - Can't ORIF the pelvis

Theoretical and a marginal indication, but there is literature support

Barei, D. P.; Shafer, B. L.; Beingessner, D. M.; Gardner, M. J.; Nork, S. E.; and Routt, M. L.: The impact of open reduction internal fixation on acute pain management in unstable pelvic ring injuries. *J Trauma*, 68(4): 949-53, 2010.

Indications for External Fixation

- Resuscitative (hemorrhage control, stability)
- To decrease pain in polytraumatized patients?
- As an adjunct to ORIF
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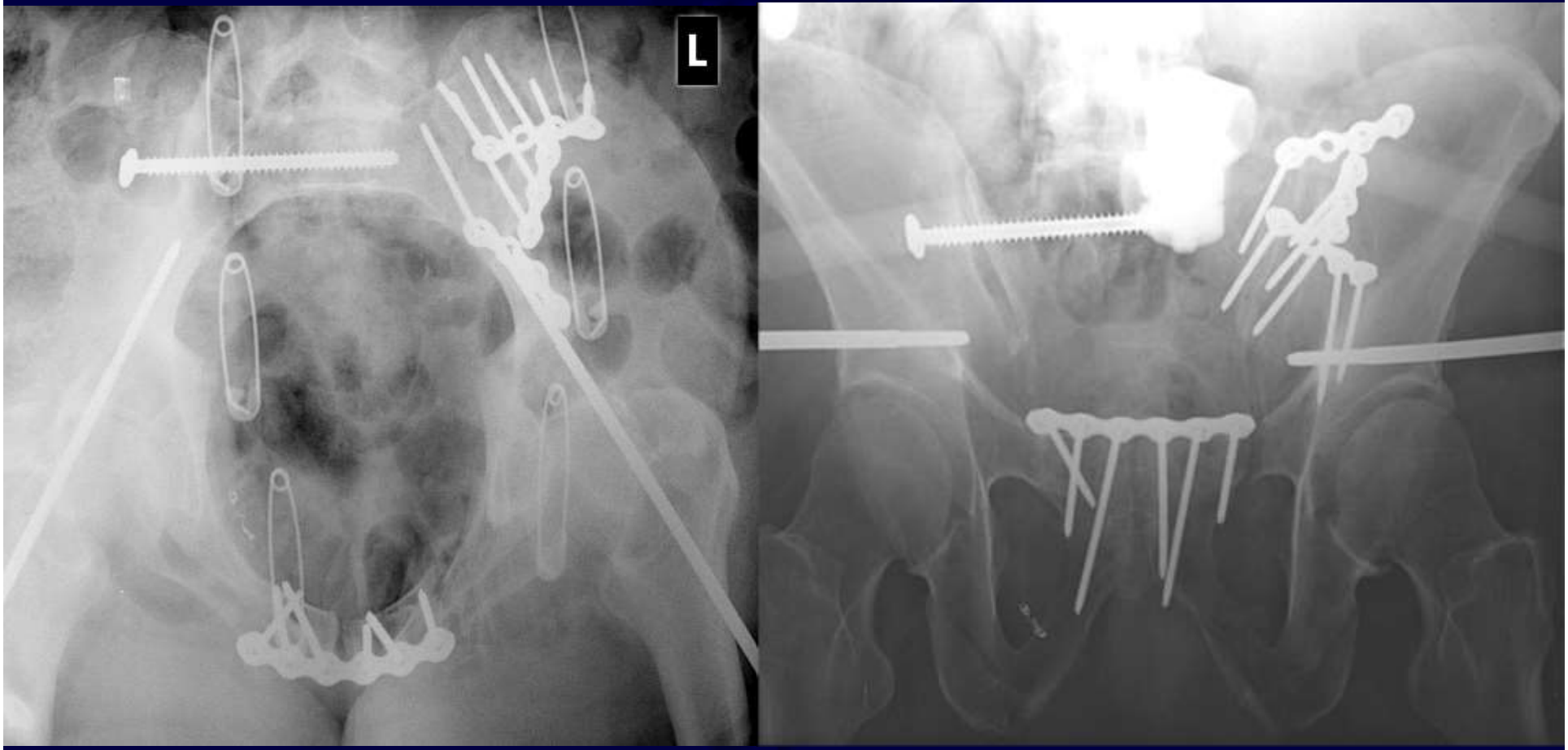
- Distraction frame
- Can’t ORIF the pelvis


RT


R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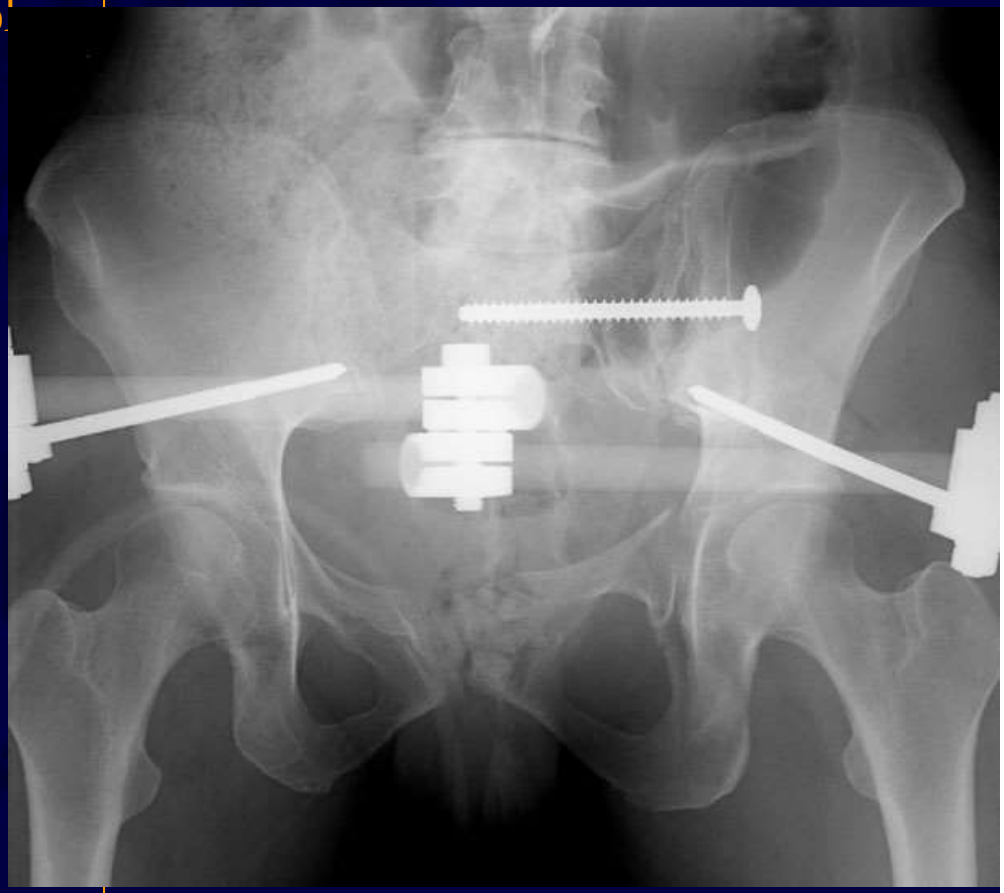
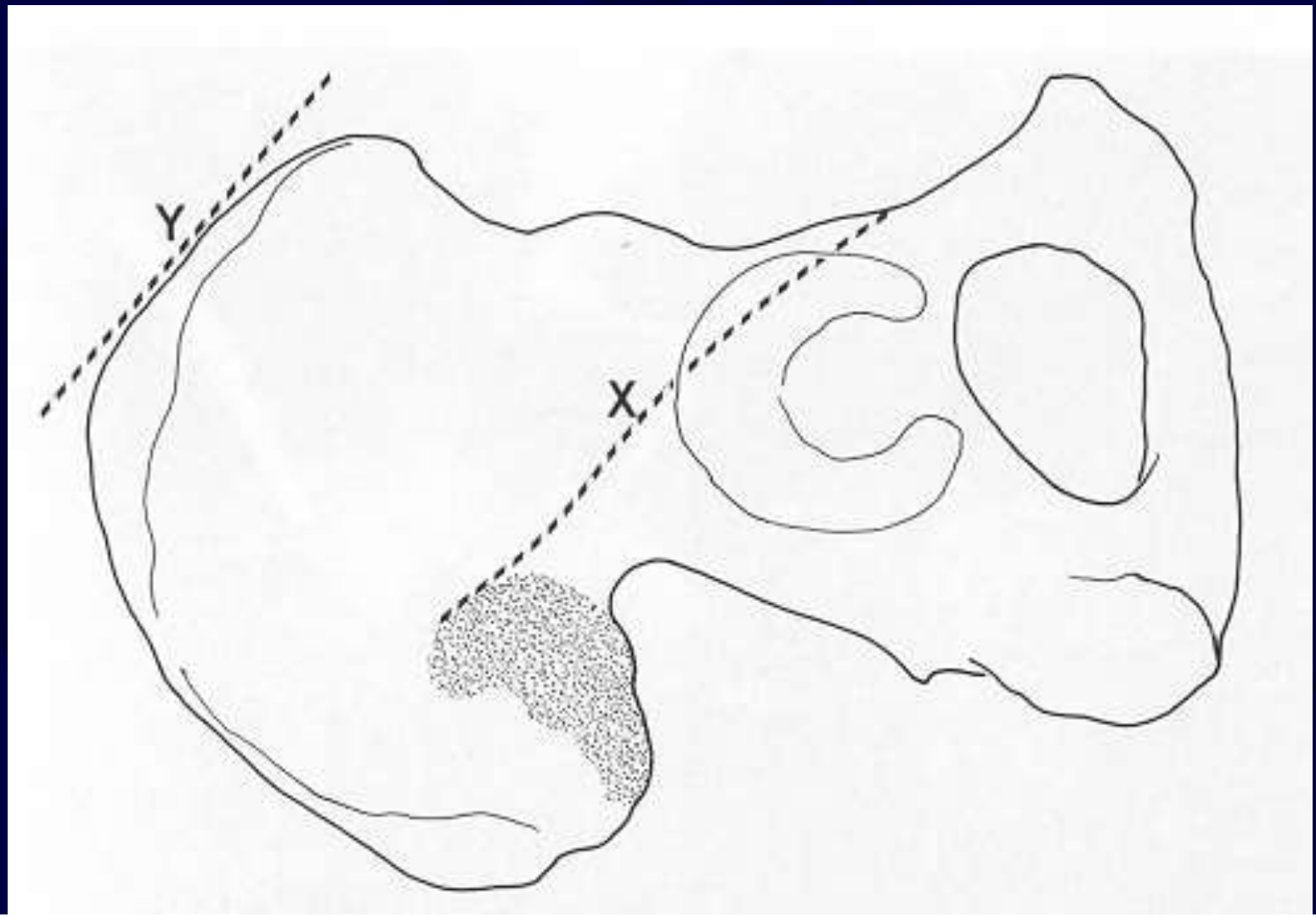
Indications for External Fixation

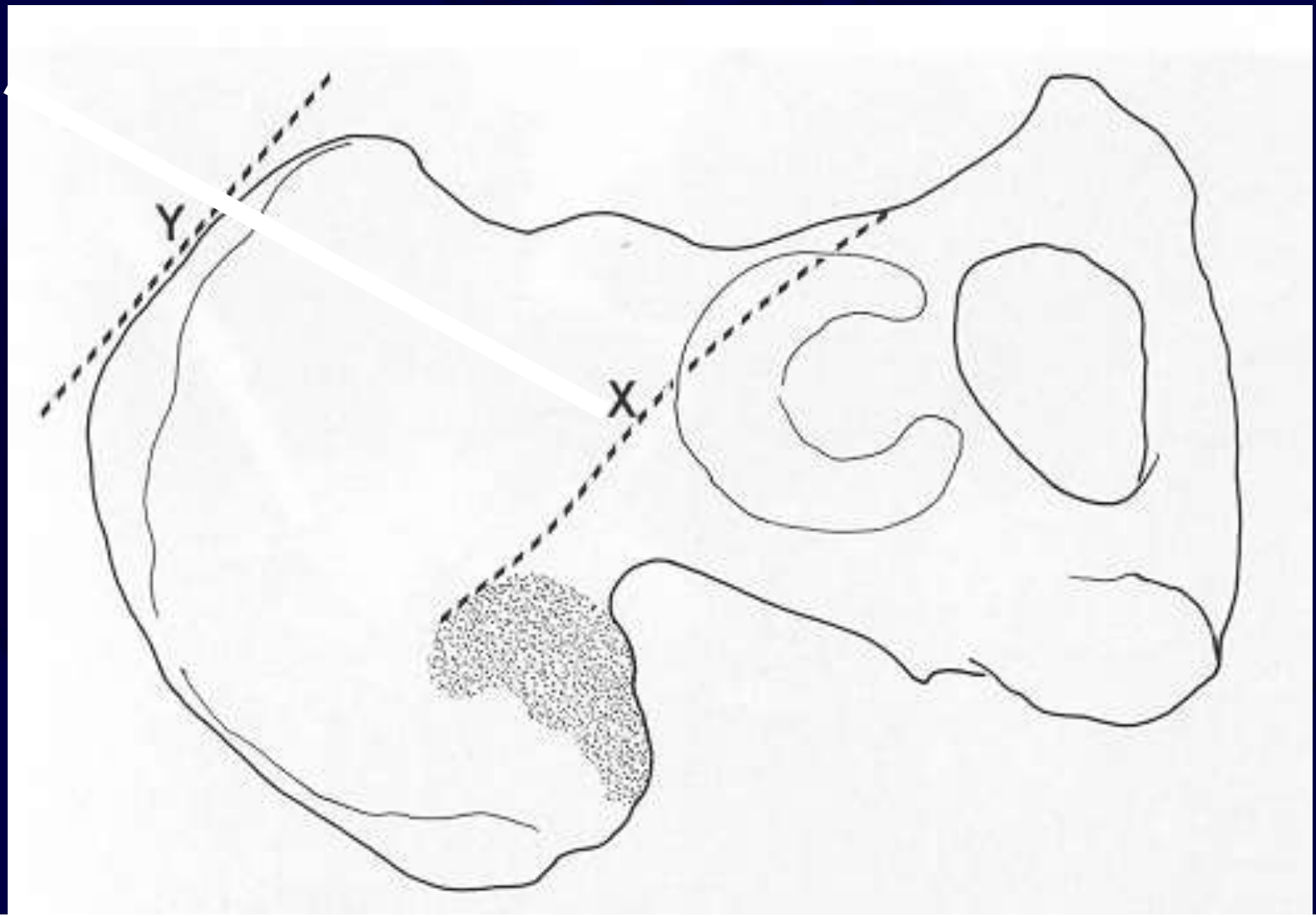
- Resuscitative (hemorrhage control, stability)
- To decrease pain in polytraumatized patients?
- As an adjunct to ORIF
- Definitive treatment (Rare!)
  - Distraction frame
  - If can't ORIF the pelvis



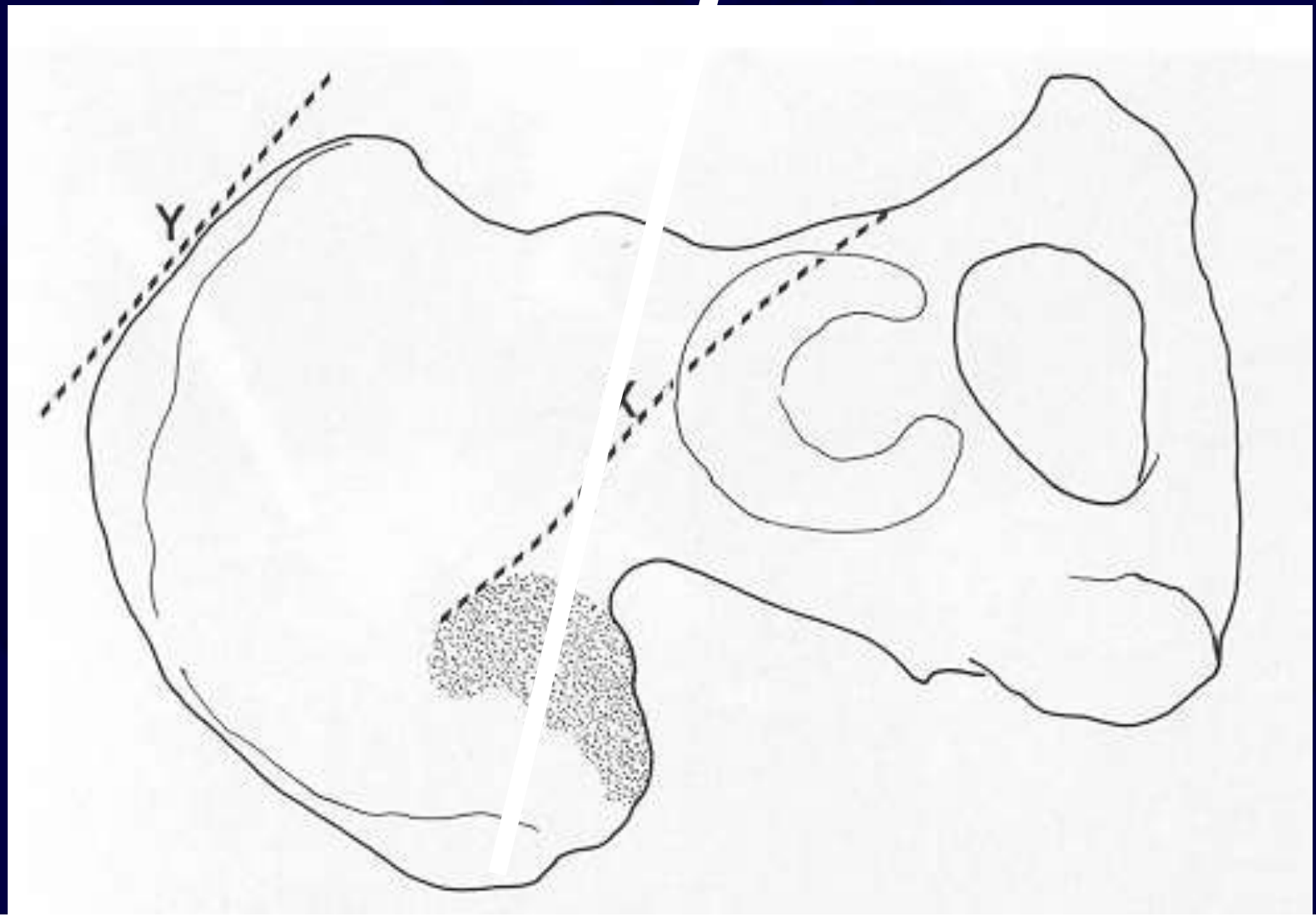
Technical Details: ASIS & AIIS Frames



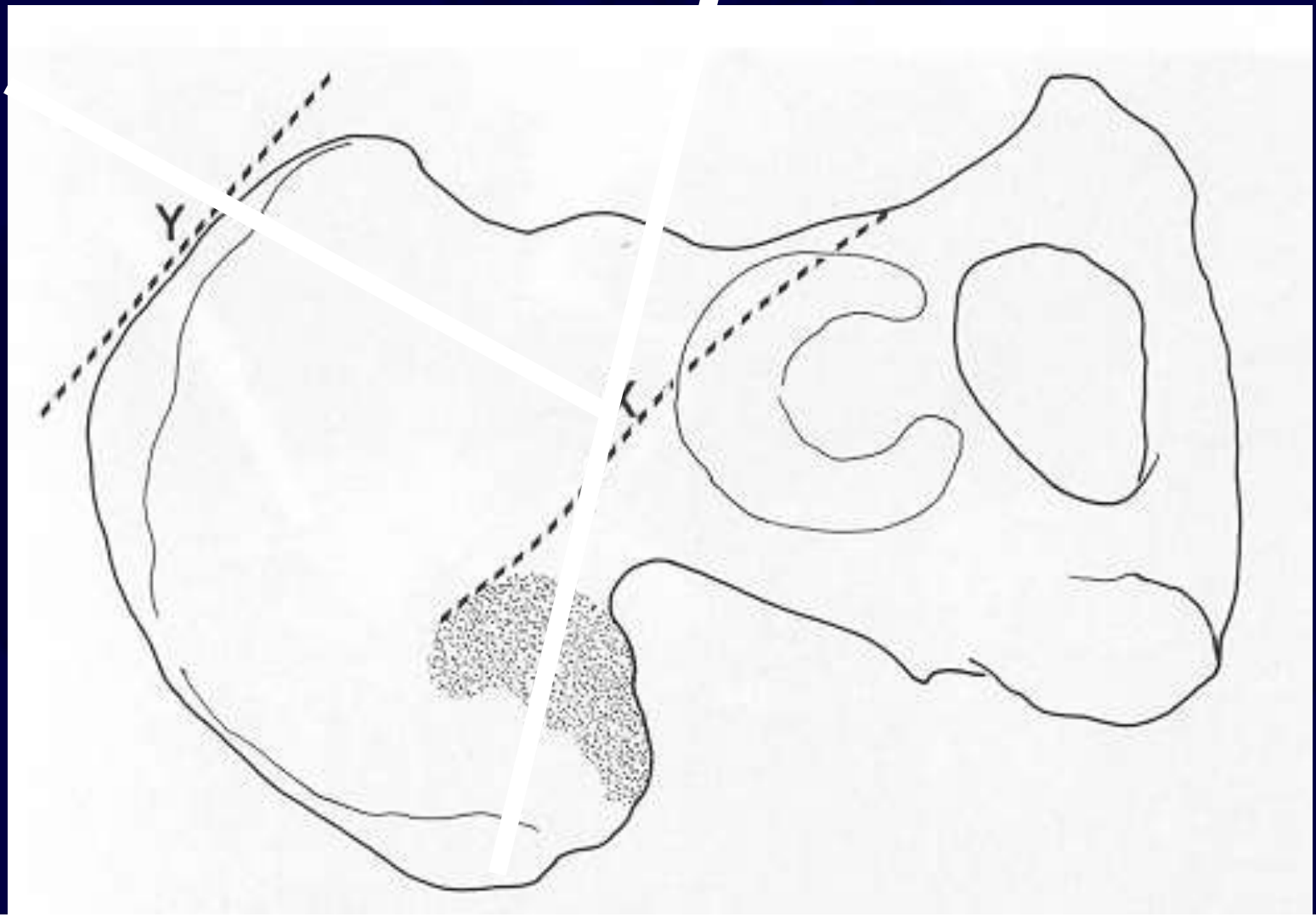
Pin Orientation: ASIS



Pin Orientation: AIIS

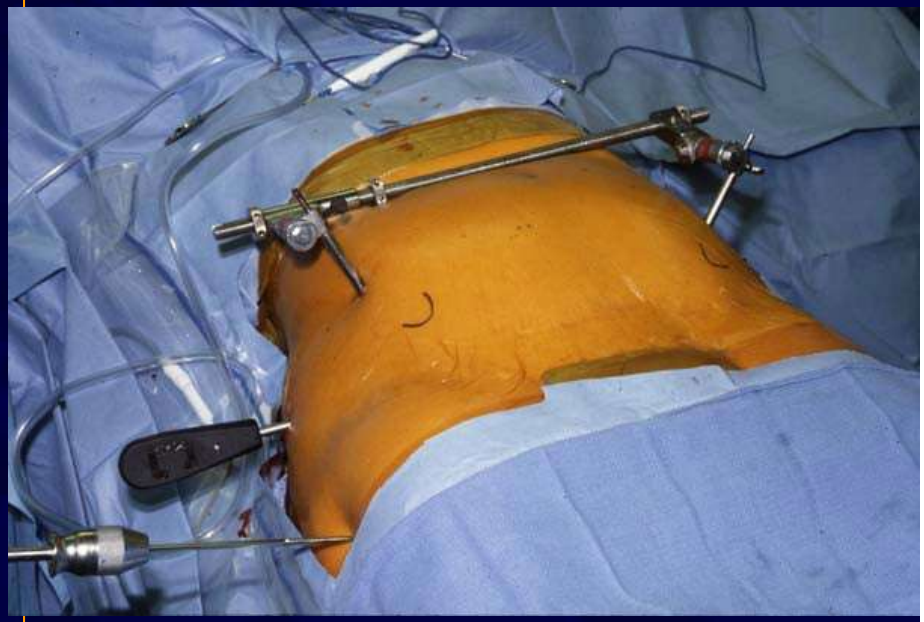


Pin Orientations



Technical Details: ASIS frames…

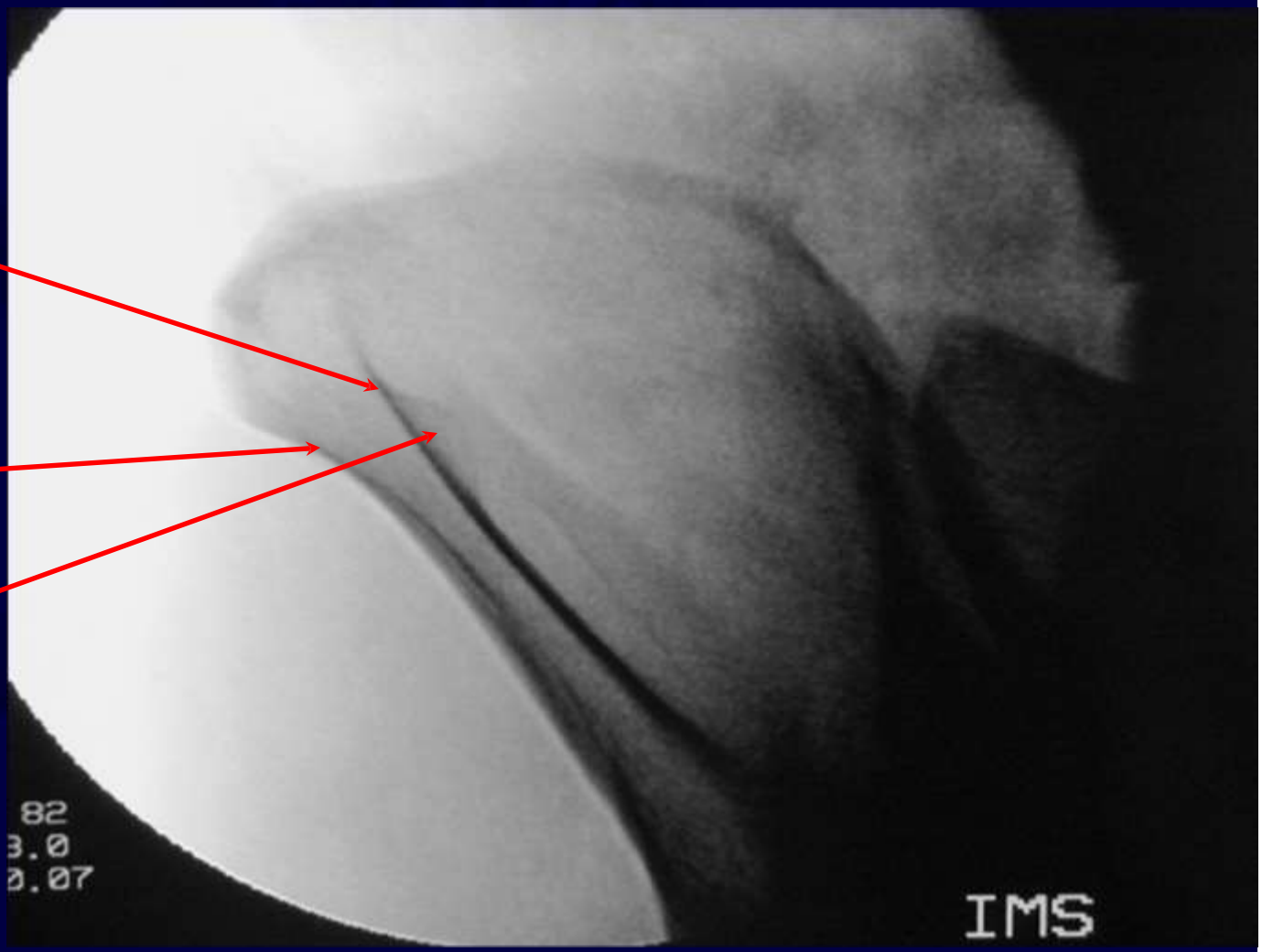
- Fluoro dependent
- 3 to 5 cm posterior to the ASIS
- Along the gluteus medius pillar
- Incisions directed toward the anticipated final pin location
- Pin entry at the junction of the lateral 2/3 and medial 1/3 of the iliac crest (lateral overhang of the crest)
- Aim: 30 to 45 degrees (from lateral to medial)
- Toward the hip joint



Consider partial closed reduction first!

Outlet Oblique Image

- Inner Table
- Outer Table
- ASIS



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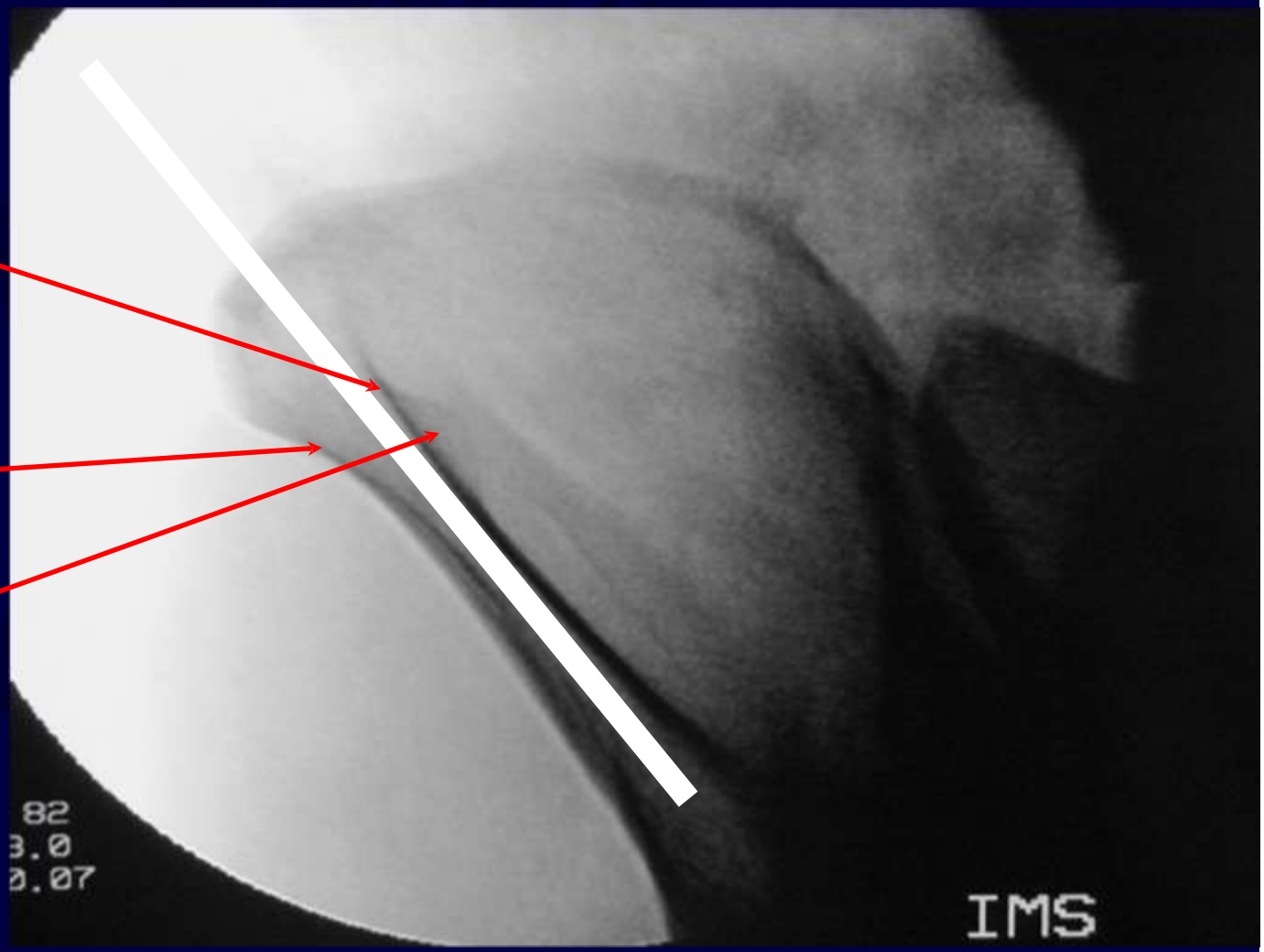

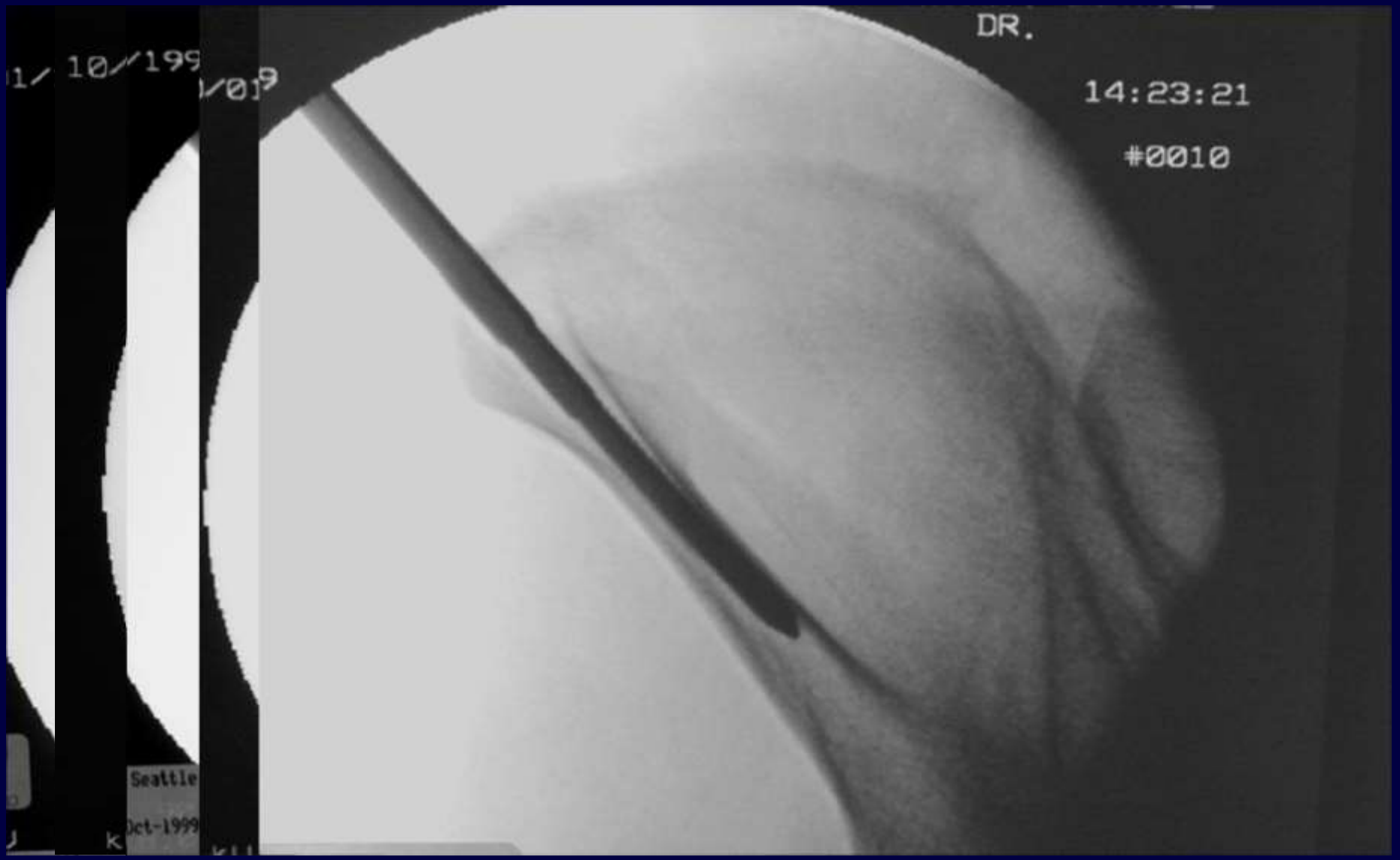
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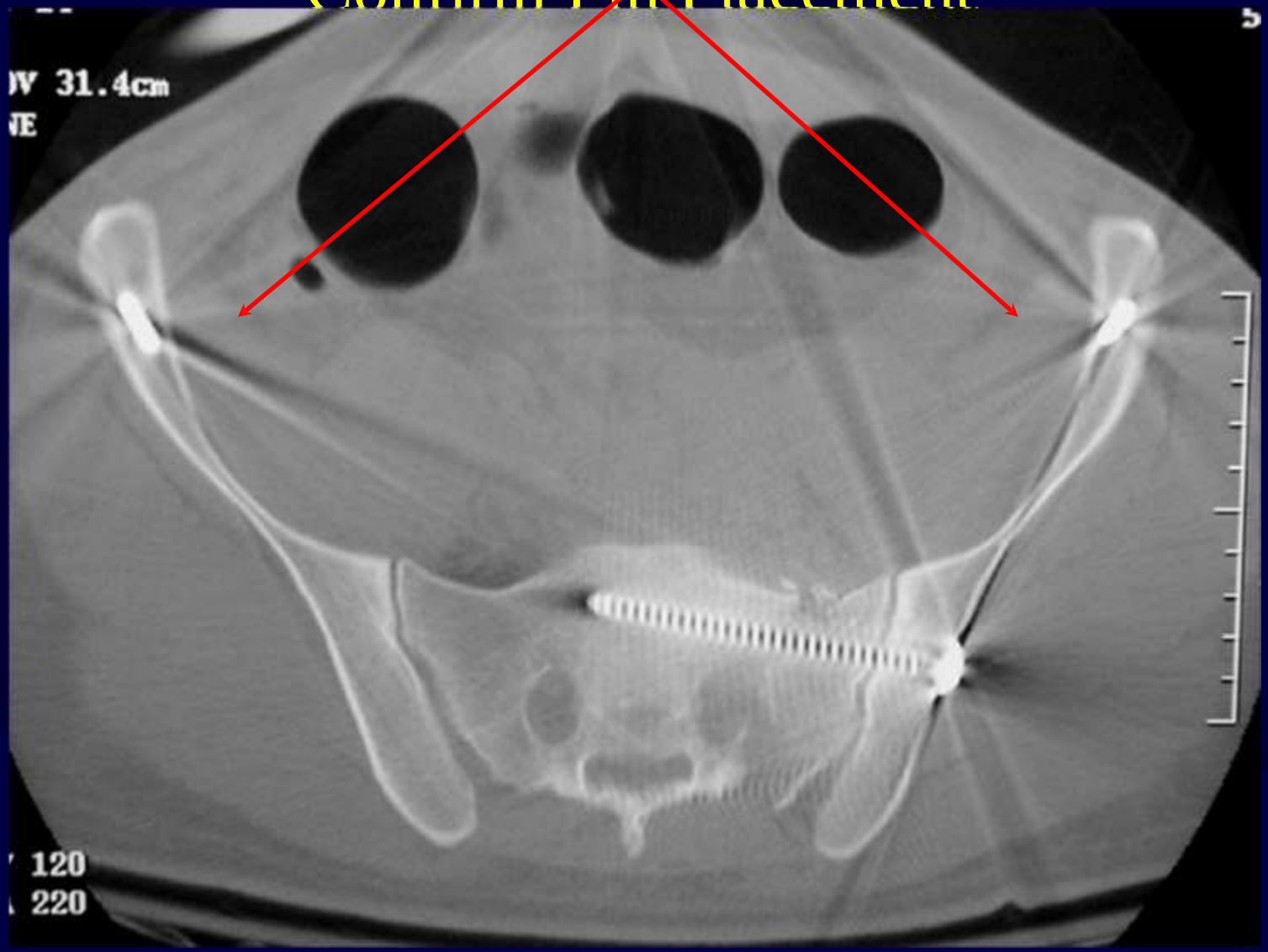
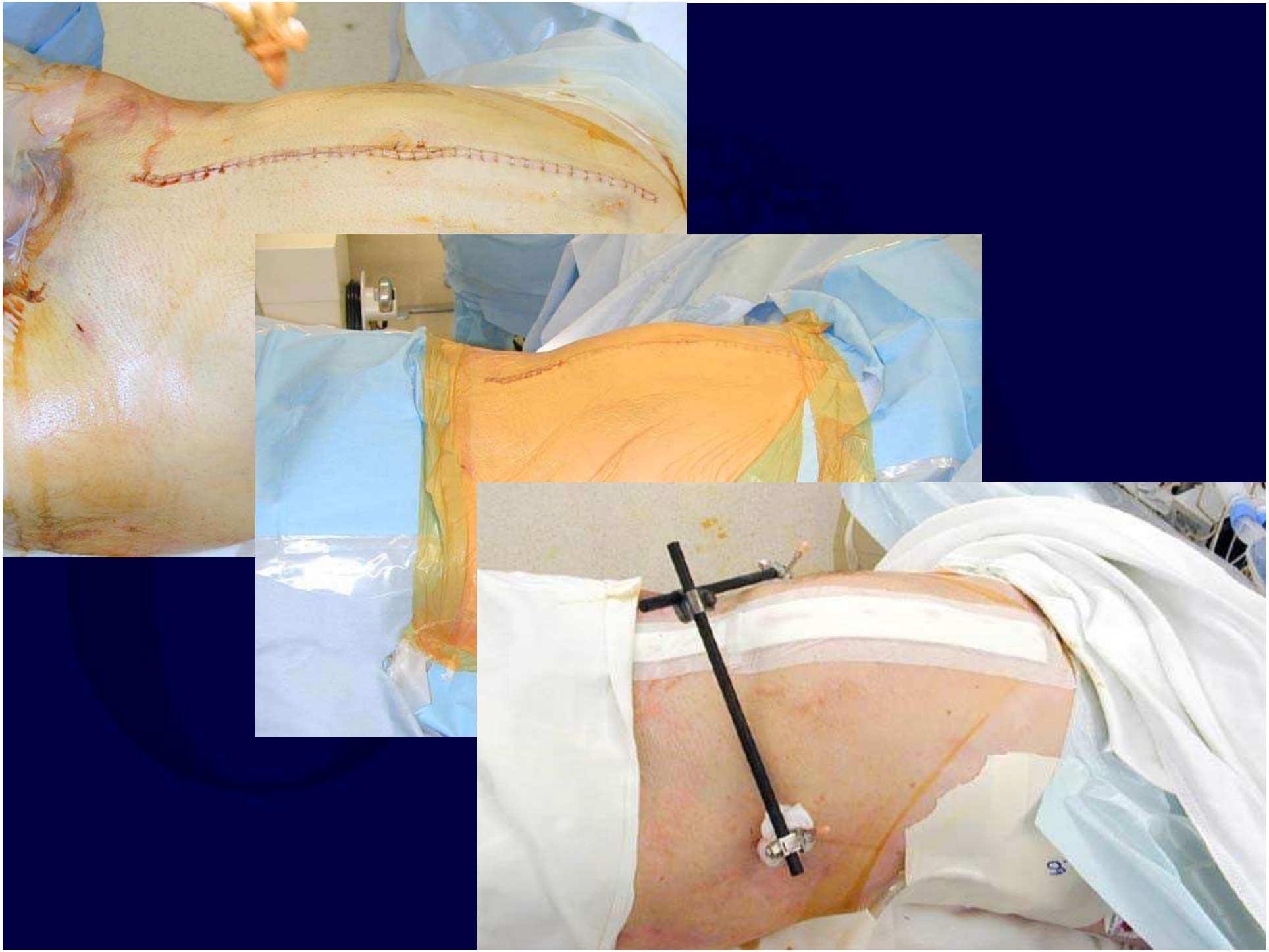
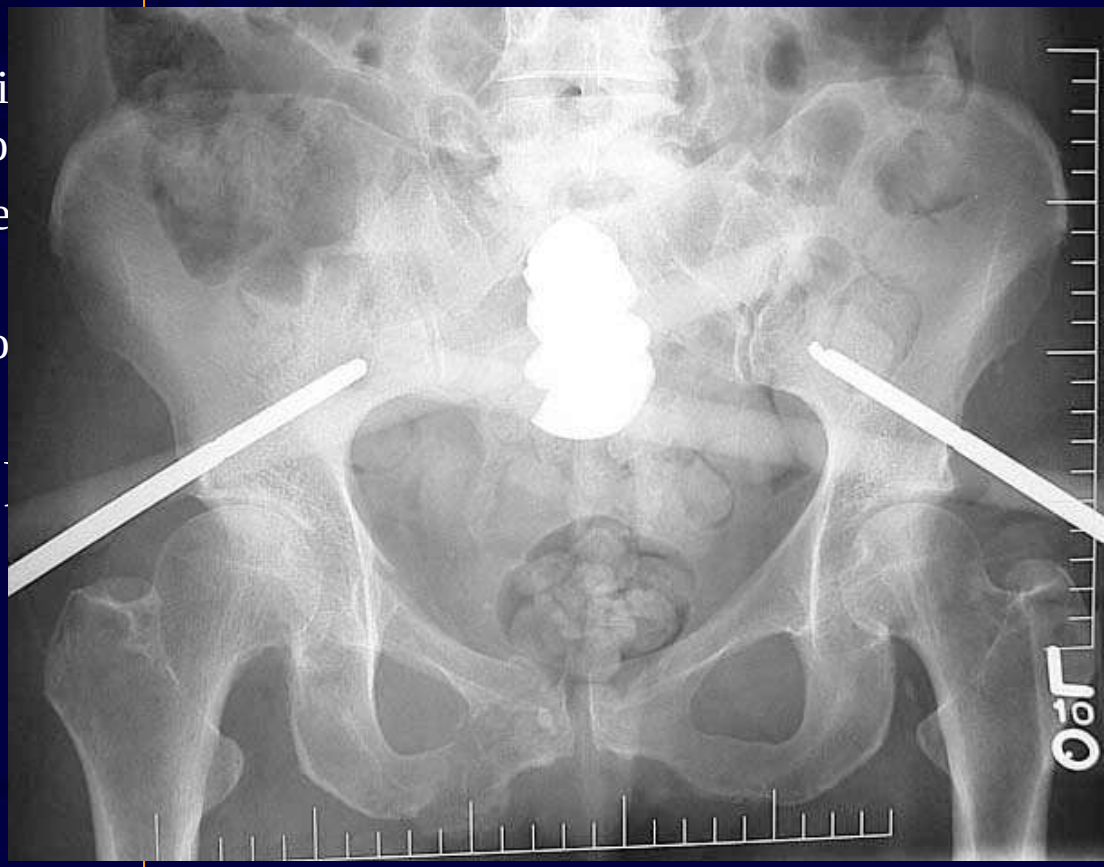
Confirm Pin Placement





Technical Details: AIIS frames…

- Fluoro dependent:
- 1. 30/30 outlet/obturator obl i (confirm entry location and directio
- 2. Iliac oblique (confirm dir e above sciatic notch)
- 3. Inlet/obturator oblique (c o depth)
- Incisions directed toward t anticipated final location
- Blunt dissection
- Aim: According to fluoro



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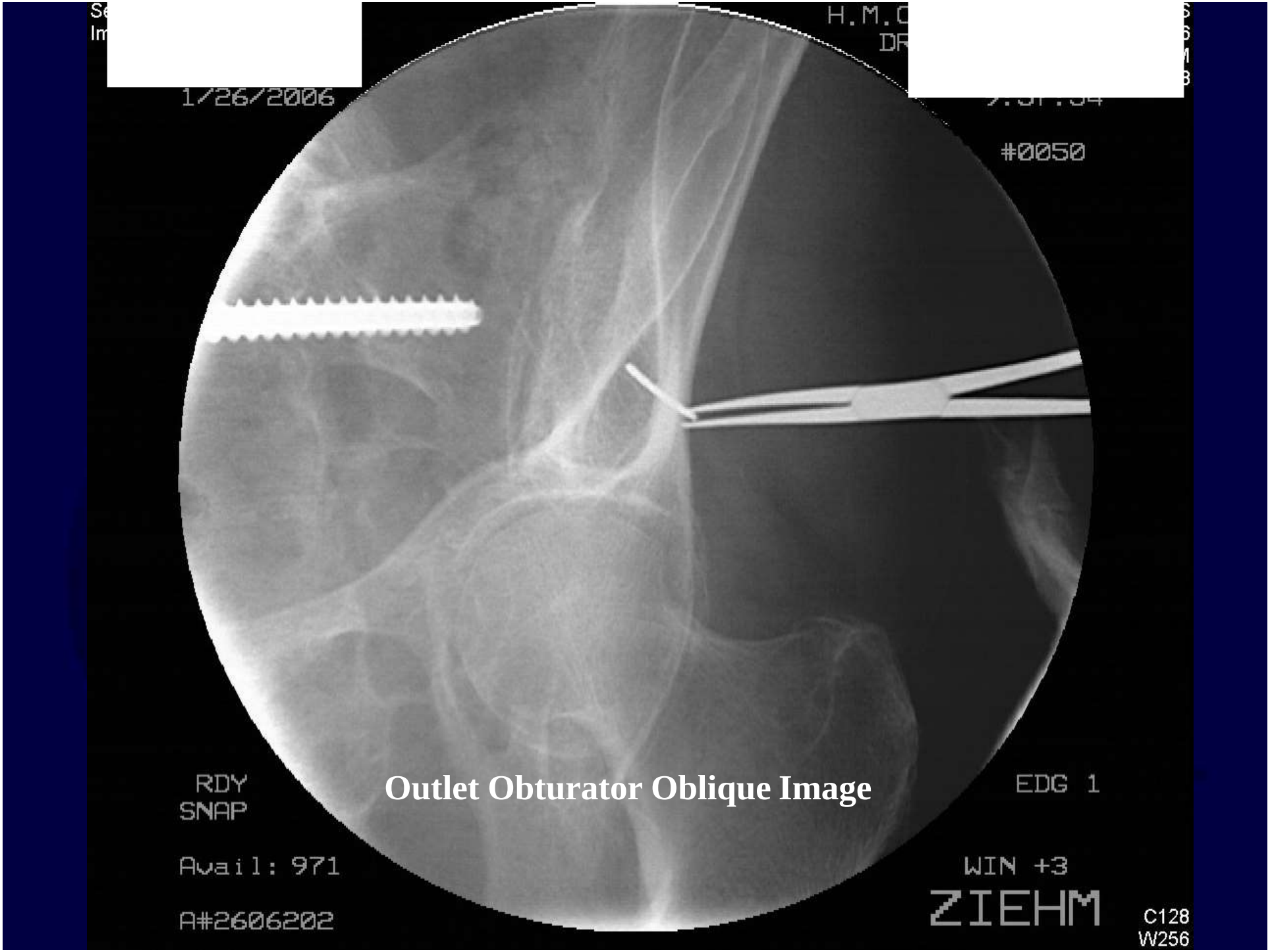
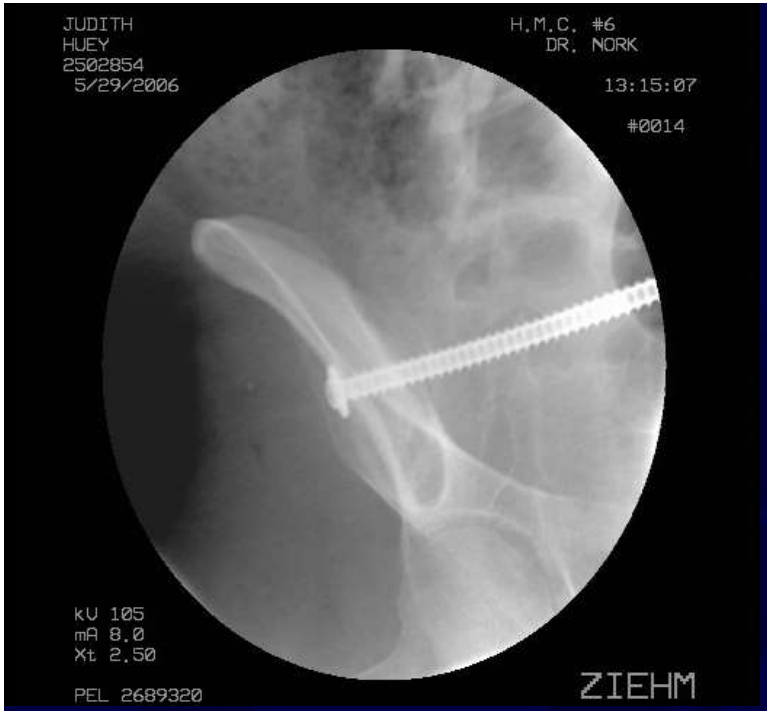


Outlet Obturator Oblique Image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Xt 2.50
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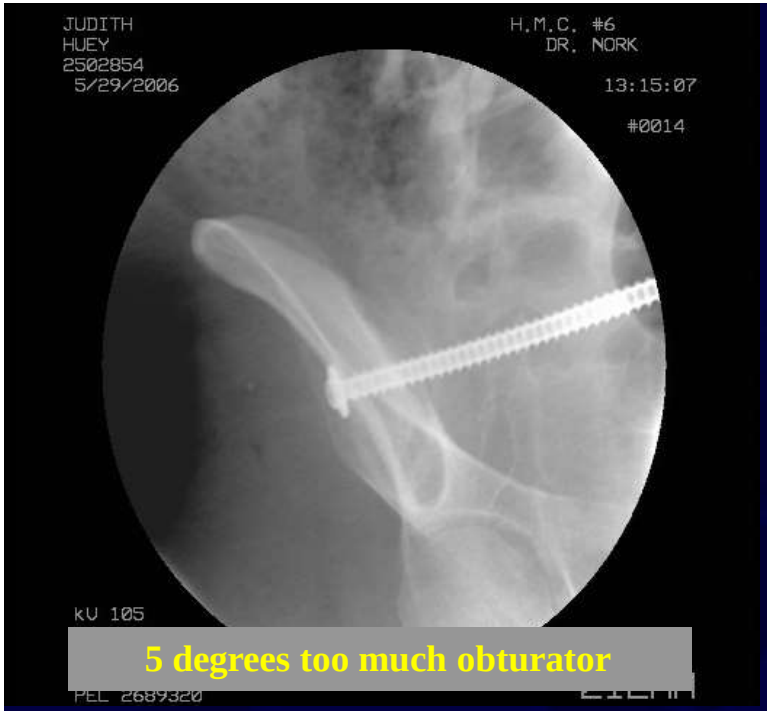
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kV 105
5 degrees too much obturator


JUDITH
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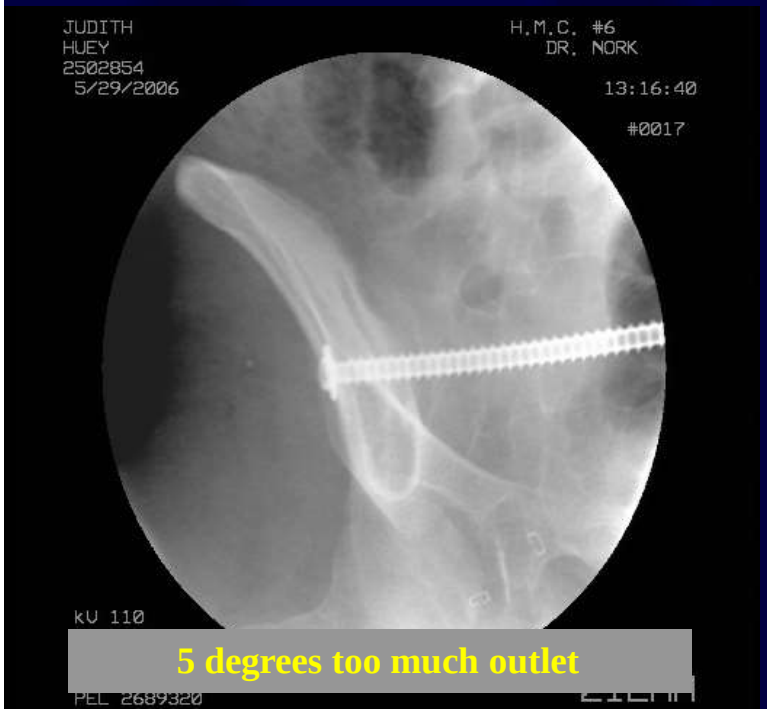
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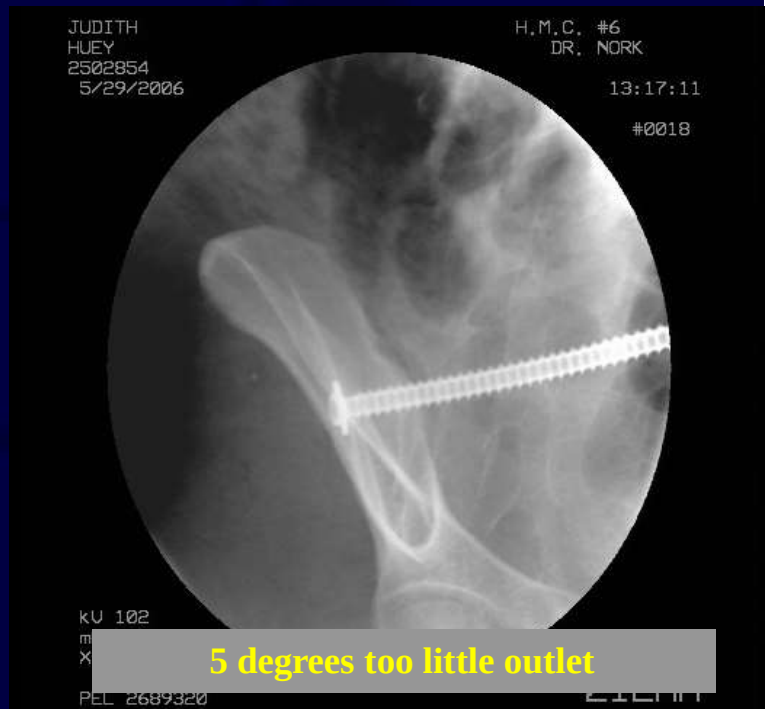
kV 110
5 degrees too much outlet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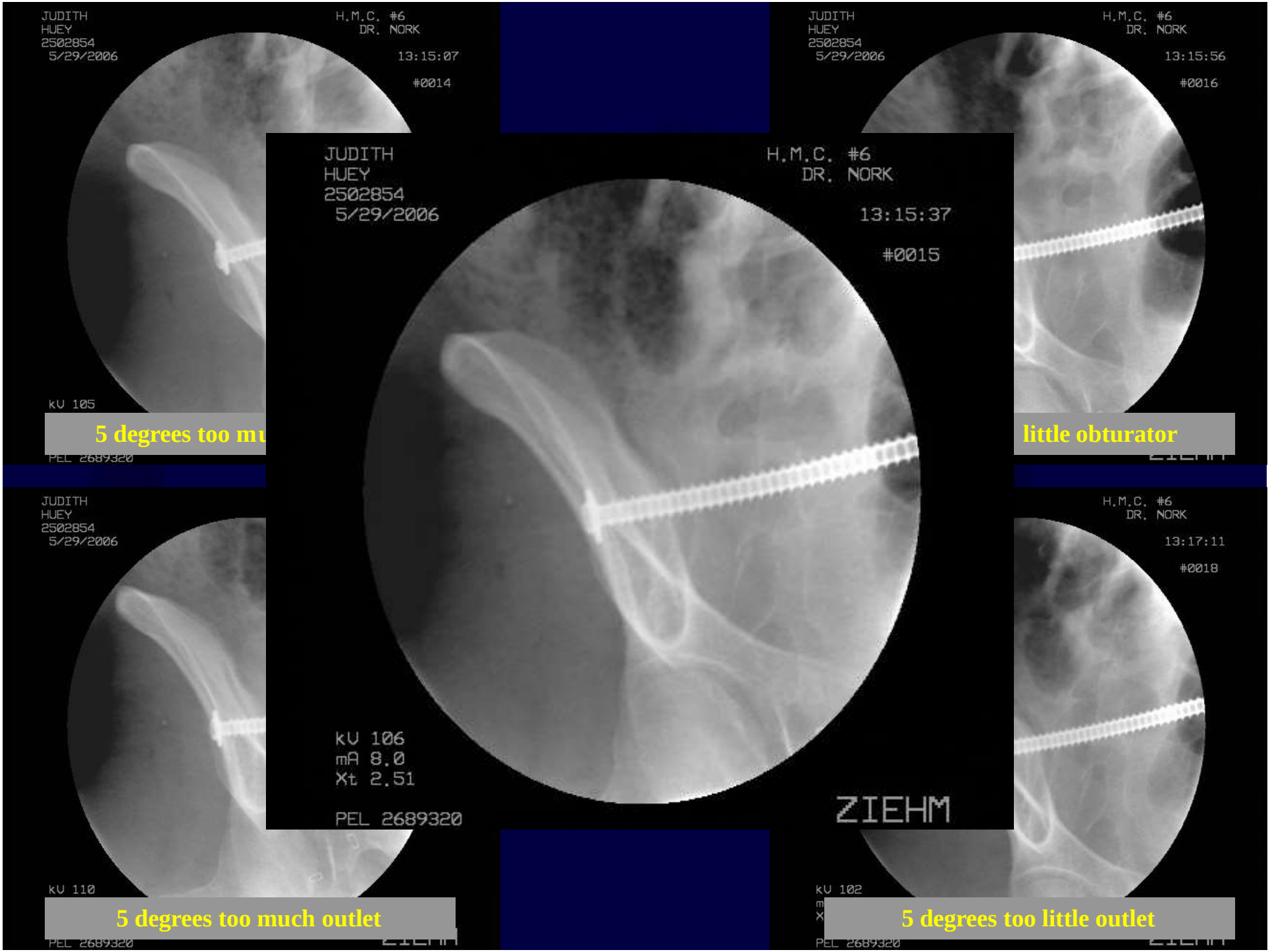
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little obturator
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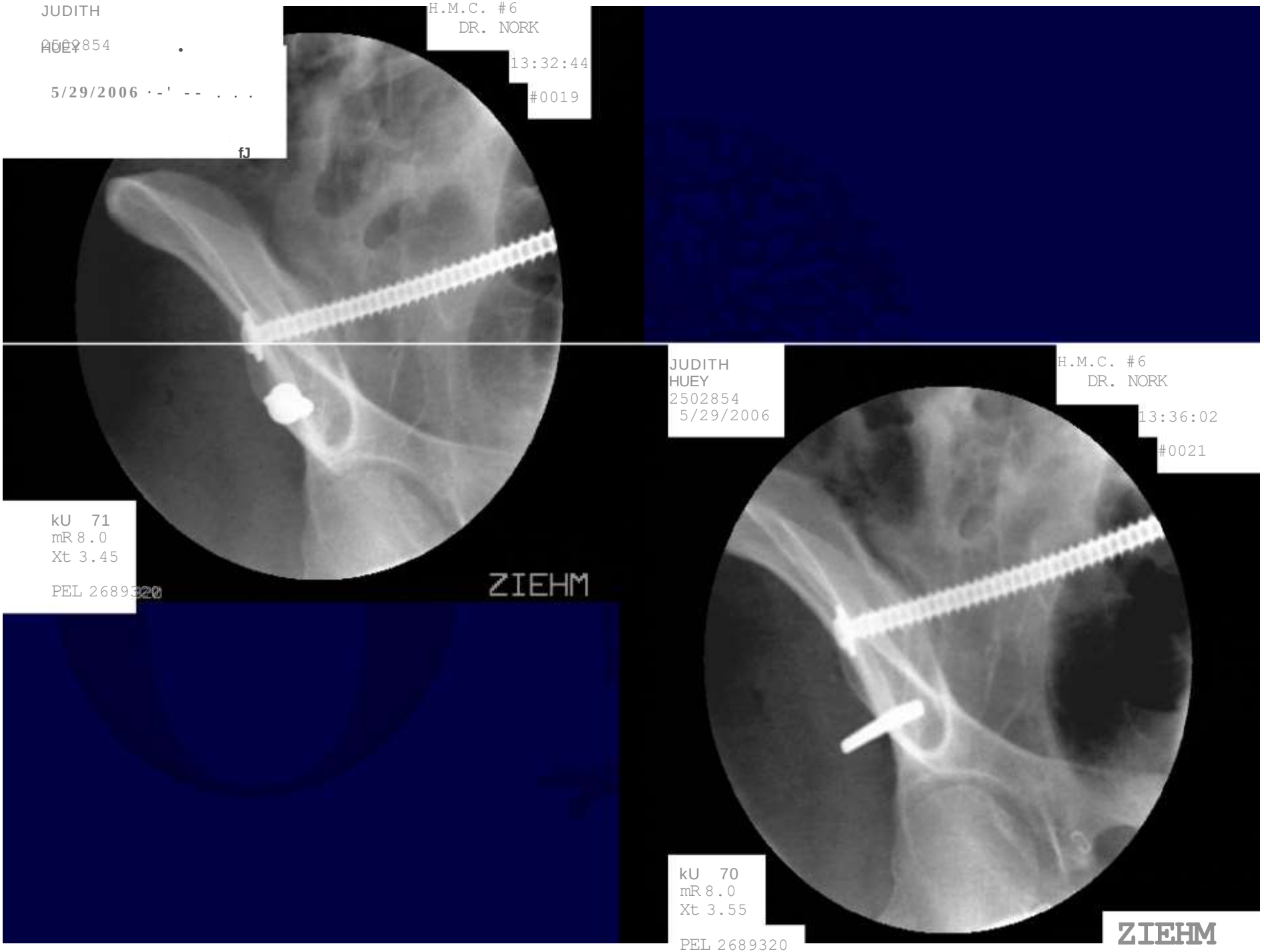
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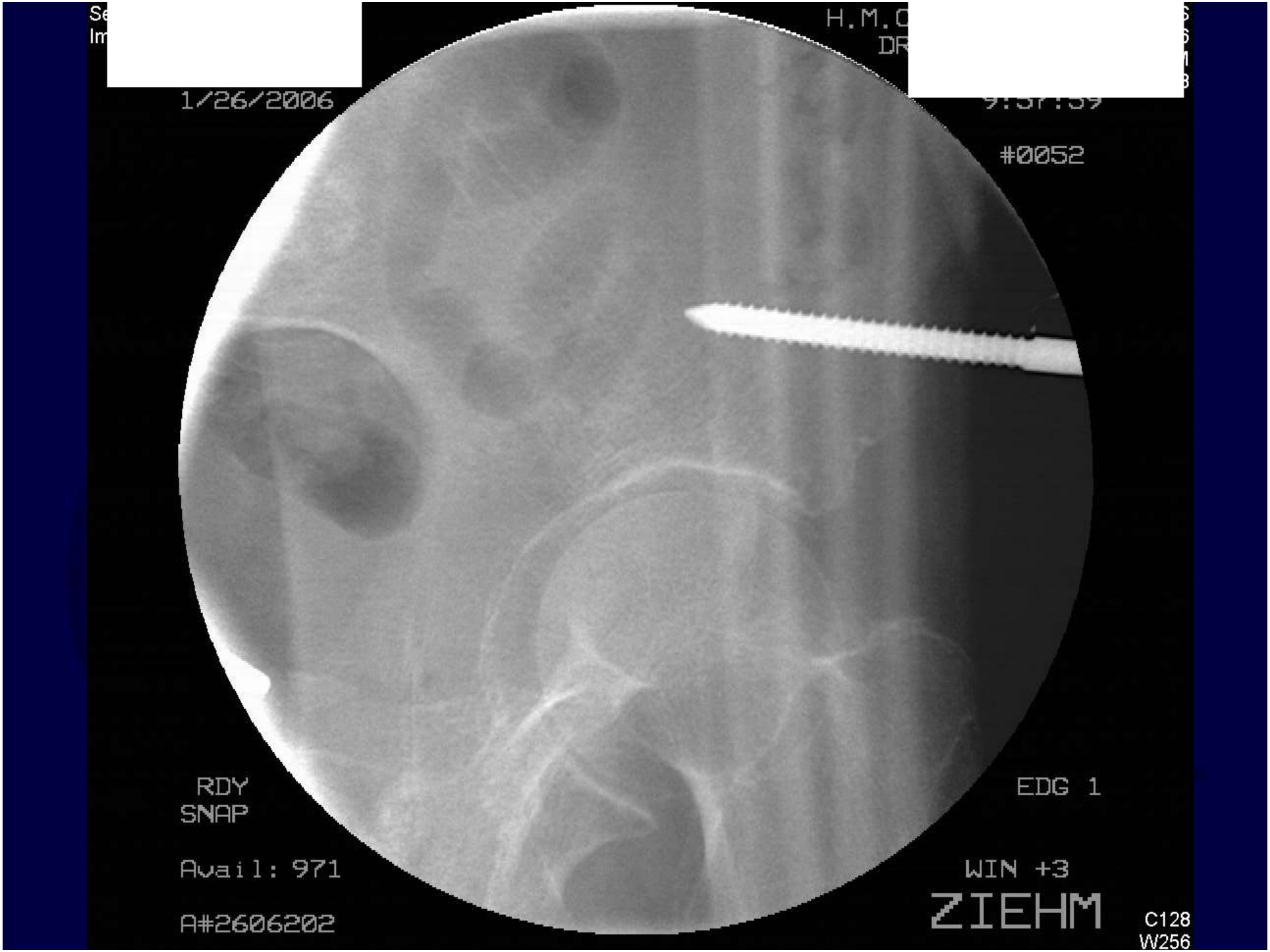
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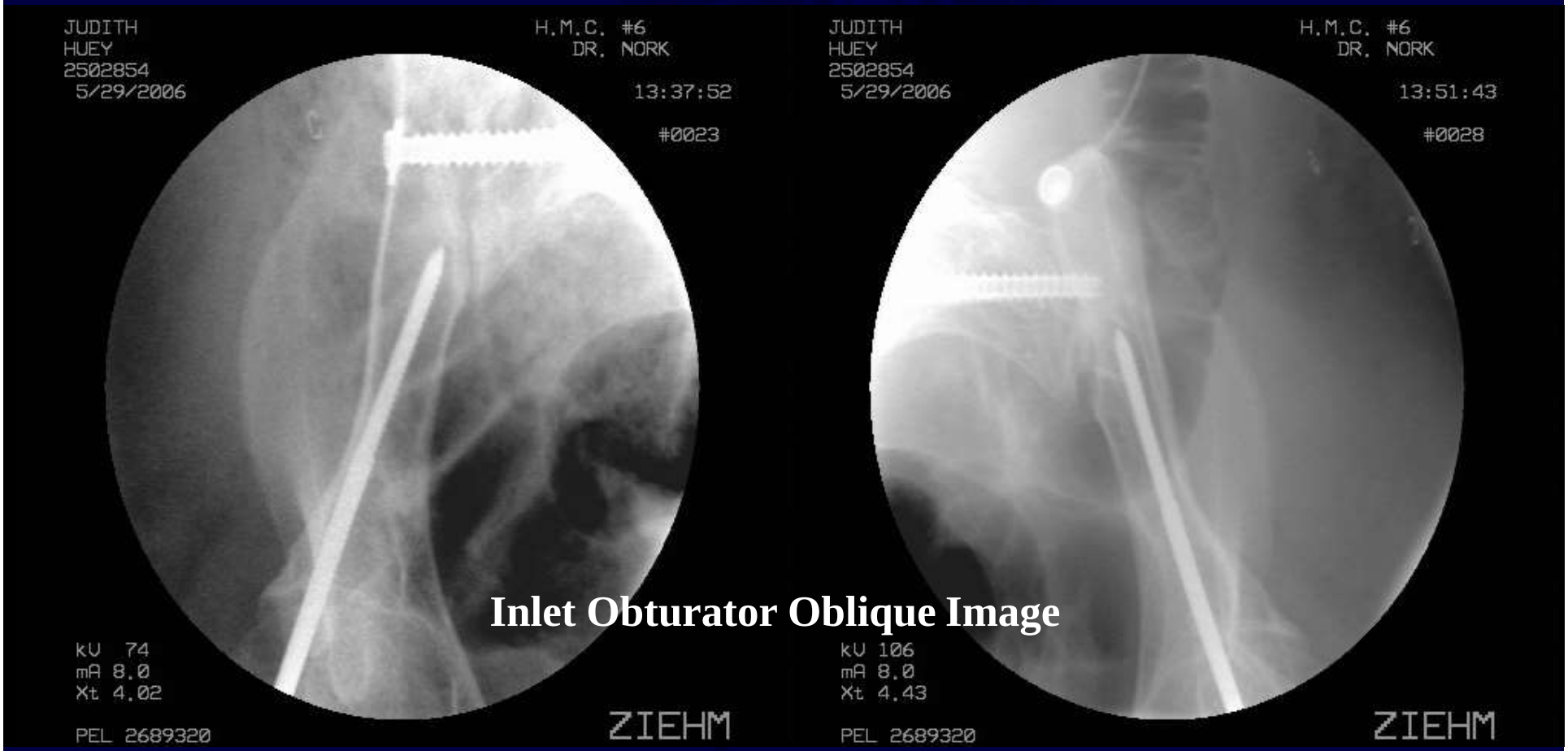
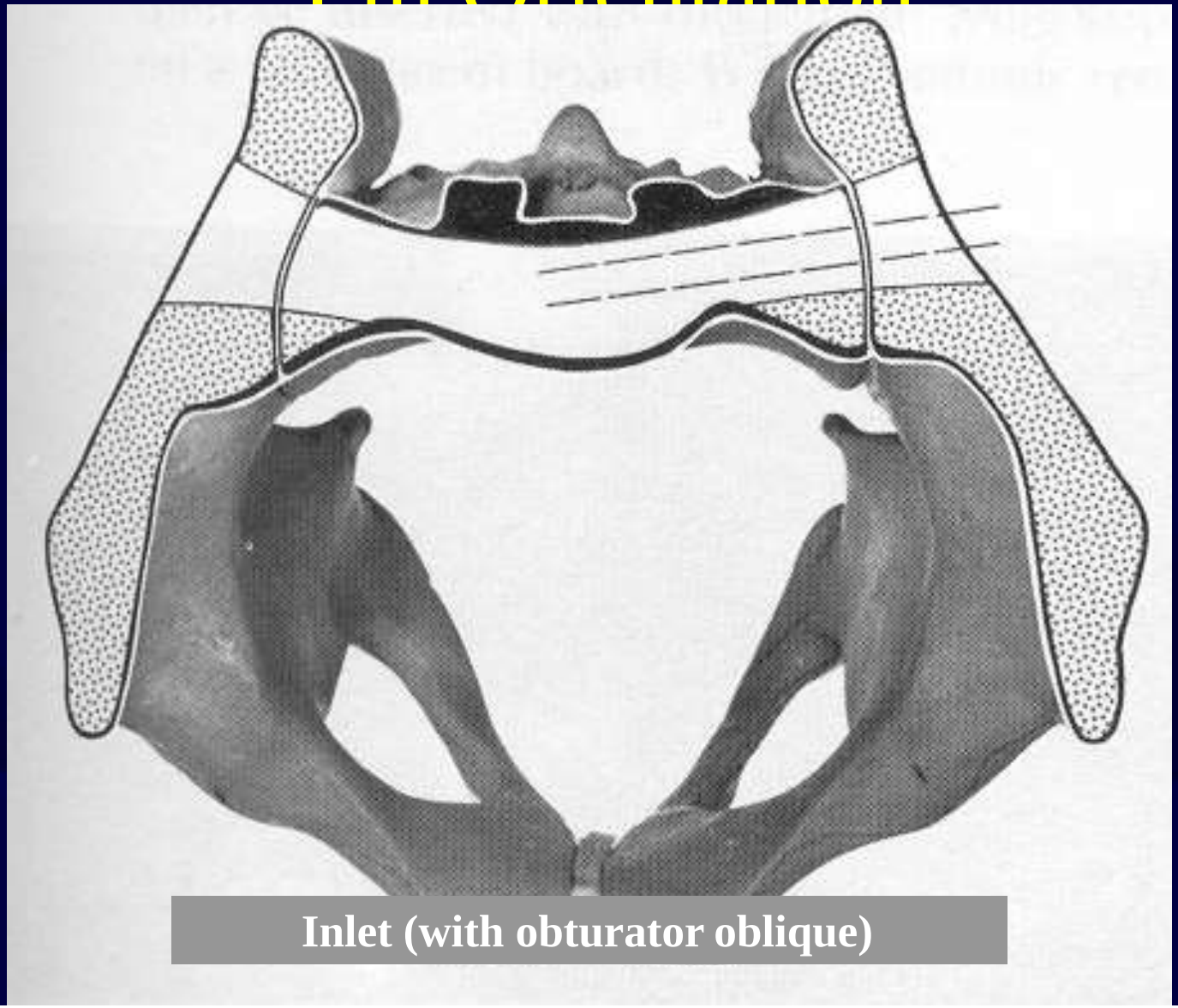
C128
W256



Inlet Obturator Oblique Image

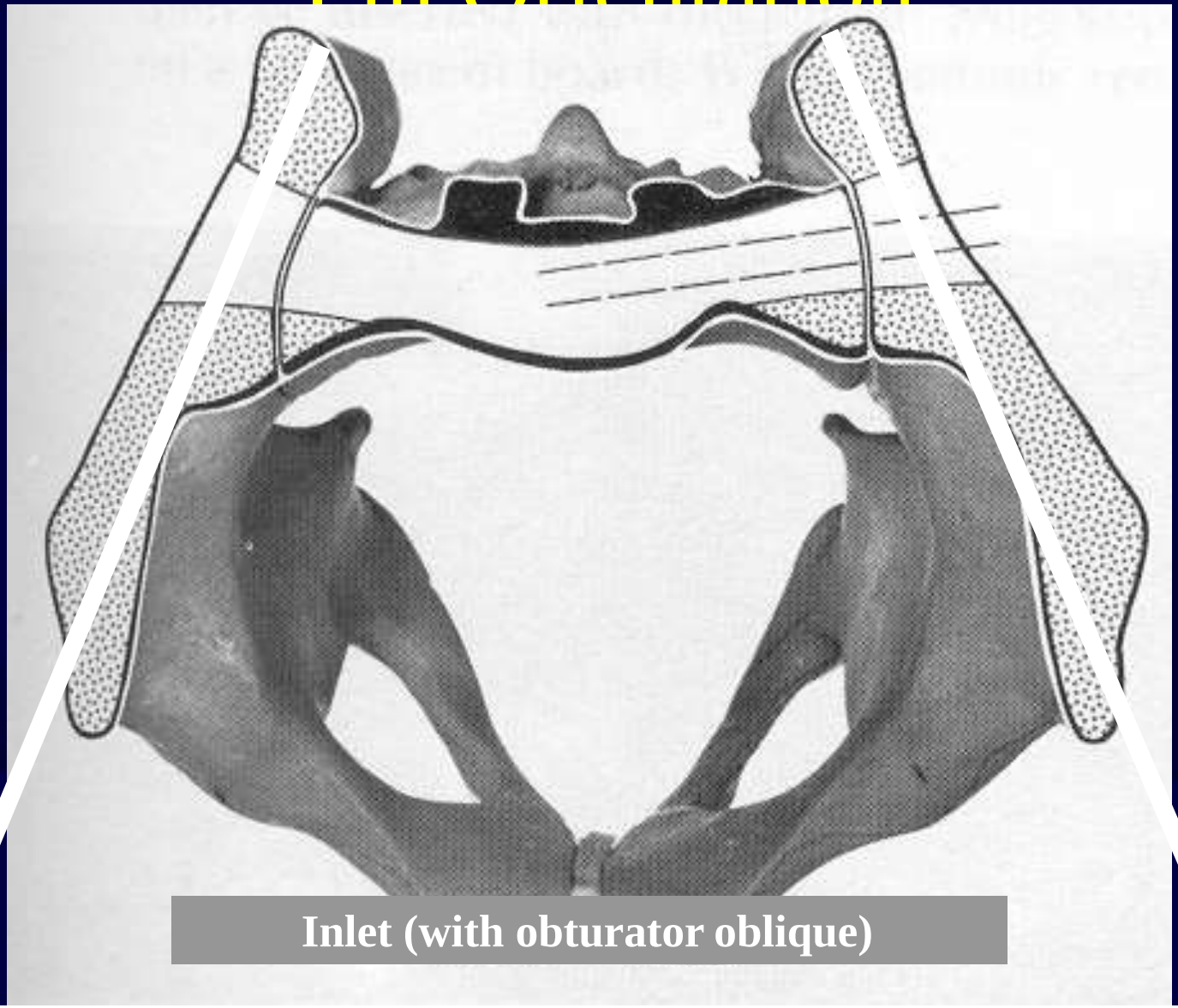
Outlet Obturator Oblique Image

Pin Orientation



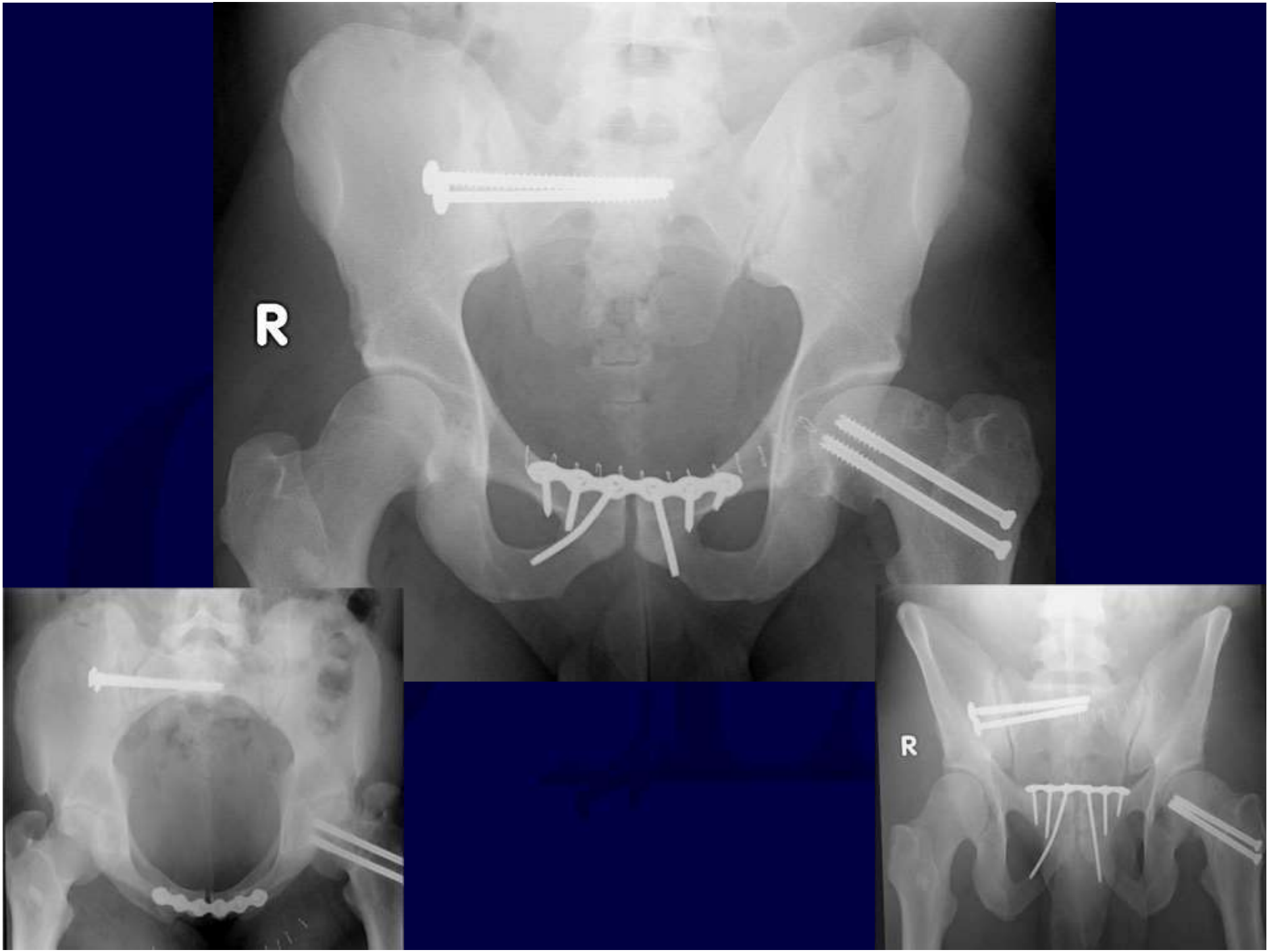
Inlet (with obturator oblique)

Pin Orientation



Inlet (with obturator oblique)


R
L


R
R

Anti-shock Clamp (C-clamp)

Better posterior pelvis stabilization

Allows abdominal access

Consider application with fluoro or in the OR to prevent poor pin placement

Can be combined with pelvic packing

Ertel, W et al, JOT, 2001

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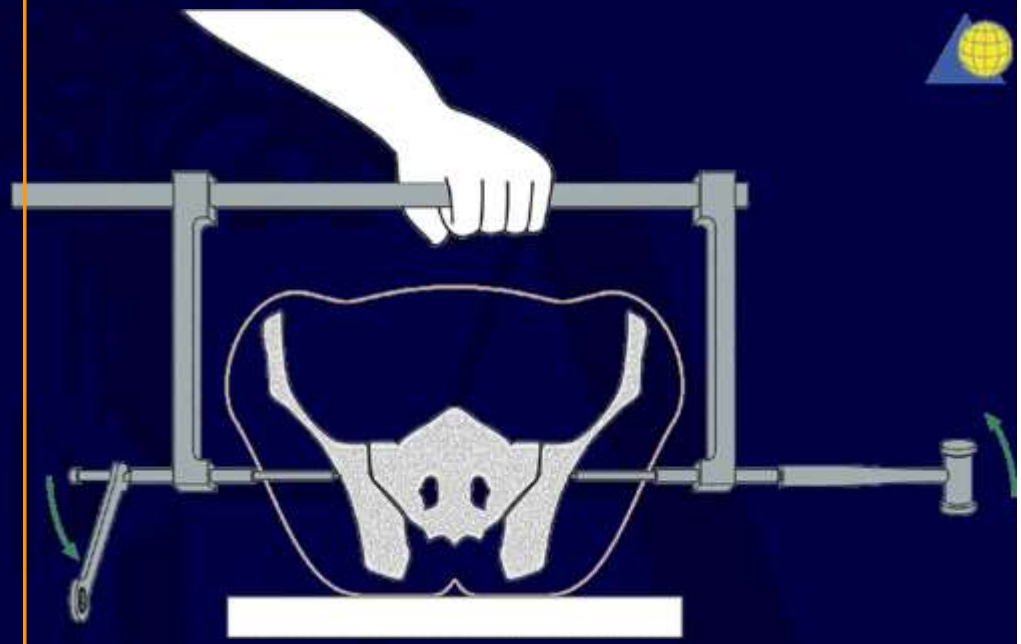

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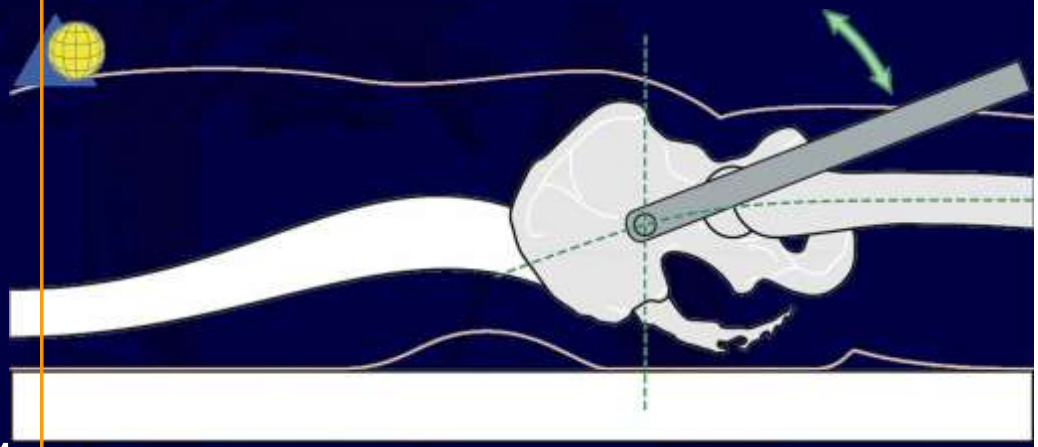
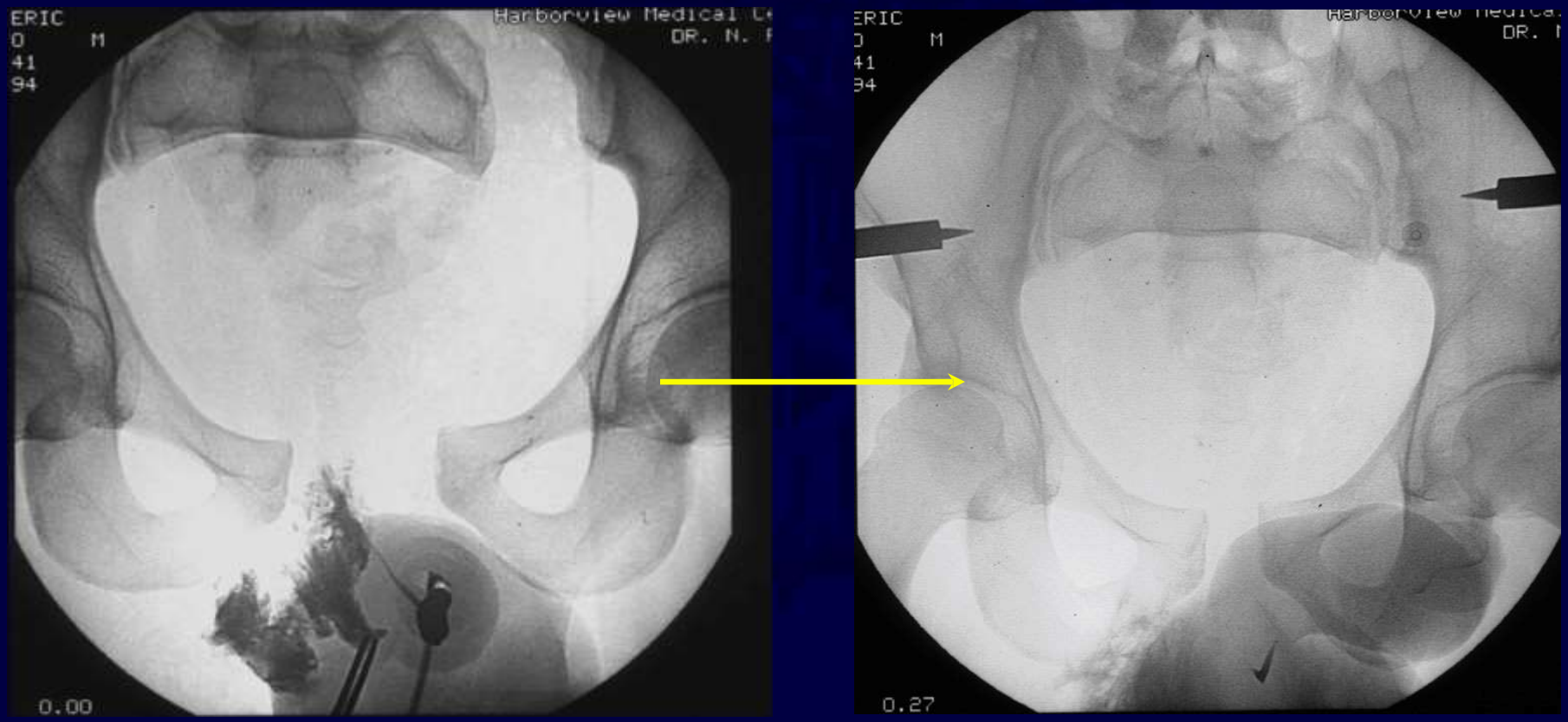


Emergent Application

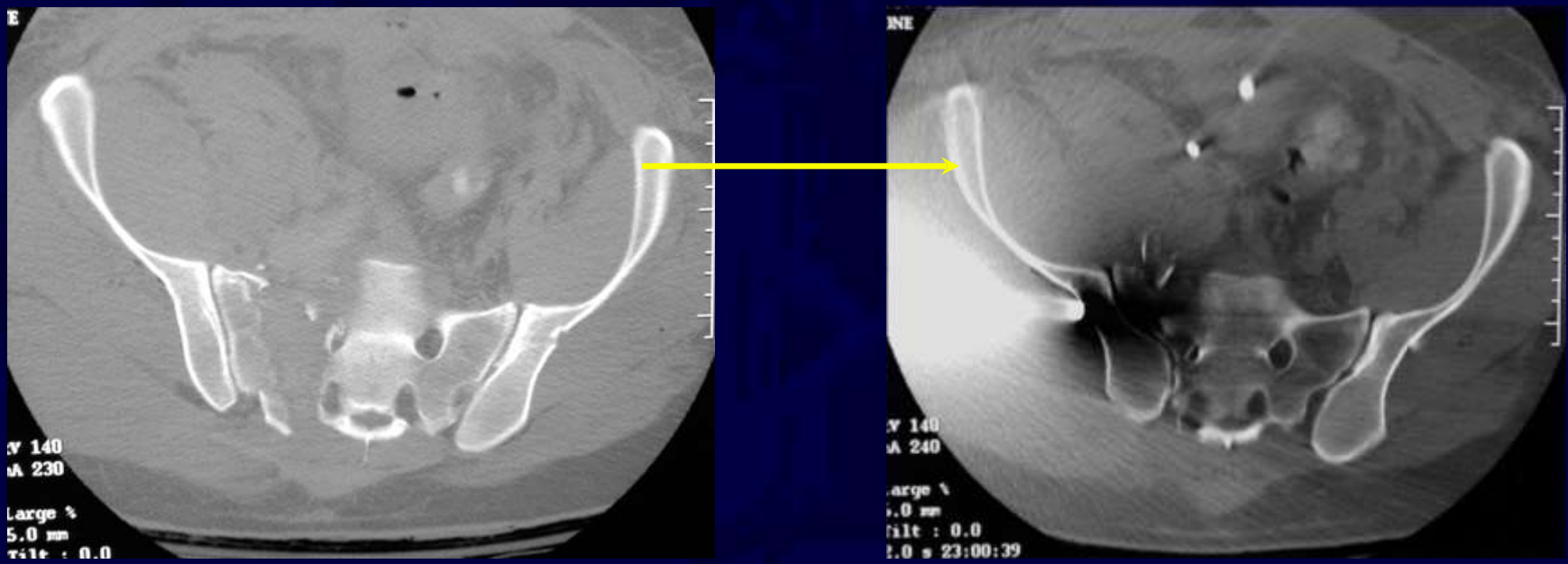


C-clamp: Anatomical Landmarks

- Same (similar location) as the starting point for an iliosacral screw
- "Groove" located on the lateral ilium as the wing becomes the posterior pelvis
- Allows for maximum compression
- Can be identified without fluoro in *experienced* hands

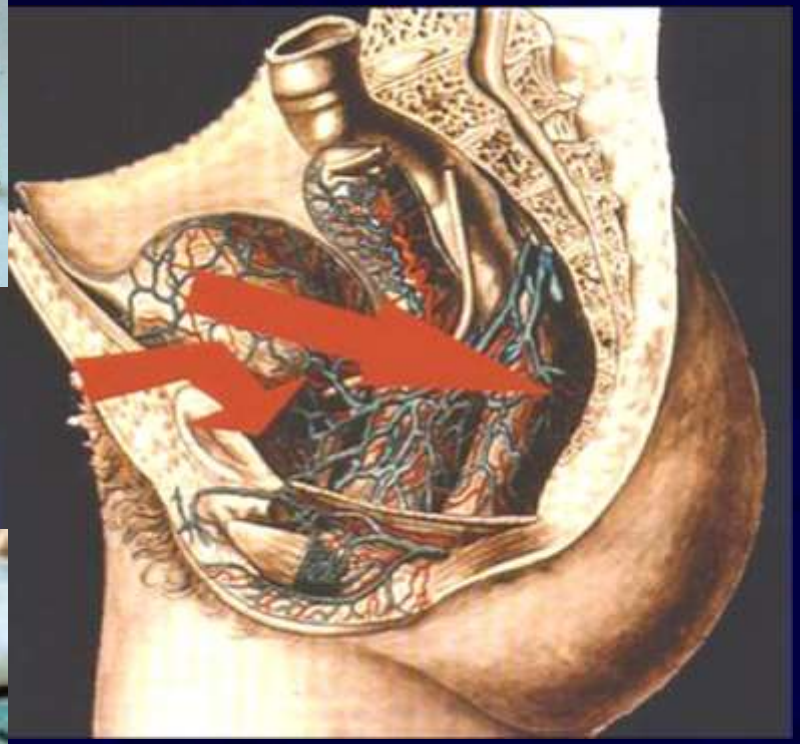
Pohlemann et al, JOT, 2004

Caution…



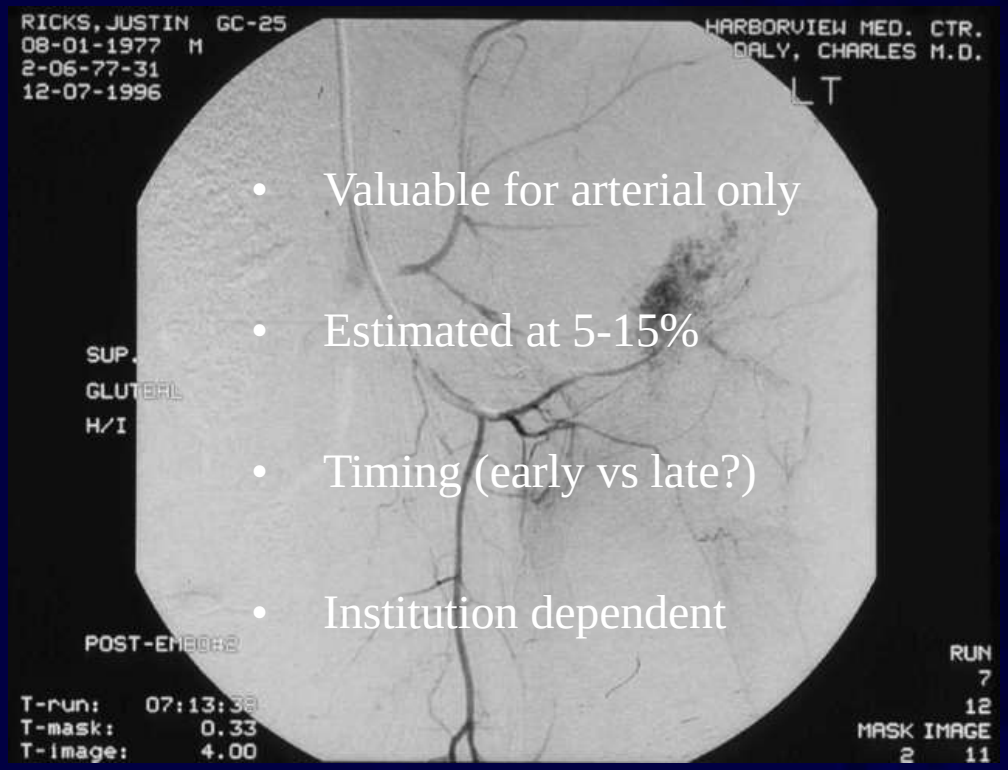
Avoid Over-compression in Sacral Fractures!

Pelvic Packing



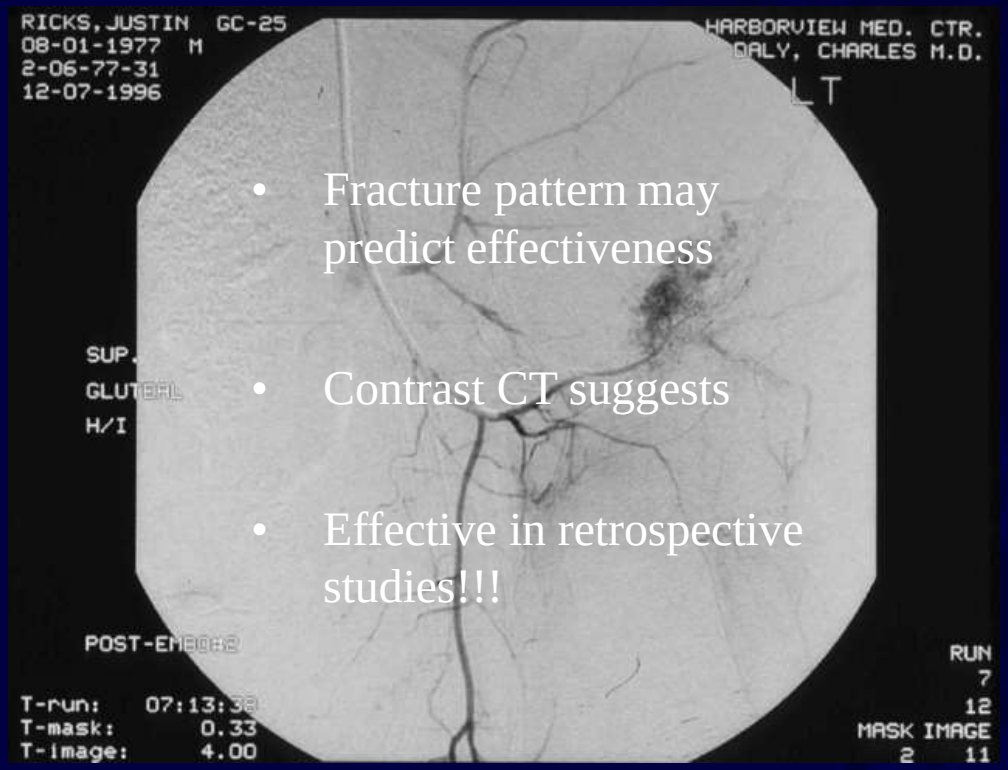
- Ertel, W et al, JOT, 2001
- Pohlemann et al, Giannoudis et al,

Role of Angiography???



- Valuable for arterial only
- Estimated at 5-15%
- Timing (early vs late?)
- Institution dependent

Role of Angiography???



- Fracture pattern may predict effectiveness
- Contrast CT suggests
- Effective in retrospective studies!!!

Vascular Injuries

- Arterial vs Venous vs Cancellous
- Unstable posterior ring association
- Associated fracture extension into notch
- Role of angiography

Cryer et al, JT, 1988
O'Neill et al, CORR, 1996
Goldstein et al, JT, 1994


RICKS, JUSTIN GC-25
08-01-1977 M
2-06-77-31
12-07-1996
HARBORVIEW MED. CTR.
LT
SUP.
GLUTEAL
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POST-EMBOLIZ
RUN
7
12
MASK IMAGE
T-run: 07:13:38
T-mask: 0.33
T-image: 4.00


21:14:34


21:10:50


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kV 120
mA 180
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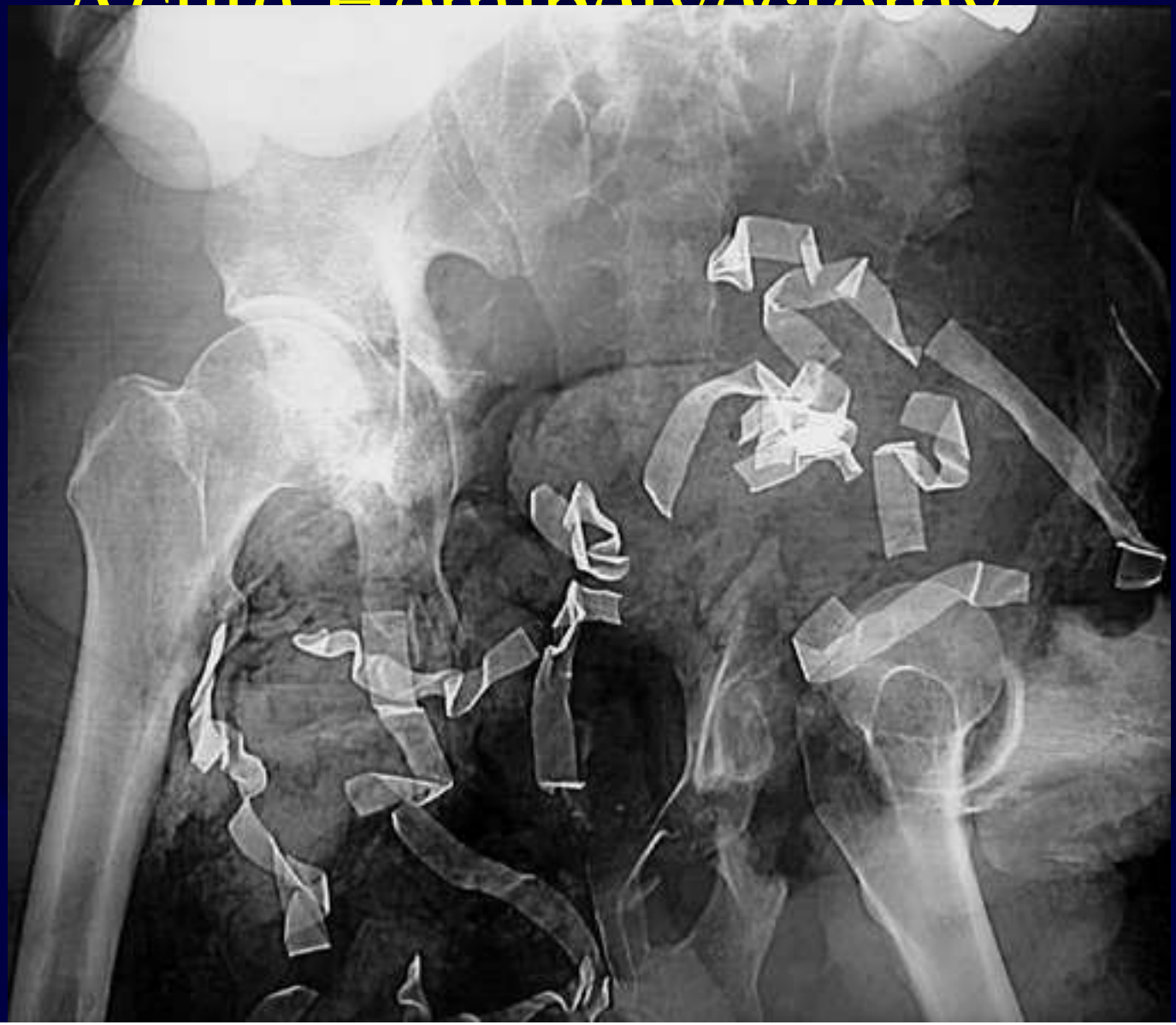
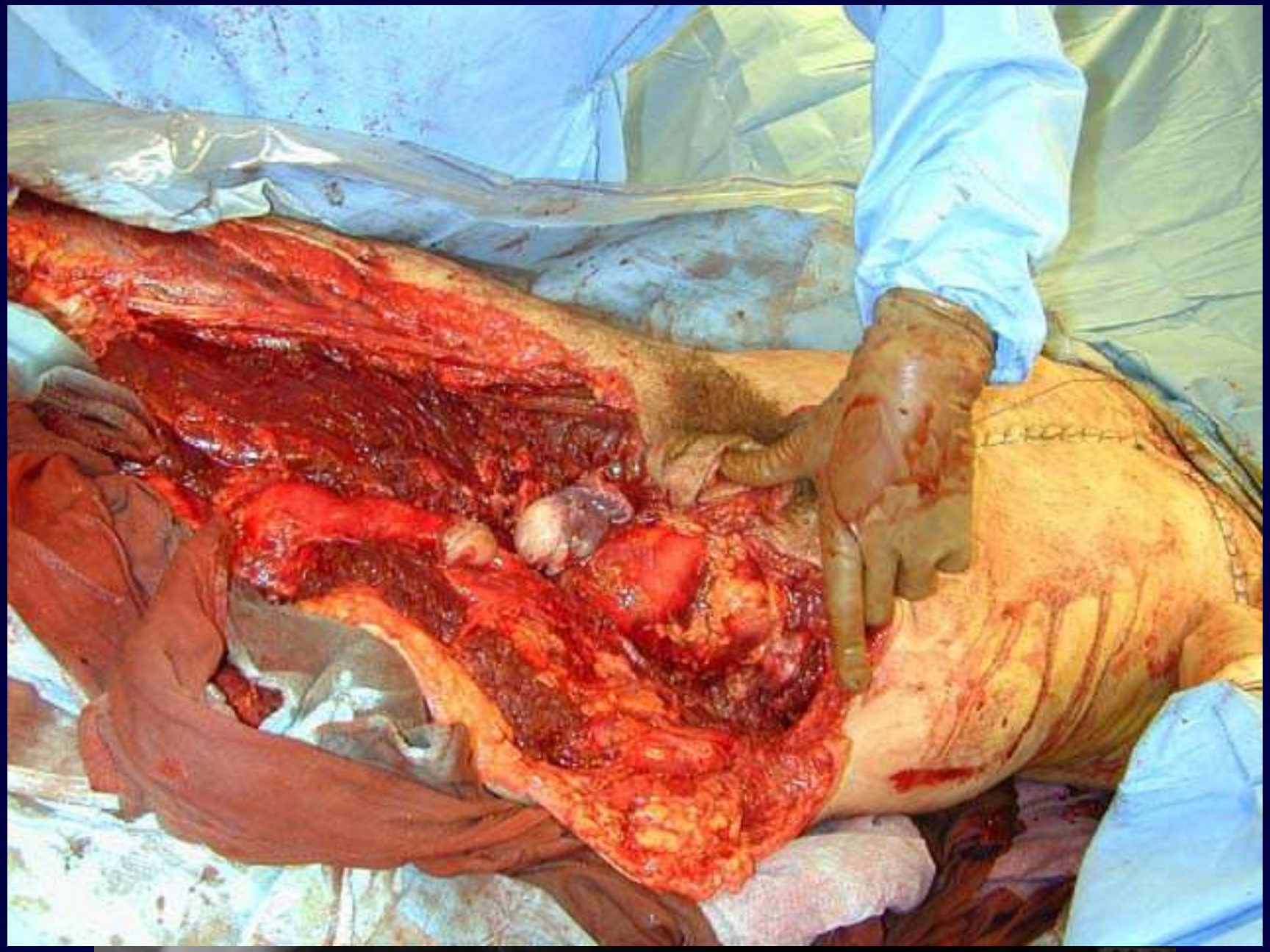
2.0 s 03:10:56 AM
P160
L = 400

Acute Hemipelvectomy



Acute Hemipelvectomy


22 DE

Retrospective evidence

- Hypotensive with unstable pelvic pattern…
- Proceed to Laparotomy *(85% with abdominal hemorrhage)*

- Hypotensive with unstable pelvic pattern…
- Proceed to Angio *(59% with positive angio)*

Easley et al, JT, 2002

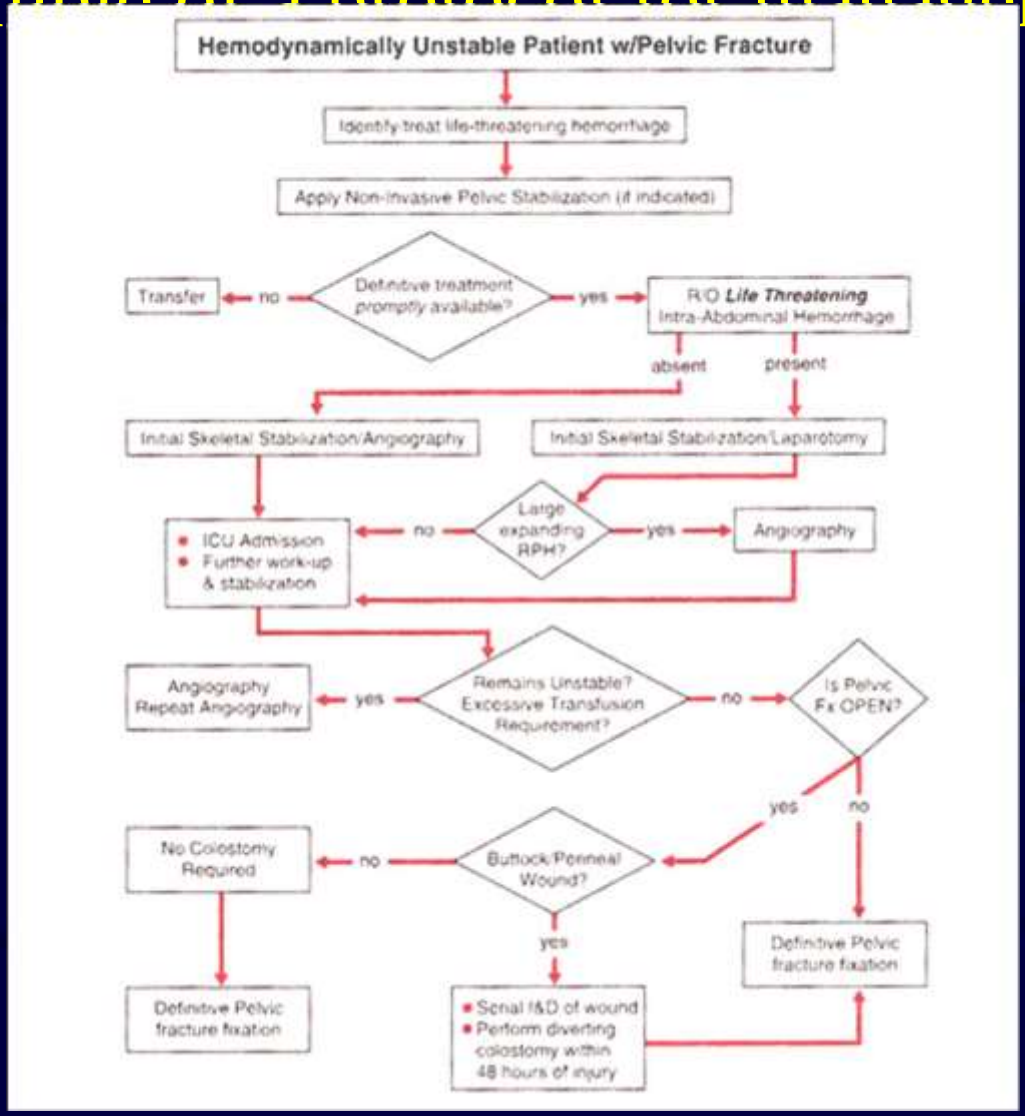
Contrast enhanced CT very suggestive of arterial source

(40 fold likelihood ratio)

(PPV and NPV of 80%, 98%)

Stephen et al, JT, 1999

Example of a protocol for management



Example of a protocol for management

- Hypovolemic shock and no response to fluids…
- (+) DPL: 1. Laparotomy (+/- packing with ex fix)
- 2. Angio
- (-) DPL: 1. Sheet/binder/ex-fix (some still crash lap)
- 2. Angio

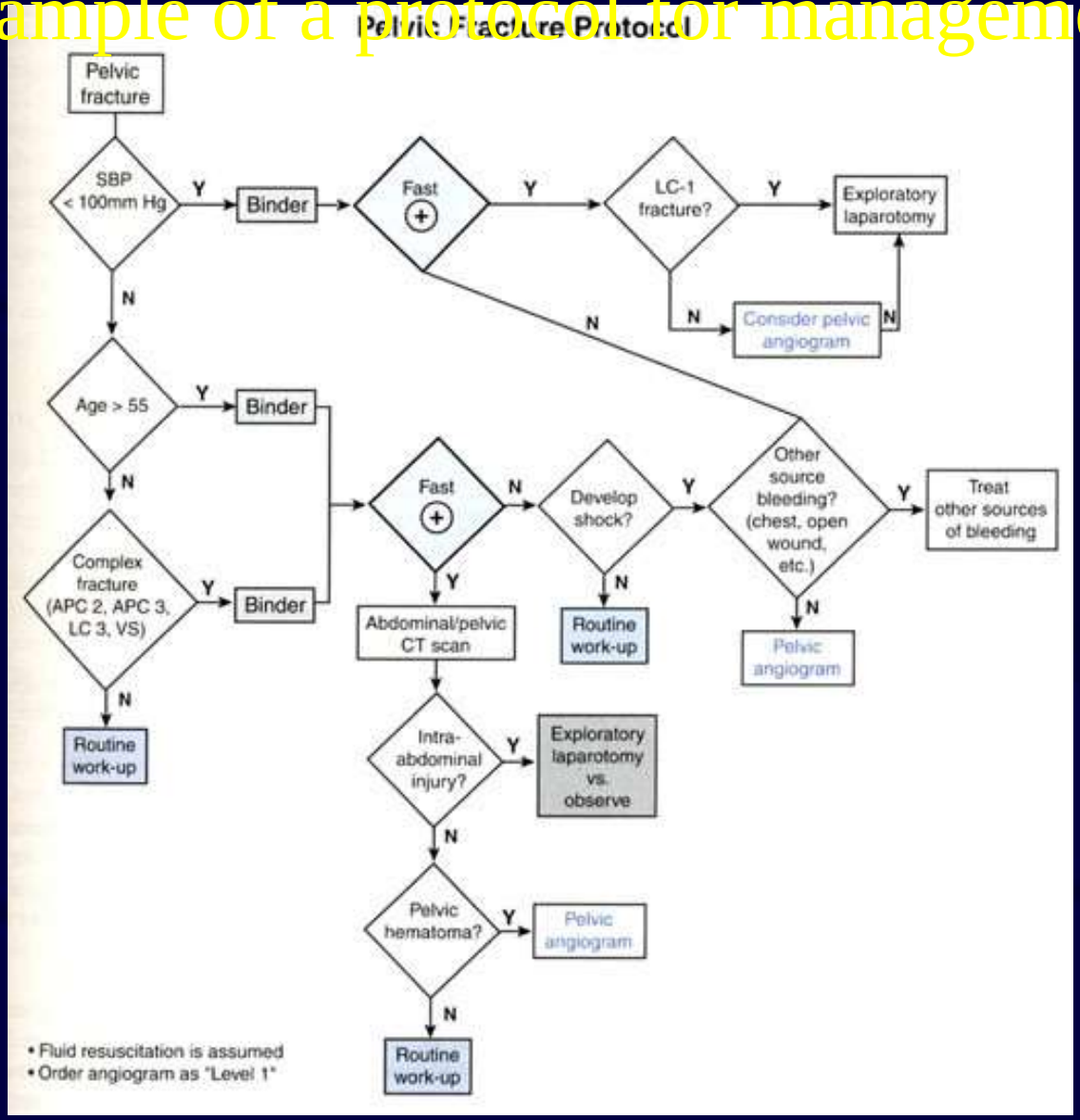
Hypovolemic shock with response to fluids…

(++) DPL:
1. **Laparotomy (+/- packing with ex fix)**
2. **Ex Fix**
3. **Angio**

(+) DPL: 1. Ex Fix
2. **Laparotomy**
3. **Angio**

(-) DPL:
1. **Sheet/binder**
2. **Angio**
3. **Ex Fix**

Example of a protocol for management



Protocol for Management

- Biffl et al, Evolution of a mutlidisciplinary clinical pathway for the management of unstable patients with pelvic fractures. JOT, 2001

5 elements:

Immediate trauma surgeon availability (+ Ortho!)

Early simultaneous blood and coagulation products

Prompt diagnosis & treatment of life threatening injuries

Stabilization of the pelvic girdle

Timely pelvic angiography and embolization

Changes:

Patients more severely injured (52% vs 35% SBP < 90)

DPL phased out for U/S

Pelvic binders and C-clamps replaced traditional ex fix

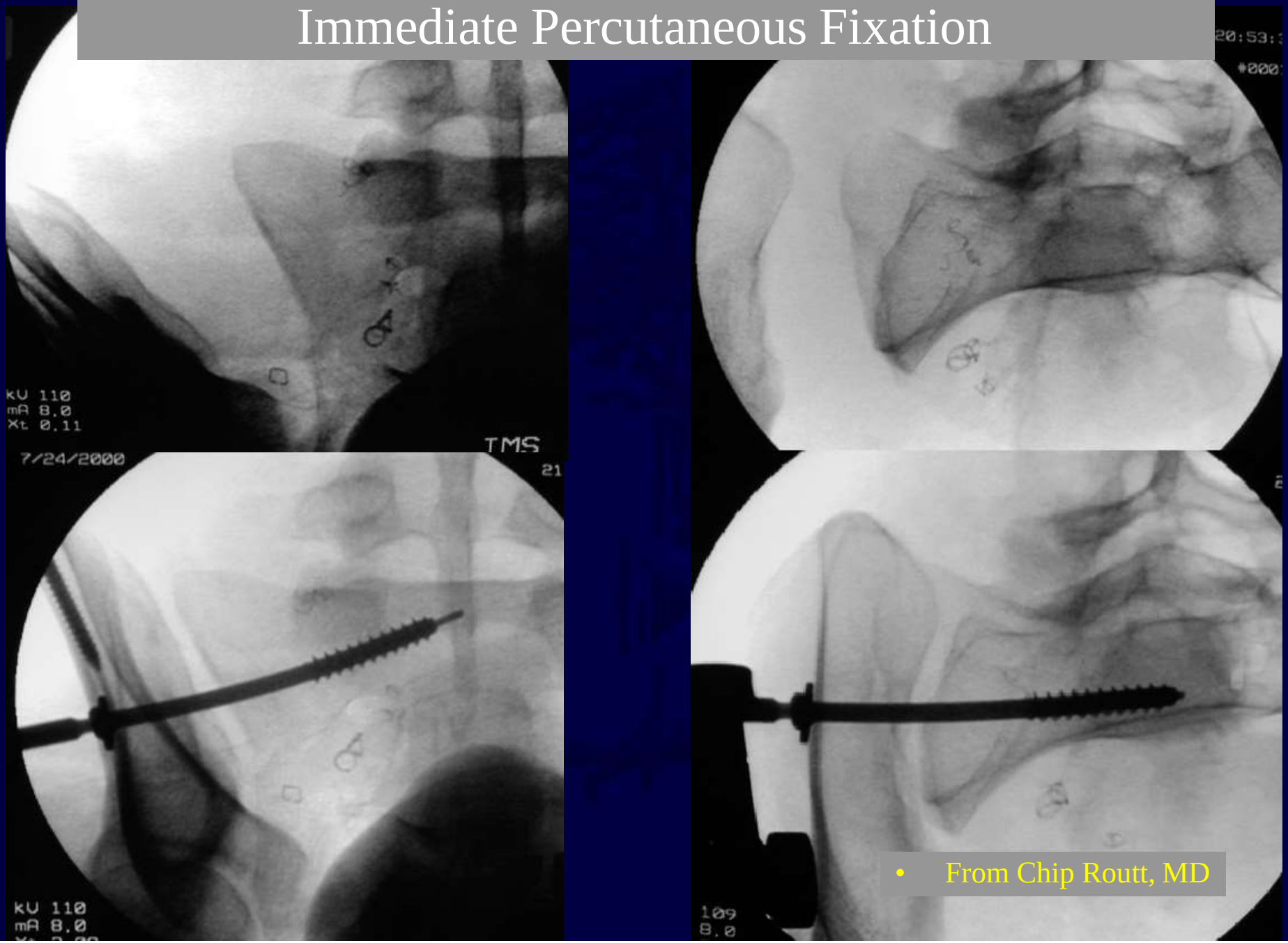
Protocol for Management

- Biffl et al, Evolution of a mutlidisciplinary clinical pathway for the management of unstable patients with pelvic fractures. JOT, 2001

Mortality decreased	**from 31% to 15%**
Exsanguination death	**from 9% to 1%**
MOF	**from 12% to 1%**
Death (<24 hours)	**from 16% to 5%**

The evolution of a multidisciplinary clinical pathway, coordinating the resources of a level 1 trauma center and directed by joint decision making between trauma surgeons and orthopedic traumatologists, has resulted in improved patient survival. The primary benefits appear to be in reducing early deaths from exsanguination and late deaths from multiple organ failure.

Immediate Percutaneous Fixation



- From Chip Routt, MD

Summary: Acute Management

- Play well with others (general surgery, urology, interventional radiology, neurosurgery)
    - Understand the fracture pattern
    - Do something (sheet, binder, ex fix, c-clamp)
- Combine knowledge of the fracture, the patients condition, and the physical exam to decide on the next step

Thank You

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University of Washington

HMC Faculty

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If you would like to volunteer as an author for the Resident Slide Project or recommend updates to any of the following slides, please send an e-mail to ota@ota.org

E-mail OTA about Questions/Comments

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