

# Complex Pelvic Fractures

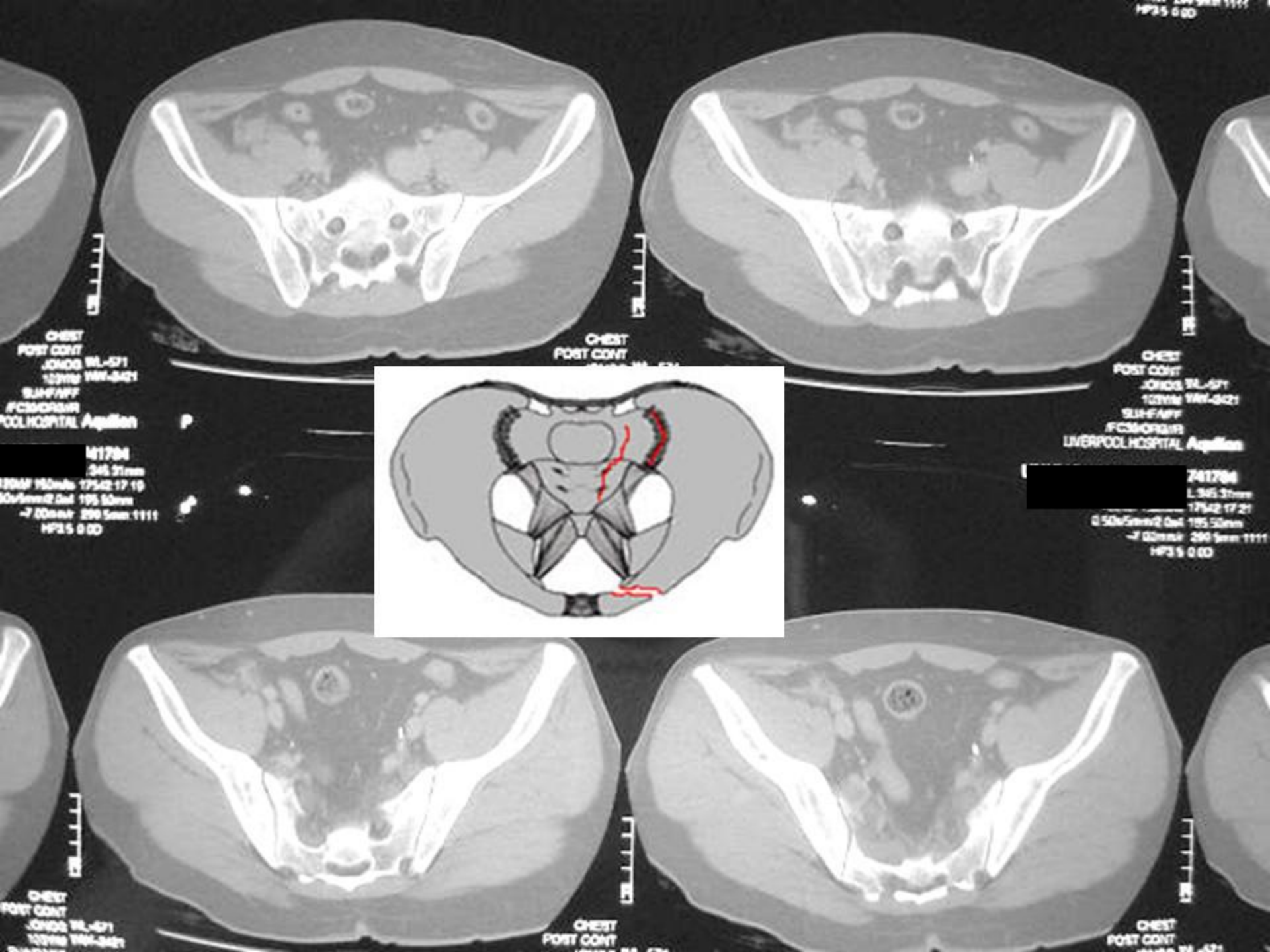
A/Prof Zsolt Balogh, MD, PhD, FRACS

Director of Trauma

John Hunter Hospital

Newcastle

AUSTRALIA



# B-2 Lateral Compression

- Associated injuries:
  - Pelvic viscera

**Bleeding risk +/-**



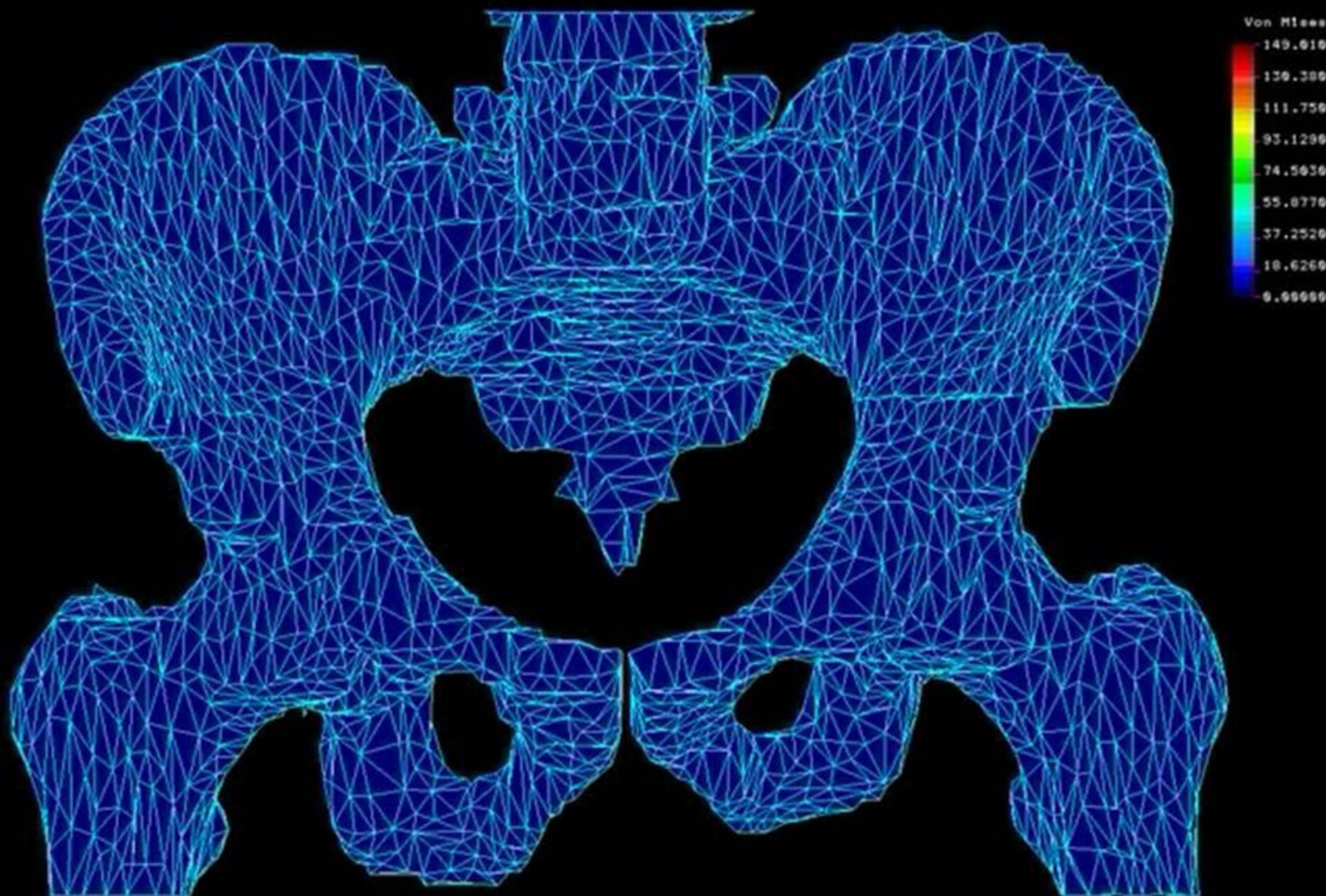
# Classification



Tile C



Le=1  
1



# Significance

- 35% mortality in Australasian Major Centres
  - » *Verbeek et al. World J Surgery in press*
- Most frequent preventable bleeding-related hospital trauma deaths
  - » *Brenneman et al. J Trauma 2006*
- Level of evidence is low
- We can make a difference
  - » *Biffl et al Ann Surg 2001*
  - » *Balogh et al J Trauma 2005*



# MANAGEMENT

“Multidisciplinary Approach”

= Nobody does anything

- General surgeon
- Orthopaedic surgeon
- Interventional Radiology
- Urology

# BACKGROUND

- Haemodynamically unstable patients with Pelvic #:

- 32% mortality
- Only 55% had abdominal diagnostics
- Only 28% had pelvic binding
- 27% had angiography
- 49% non-therapeutic laparotomy rate



# BACKGROUND

- Primary intervention:
  - Angiography 18% mortality (58y, ISS 42)
  - Laparotomy 29% mortality\*\*\* (56y, ISS 40)
  - Pelvic fixation 10% mortality (39y, ISS 18)

*Verbeek et al. World J Surg in press*

# Hemorrhagic Shock

22% on arrival to ED

SBP:  $98 \pm 11$  mmHg

BD:  $-13 \pm 2$  mmHg

Transfusions:  $11 \pm 2$  U PRBC

62% related to pelvis

SBP <90 mmHg

45% had no shock

46% shock patient had normal SBP

*Balogh et al. J Trauma in press*

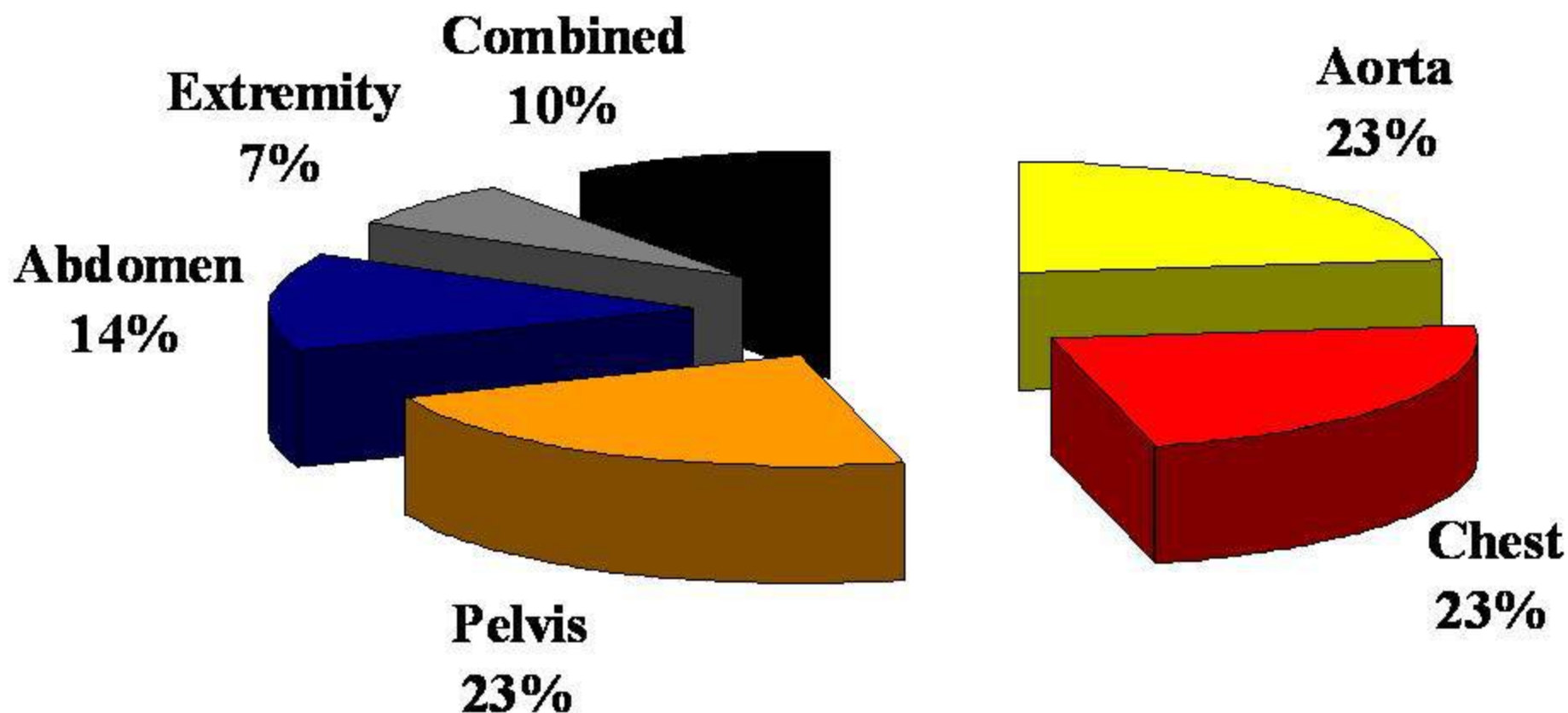


# COMPLEX PELVIC FX

- Requiring major surgical reconstruction
- Haemodynamic instability
- Open Fracture
- Associated injuries: Urethra and/or Rectum

# Cause of Exsanguination (%)

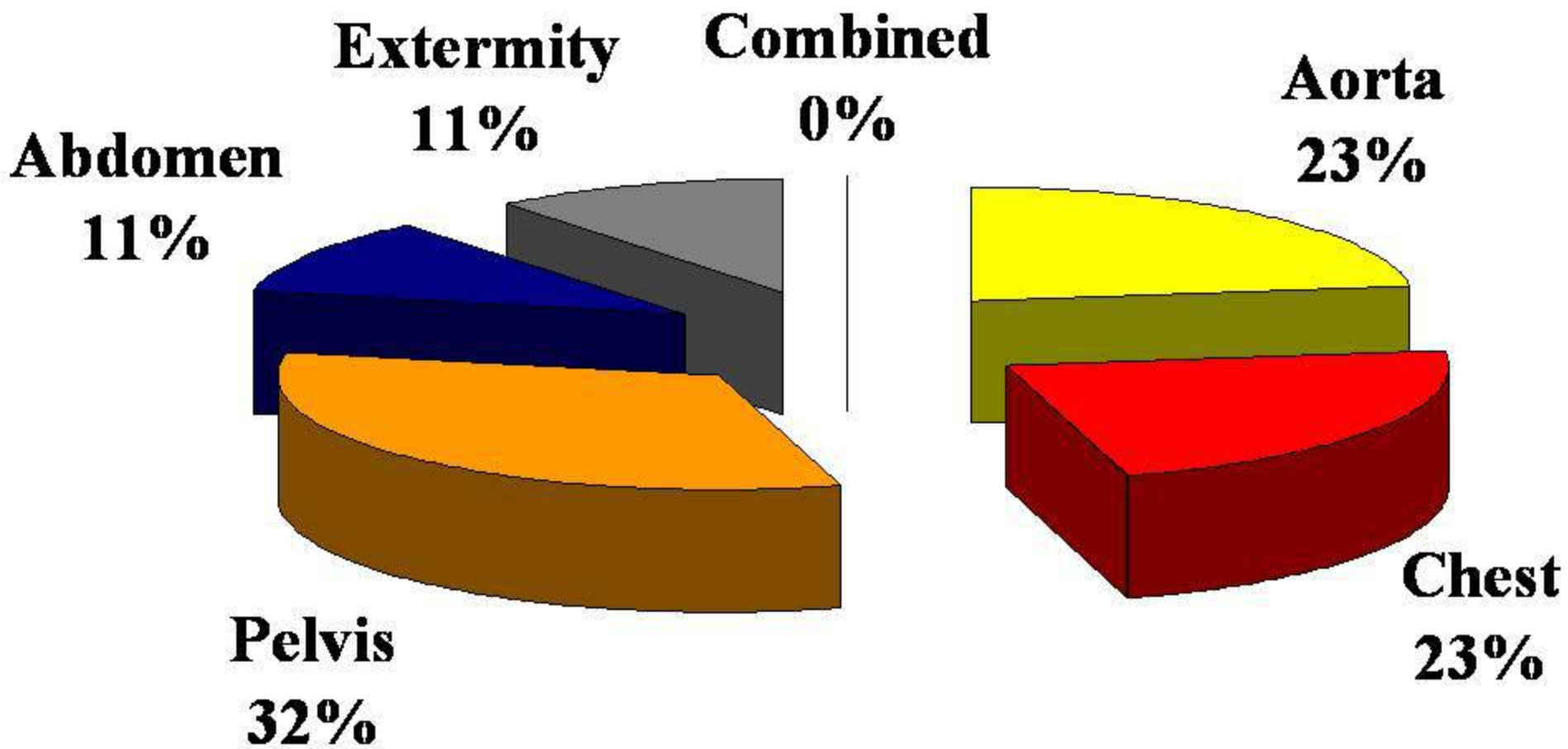
**Pre-hospital**



*Balogh et al. J Trauma in press*

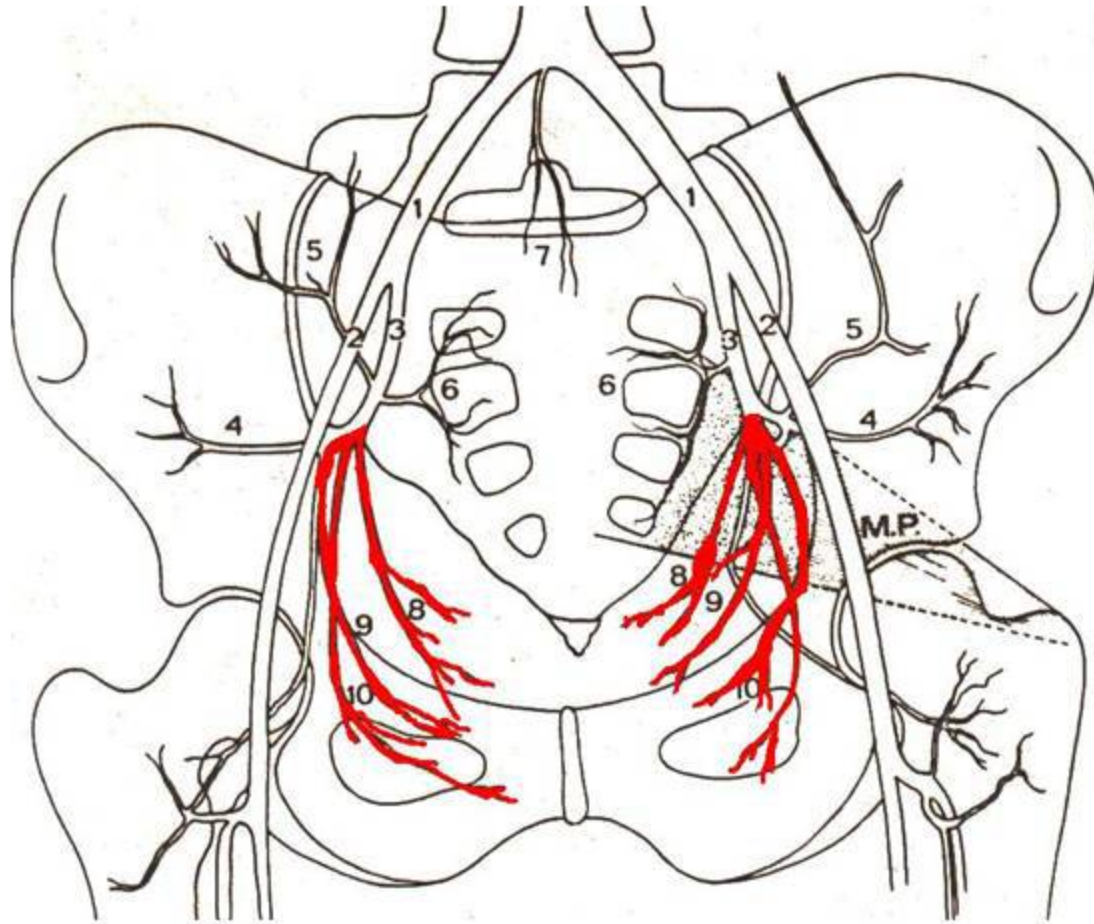
# Cause of Exsanguination (%)

**In-Hospital**

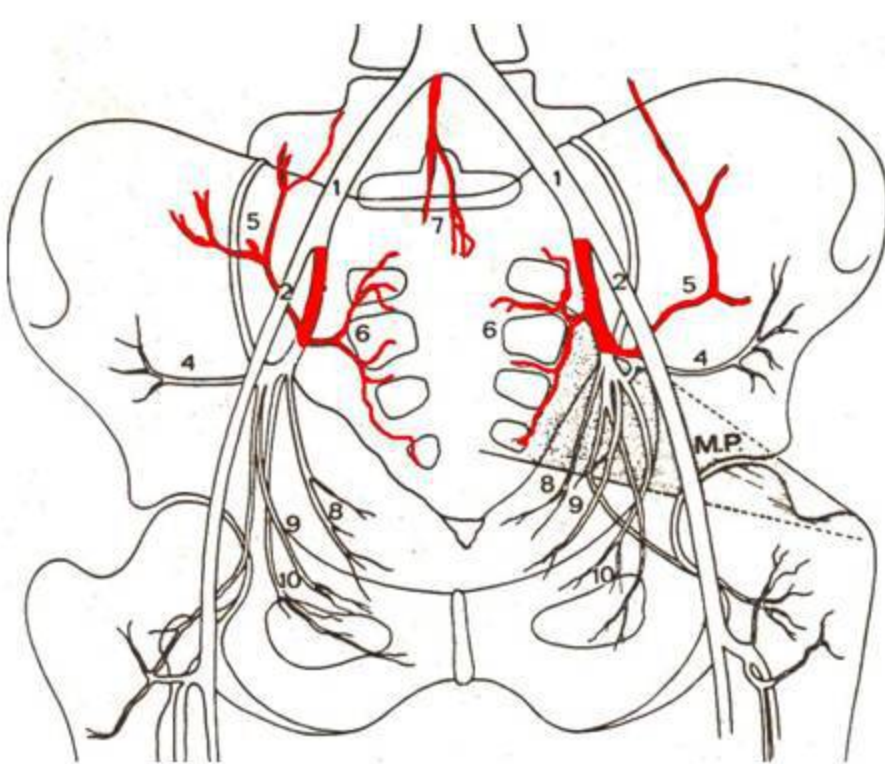




# Anterior Ring – Pelvic Floor



# Posterior Ring – Gluteal and Sacral vessel



# Probability

- 1.5/100,000/year in Australia
- 5% of all pelvic fractures
- 10% of all high energy pelvic fractures

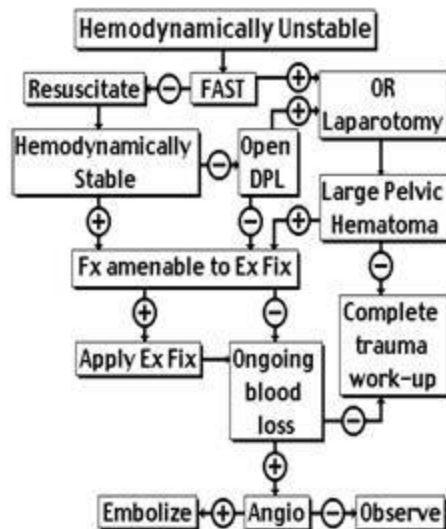
*Balogh et al. J Trauma in press*



# Probabilities: High Energy Fractures

- Only 15% has abdominal injury requiring intervention
- Only 7% requiring immediate abdominal haemorrhage control
- 5% urethral injury
- 3% rectal injuries

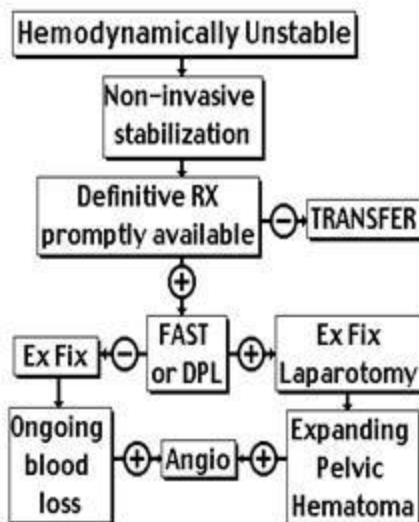
*Balogh et al. J Trauma in press*



**Hemodynamically Unstable Pelvic Injury**

Scales T, Burgess A, Pelvic Fracture; pp 824-825, TRAUMA (eds Haffner, Pellicani, Moore); McGraw Hill, NY 1999

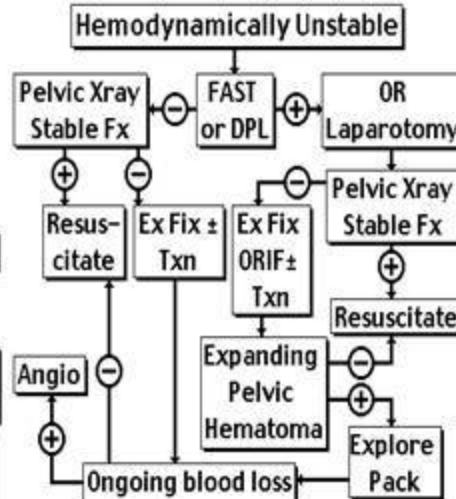
Simplified Algorithm derived from:



**Hemodynamically Unstable Pelvic Injury**

James F. Kellam (submitted for publication)

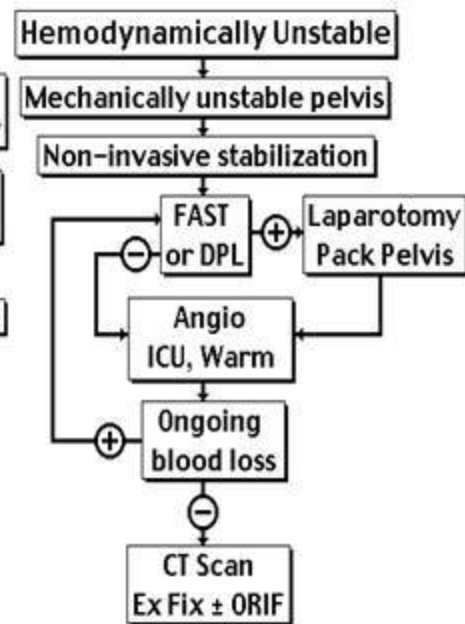
Simplified Algorithm derived from:



**Hemodynamically Unstable Pelvic Injury**

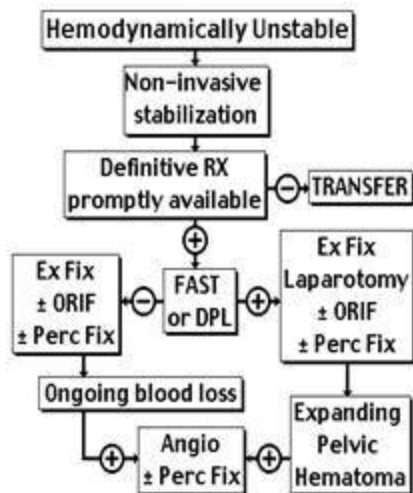
Simplified Algorithm derived from:

American Academy of Orthopedic Surgeons  
Orthopaedic Knowledge Update:  
Edited by Alan M. Levine, MD  
Section 3: Pelvis and Acetabulum:  
Section Editor, James F. Kellam  
Chapter 21: The Acute Management  
of Pelvic Ring Injuries, pp.  
217-225 by Michael J. Bosse



**Hemodynamically Unstable Pelvic Injury**

Simplified Algorithm derived from: Karim Brohi

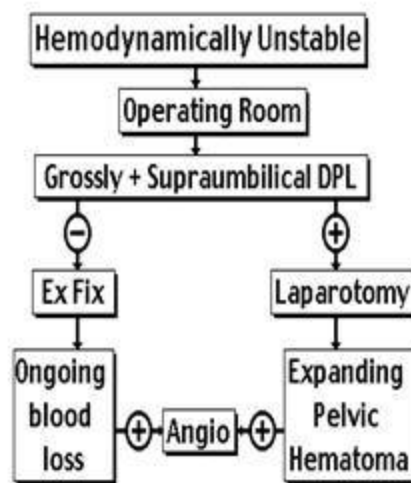


**Hemodynamically Unstable Pelvic Injury**

Simplified Algorithm derived from:

Hilton L. Reiff

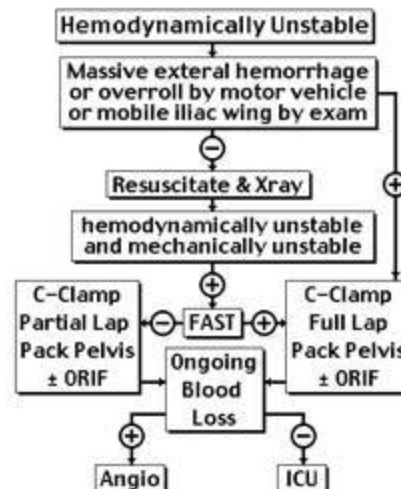
perc fix = posterior percutaneous fixation



**Hemodynamically Unstable Pelvic Injury**

Simplified Algorithm derived from:

Evers-Cryer Miller, Arch Surg 124:422-1989

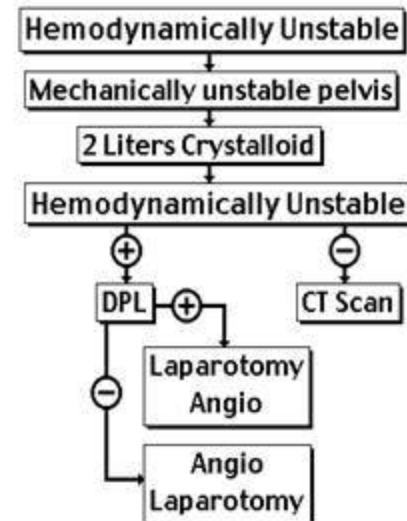


**Hemodynamically Unstable Pelvic Injury**

Partial Lap(arotomy) = umbilical to pubic symphysis  
Full Lap(arotomy) = xiphoid to pubic symphysis

Simplified Algorithm derived from:

T. Pohlmann, A. Ginzler, T. Hübner, H. Tschernke



**Hemodynamically Unstable Pelvic Injury**

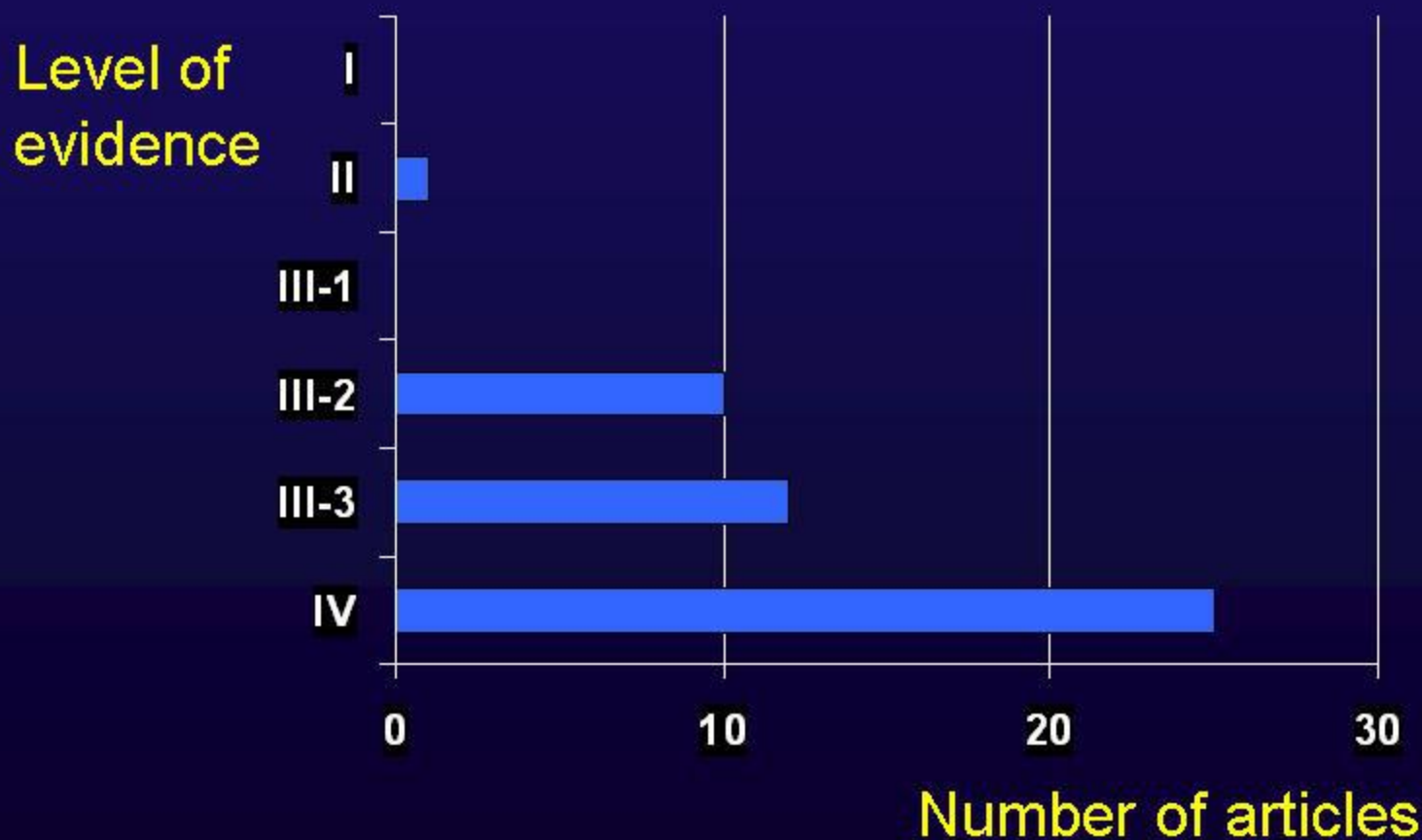
Simplified Algorithm derived from:

Agolini SF, Shah K, Jaffe J, Newcomb J, Rhodes M, Reed JF 3rd, J Trauma 1997 Sep;43(3):395-9

# “Religions”

- Embolisers
- C-clampers / ex-fix-ers
- Packers
- Ligators
- Too concerned to do anything

# Analysis of the literature on haemodynamically unstable pelvic #



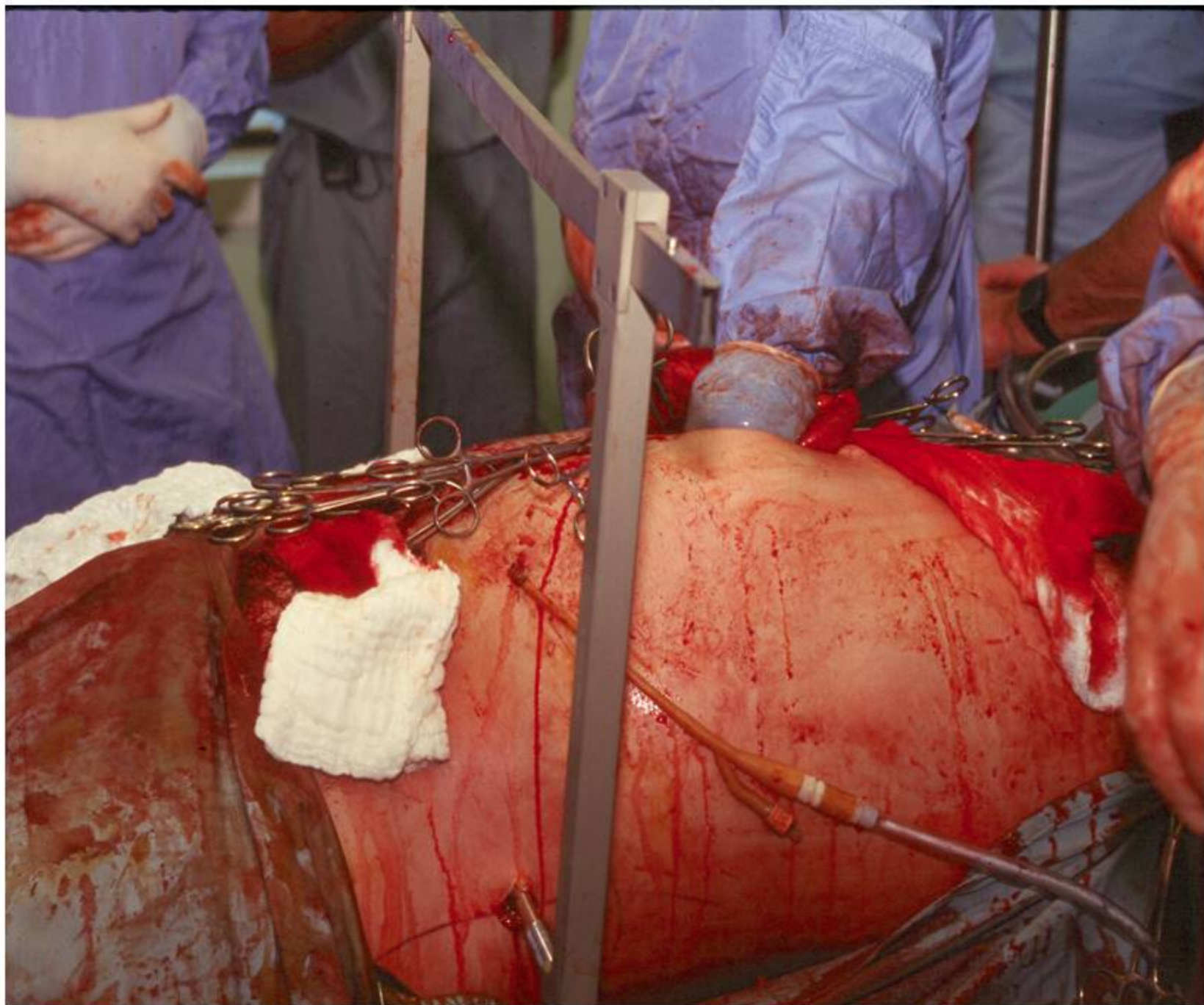












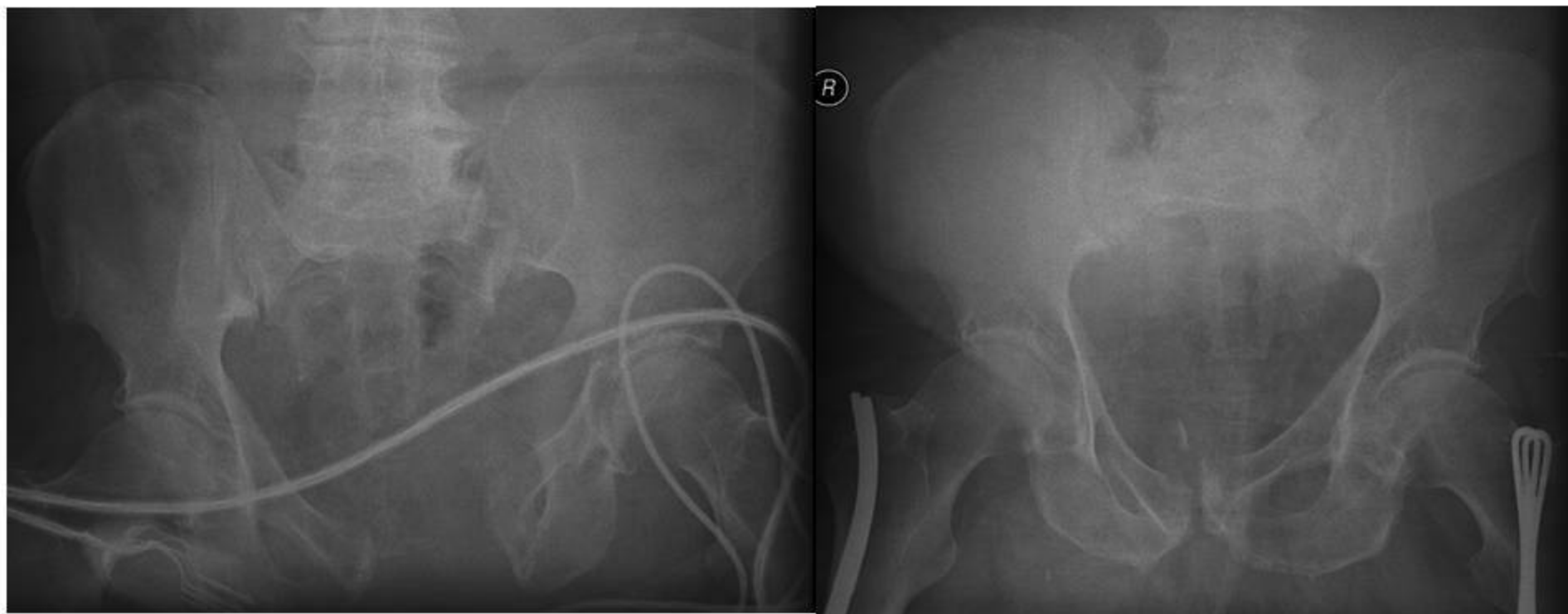


# Steps 1.

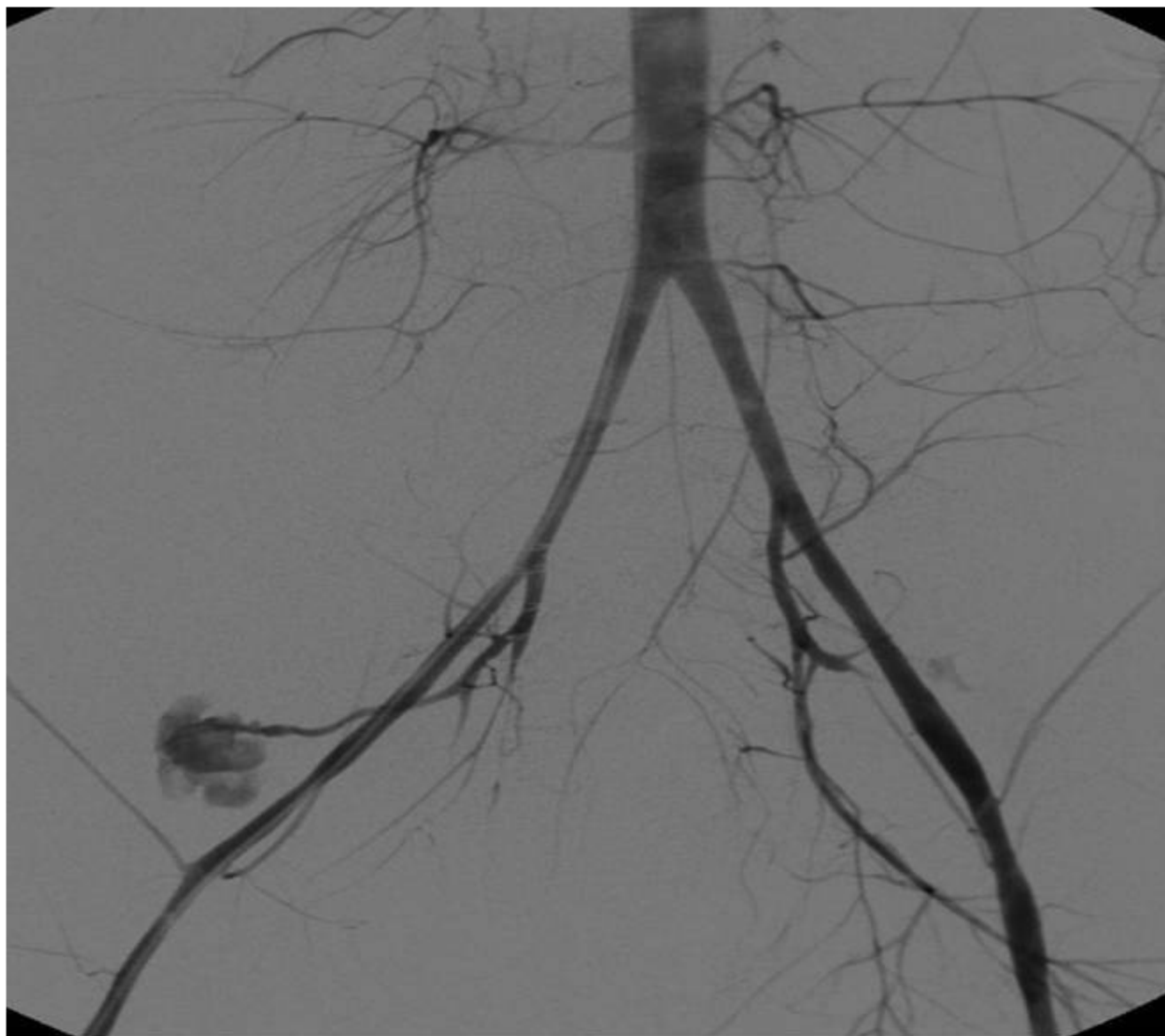
- Base Deficit is worse than 6
- (Blood Transfusion in ED)
- Other sources are excluded

Pelvic binding <10 min  
~ venous bleeding

# Pre and Post Binding



# Angiography





391439  
18/01/81

STUDY 1  
18/08/02  
TA 22:08:03  
22 - 6/11  
M 2  
5.00 sec

AXIOM-ADUS  
VA20F 020507-2  
HFS  
com/////

R

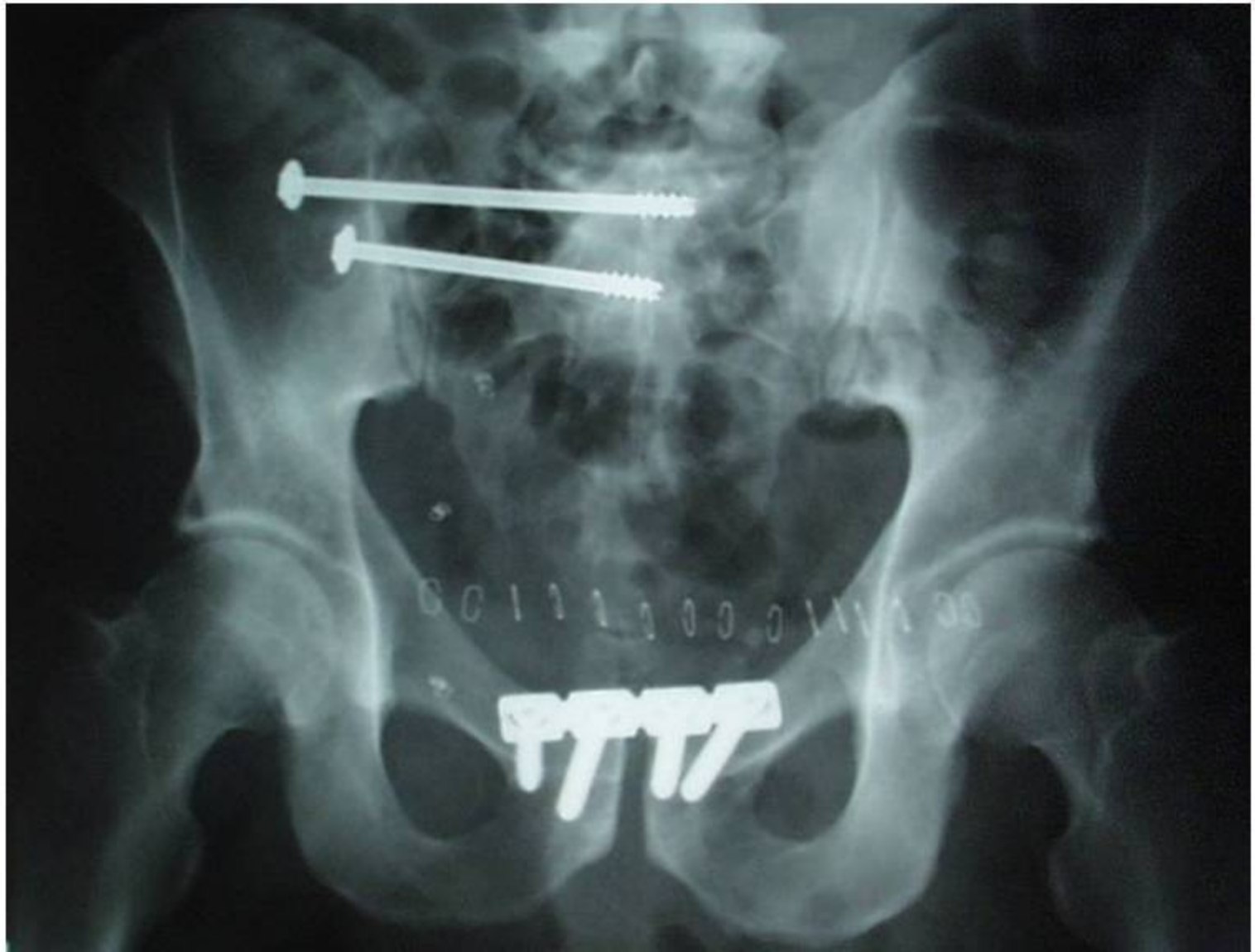
Selective 2  
40 cm  
A  
kV 68  
mA 440  
D 5225  
LAO 2° / 0°

1024  
Scale 40% o.p.

EE 5%  
AB 0%

WB 2800 x/y 0.0/0.0  
WC 50 [C 2048]  
[W 4096]

# Minimally invasive pelvic fixation <24 hours



PELVIS  
Acc# 2062372502  
View Pos: AP

Study Desc: MPPELVIS

10 cm

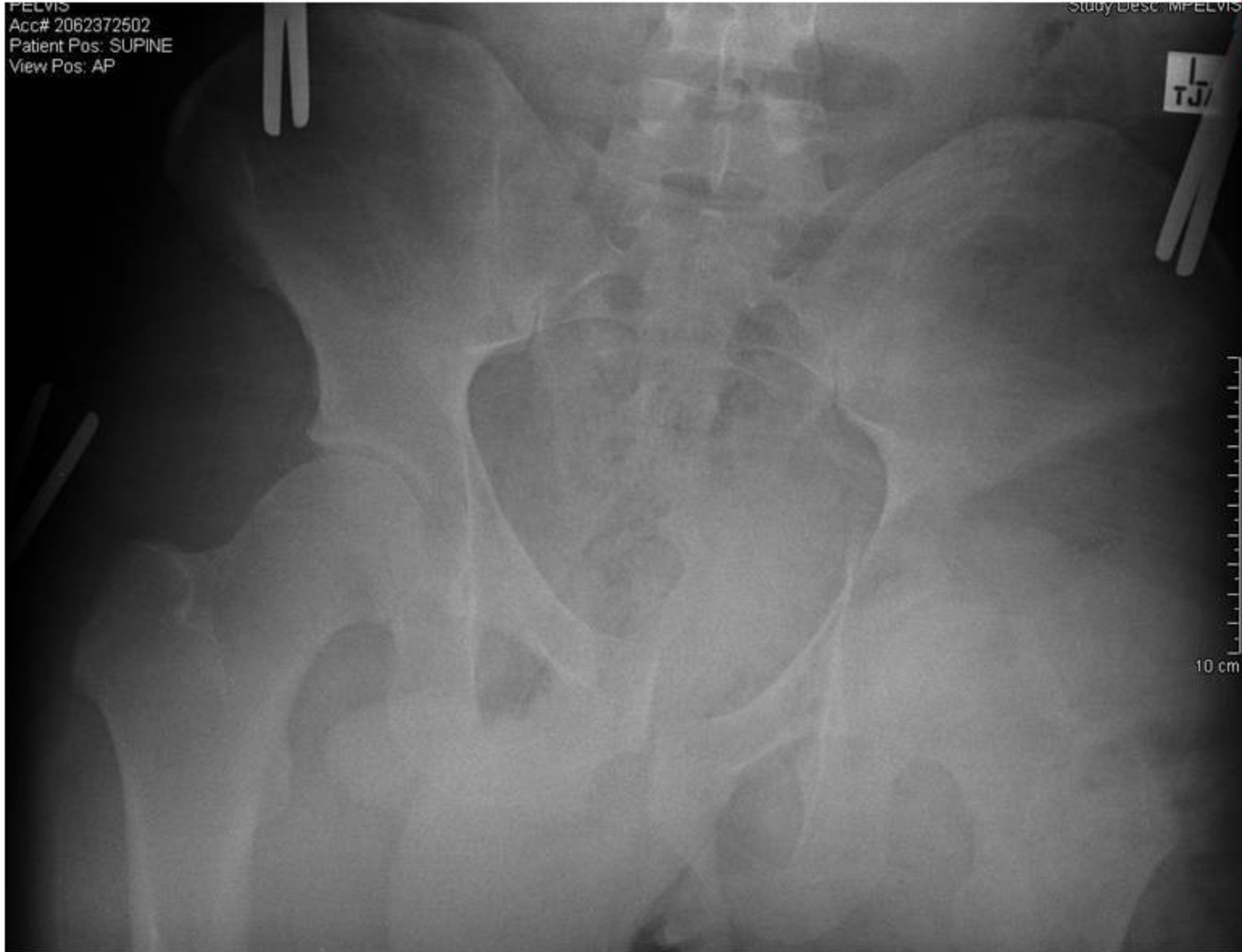


Pelvis  
Acc# 2062372502  
Patient Pos: SUPINE  
View Pos: AP

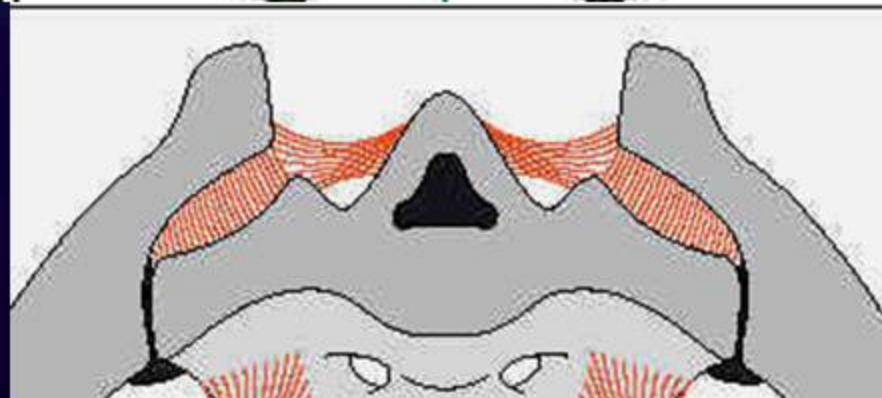
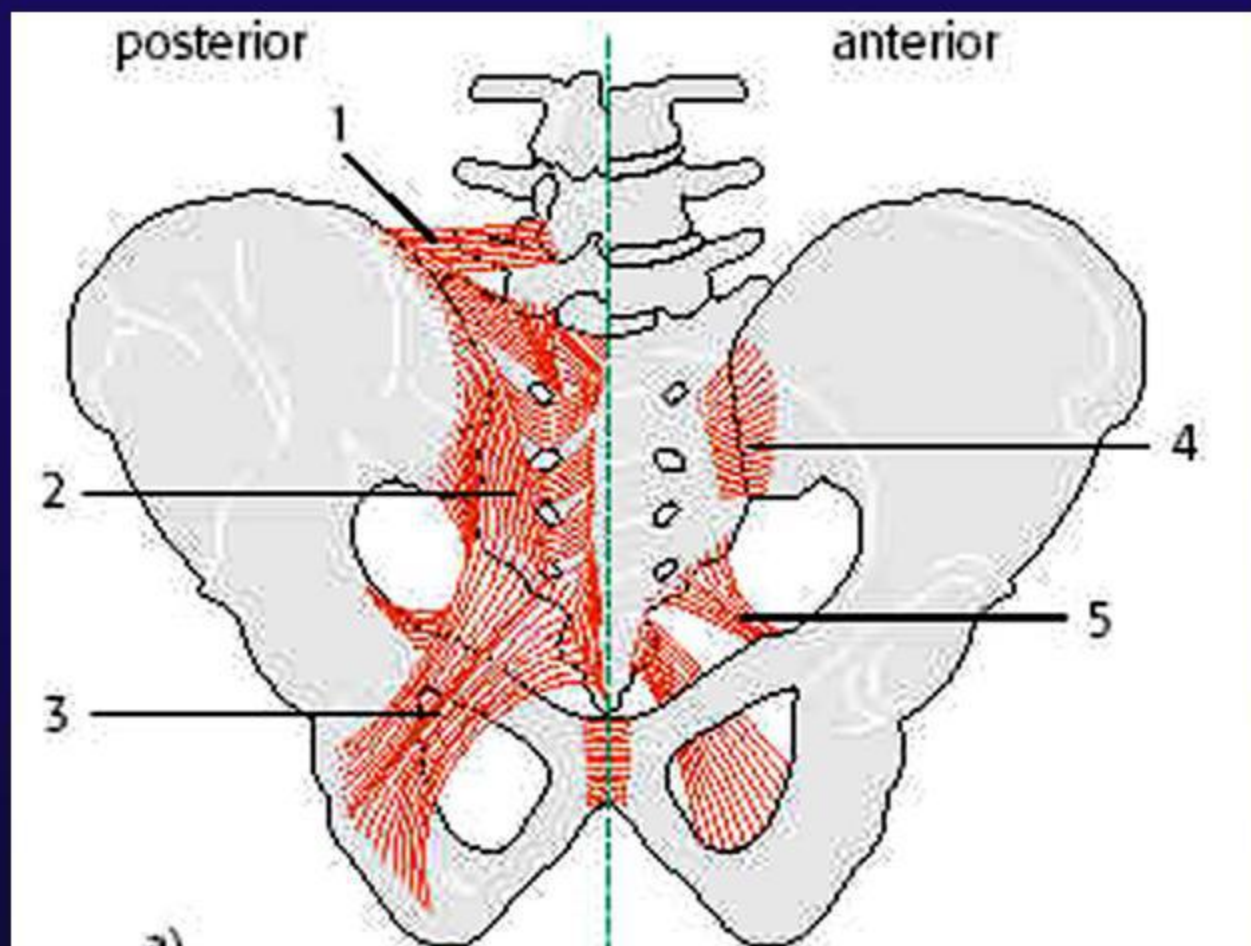
Study Desc: MP-Pelvis

L  
TJ

10 cm











# WHAT NEXT?

- ?More ED resuscitation
- ?CT
- ?OT
- ?ICU
- ?Angio Suite



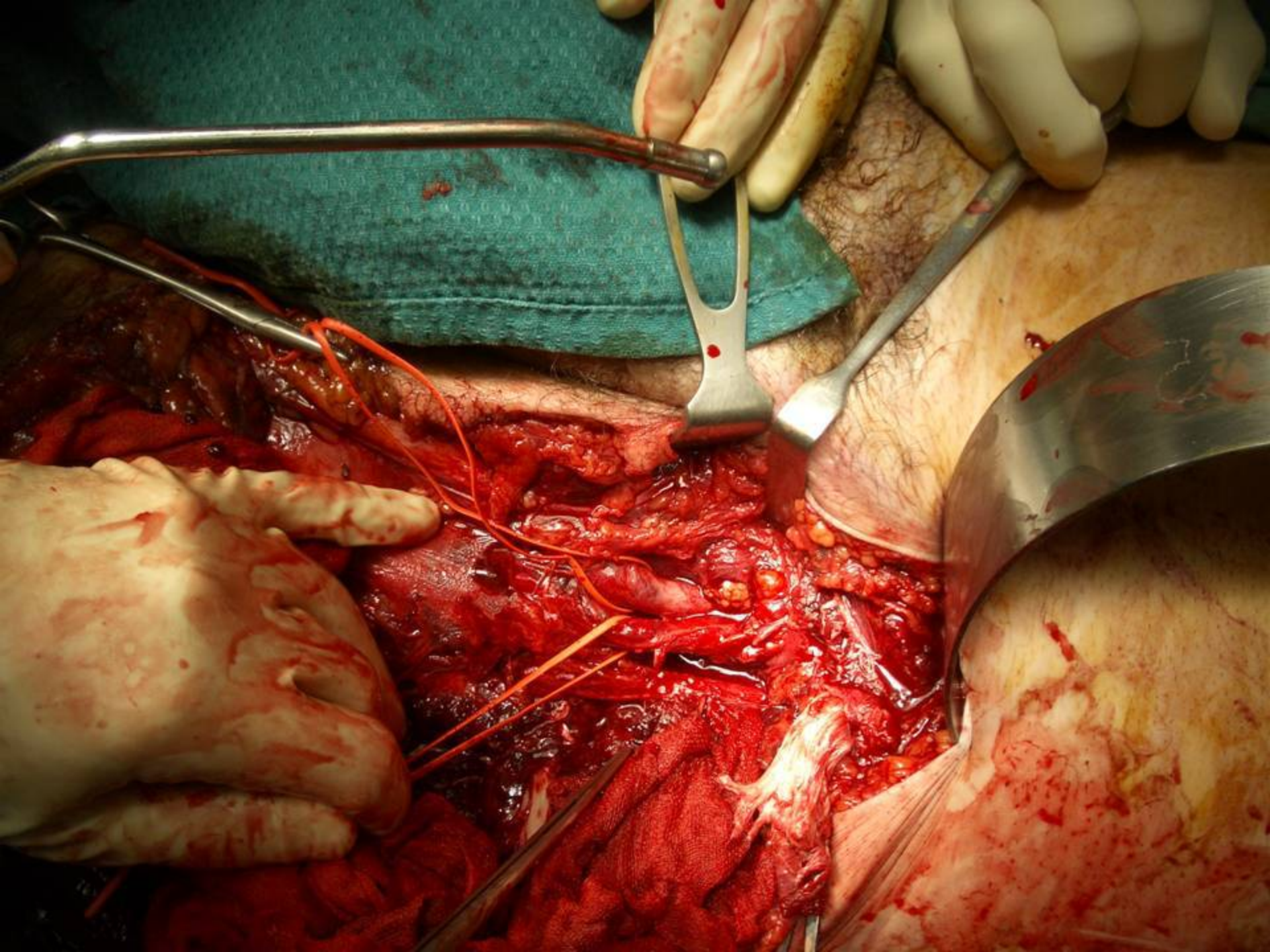




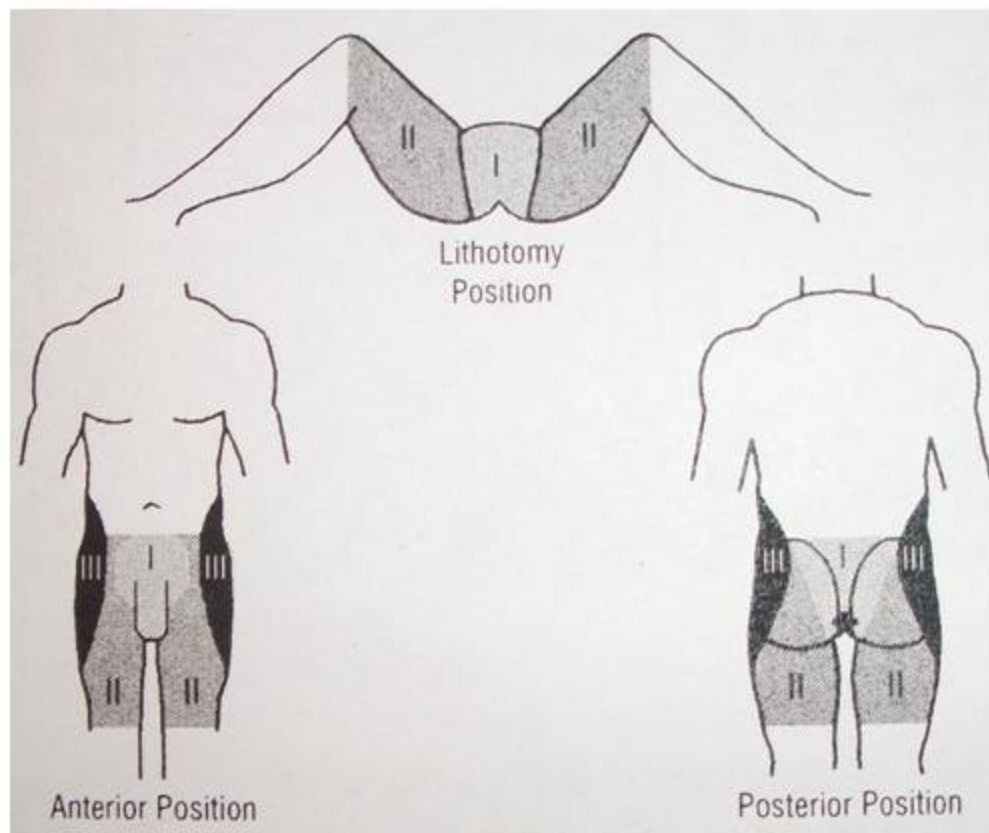








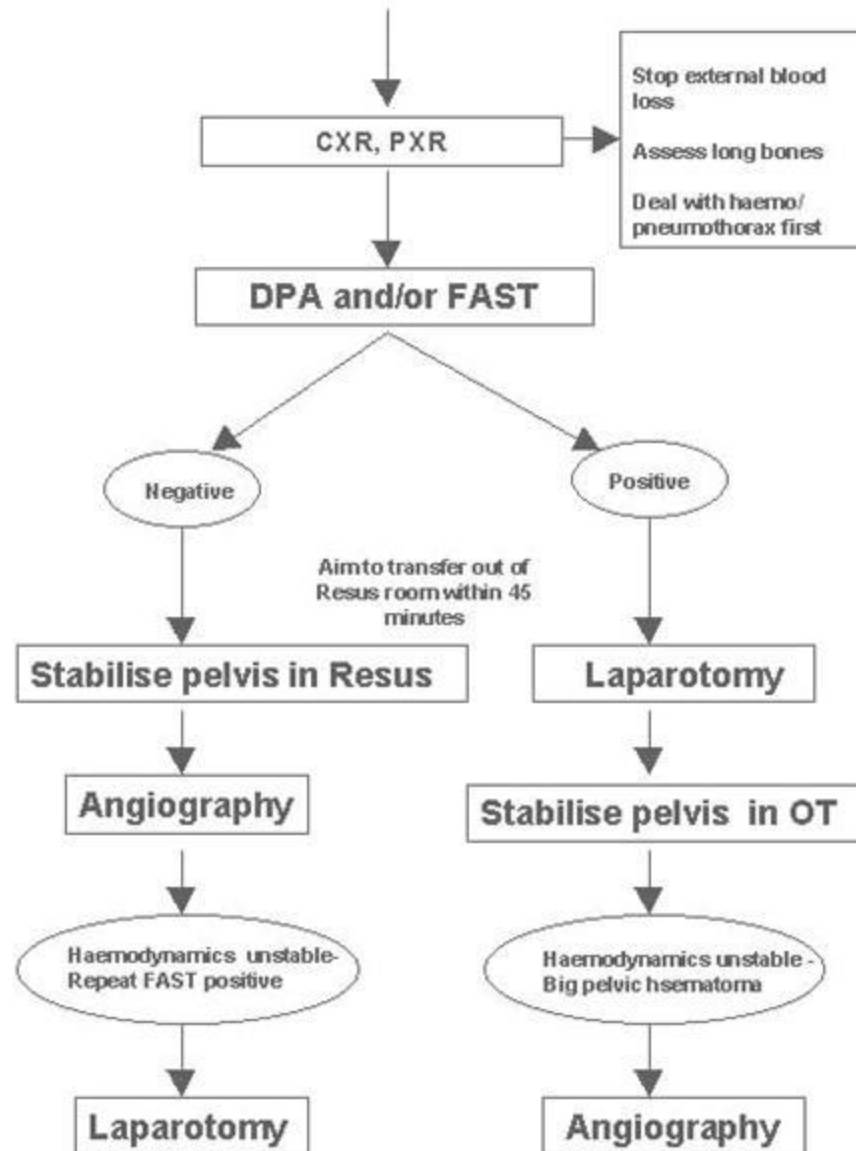
## Diversion selectively based on localization of the of perineal wounds (Faringer 1994.)



	Need for colostomy
Zone I.	Most of the cases
Zone II.	If long bedrest or faecal incontinence anticipated
Zone III.	Rarely



**Haemodynamically Unstable Patient  
with a Pelvic #**





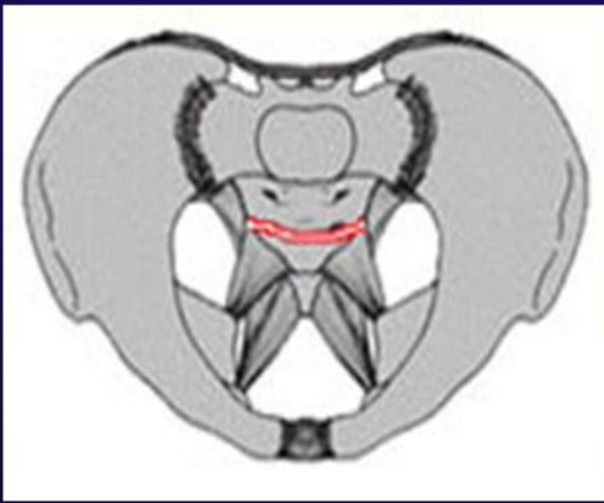
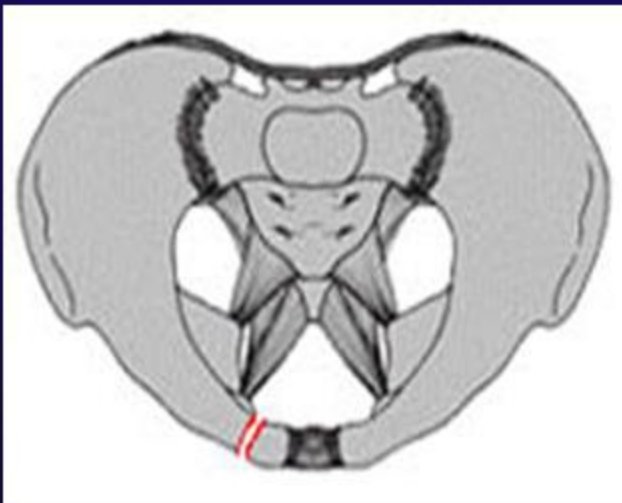
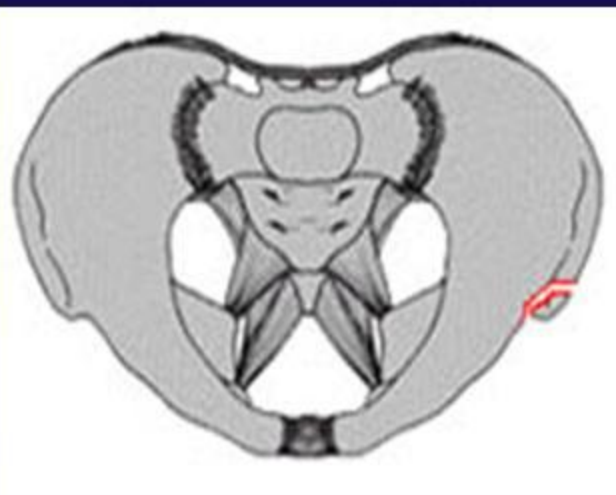
L 1  
3

MOBILE

MOBILE

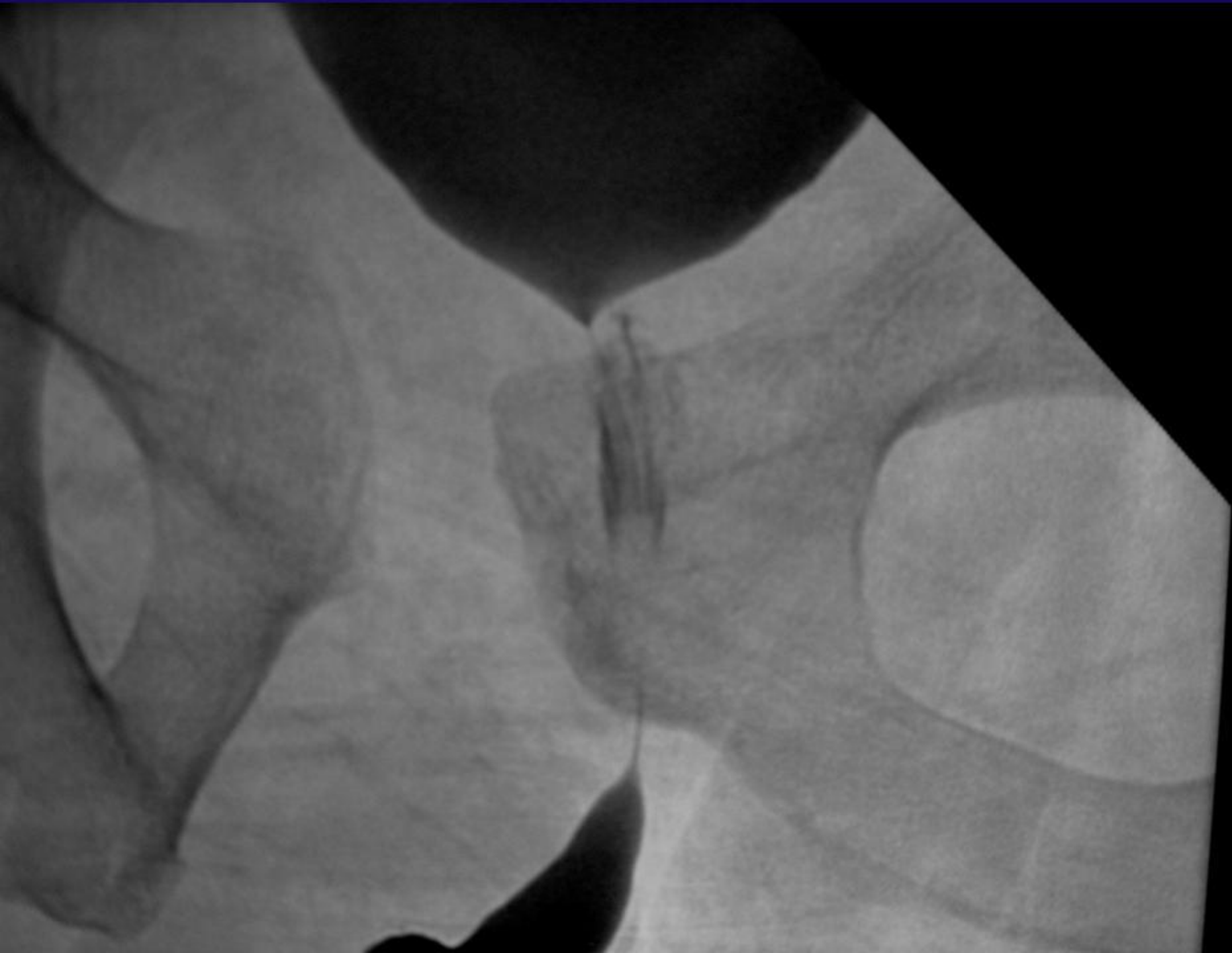


# Classification



Tile A

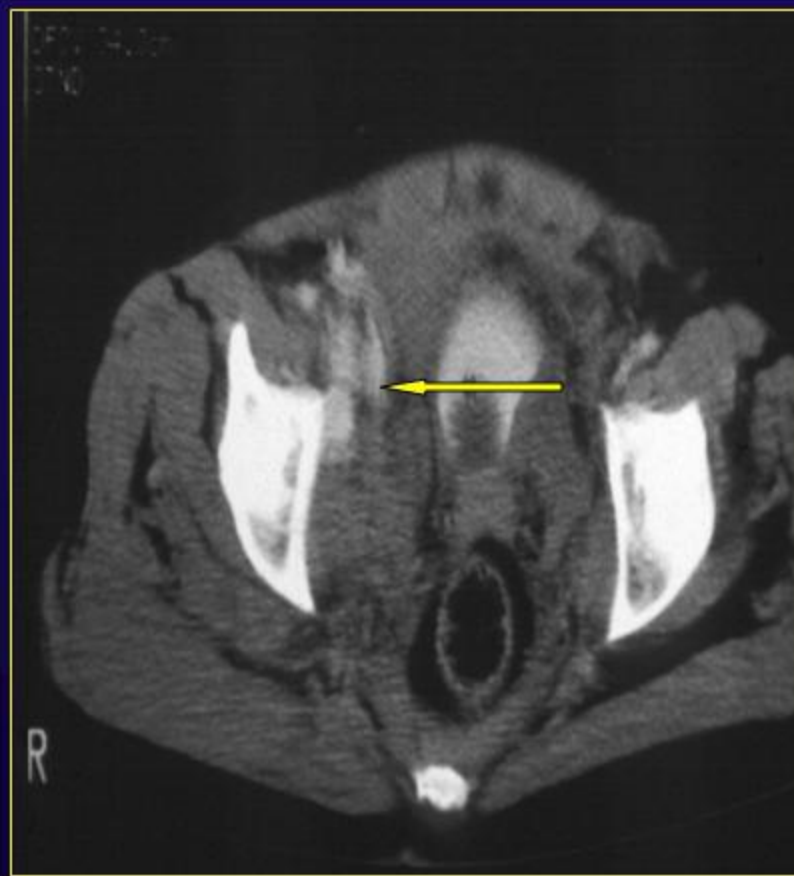
- **General surgical consult:**
  - Distended abdomen
  - Tender lower abdomen
  - NEEDS LAPAROTOMY
- **Orthopaedic surgical consult:**
  - “Too unstable” to operate
  - May put an ex-fix when general surgery finished if stable enough





# CT scan???

- **Contrast blush on angio: Very specific to arterial bleeding**
- **Only 60% sensitivity!**



# Mortality

**35%-40% ->> 10%**



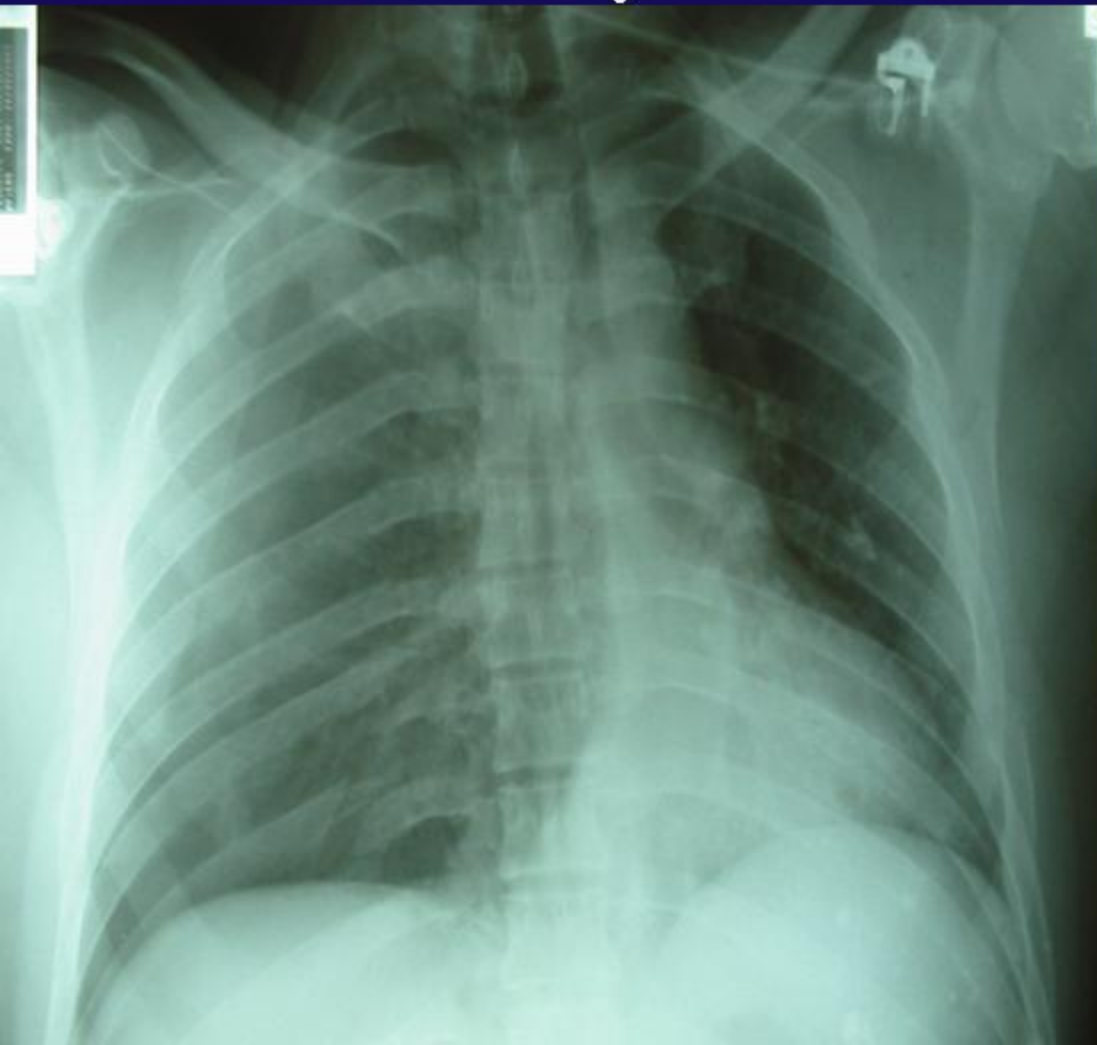
# The Solution

1. Prehospital information
2. Preparation, communication



# The Solution

## 3. Fix Airway and Breathing





# The Solution

## 4. Find the source of the bleeding

Site	Tool to Investigate	Time (minutes)
External	Eyes	1
Long Bones	Eyes	3
Chest	CXR	10
Abdomen	DPA-FAST	10
Pelvis	Palpation, PXR	1-15

# Abdomen

**FAST/DPA**

```
graph TD; A[FAST/DPA] -- "+" --> B[Laparotomy]; A -- "-" --> C[Angiography];
```

A flowchart starting with a yellow box labeled 'FAST/DPA'. Two arrows point downwards from this box. The left arrow is labeled with a '+' sign and points to a red box labeled 'Laparotomy'. The right arrow is labeled with a '-' sign and points to a red box labeled 'Angiography'.

+

**Laparotomy**

-

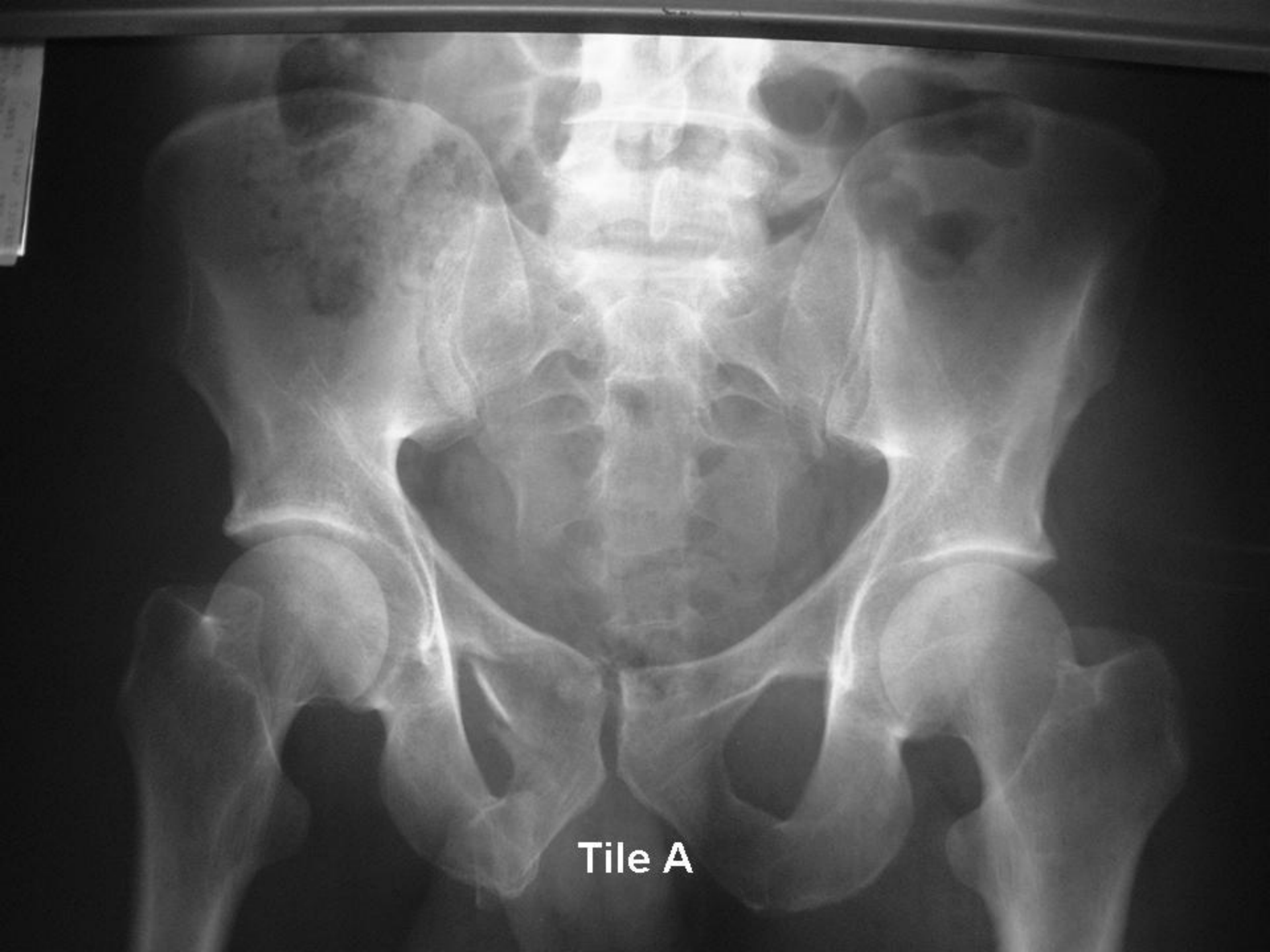
**Angiography**

## 4. External stabilisation technique









Tile A

# METHODS

Prospective data collection

18m pre guidelines *retrospective* evaluation

18m post guidelines *prospective* evaluation

*Univariate statistical analysis \* $p < 0.05$*

# METHODS

## Inclusion criteria:

High-energy trauma with pelvic #

ISS > 15

BD > 6 mEq/L

PRBC > 6U/12hr

## Exclusion criteria:

Non-pelvis related bleeding

GCS < 9

# RESULTS

Pre-guidelines: 18m ending Dec 2001  
(n=17)

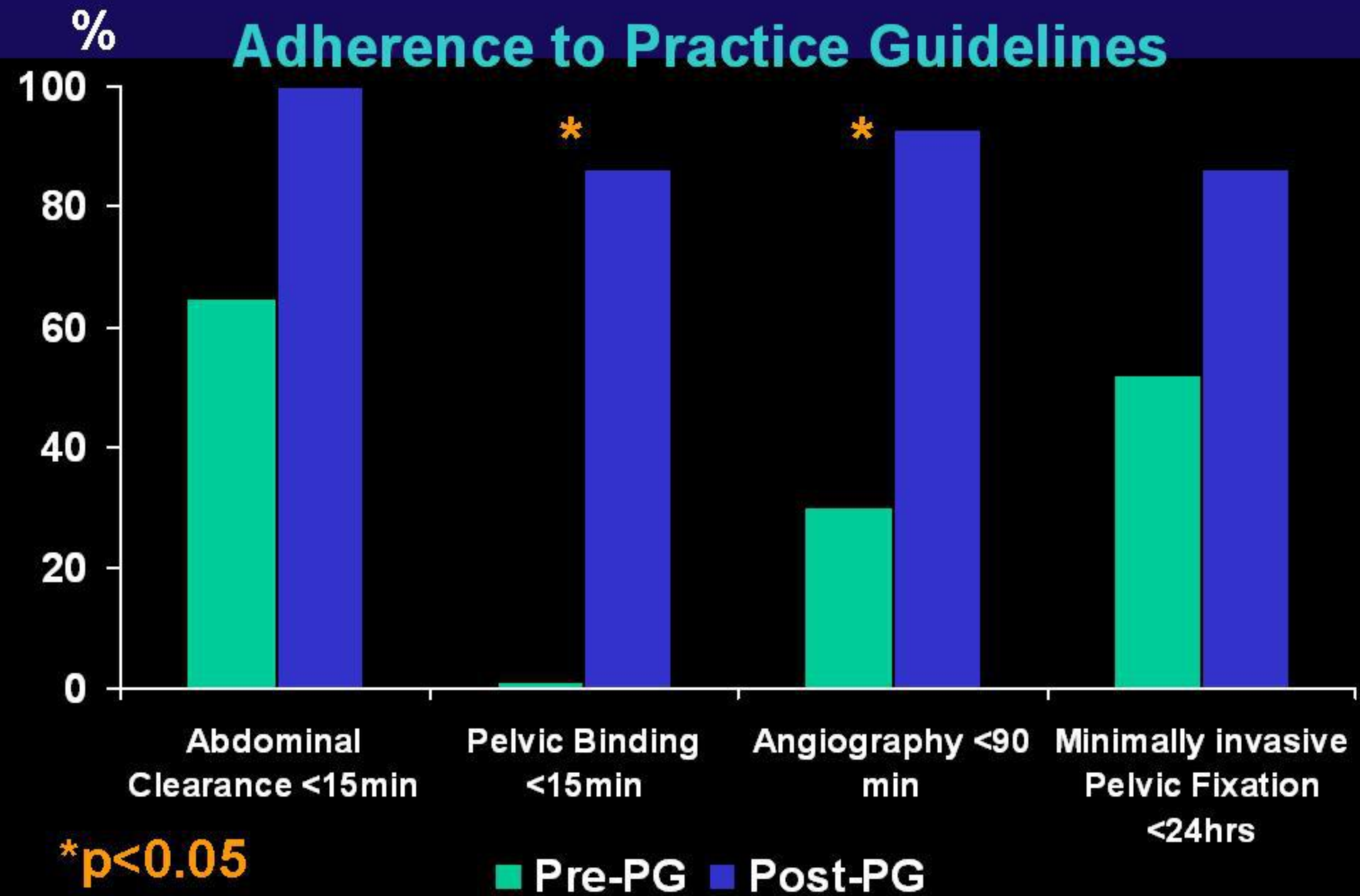
Post-guidelines: 18m after Dec 2001  
(n=14)



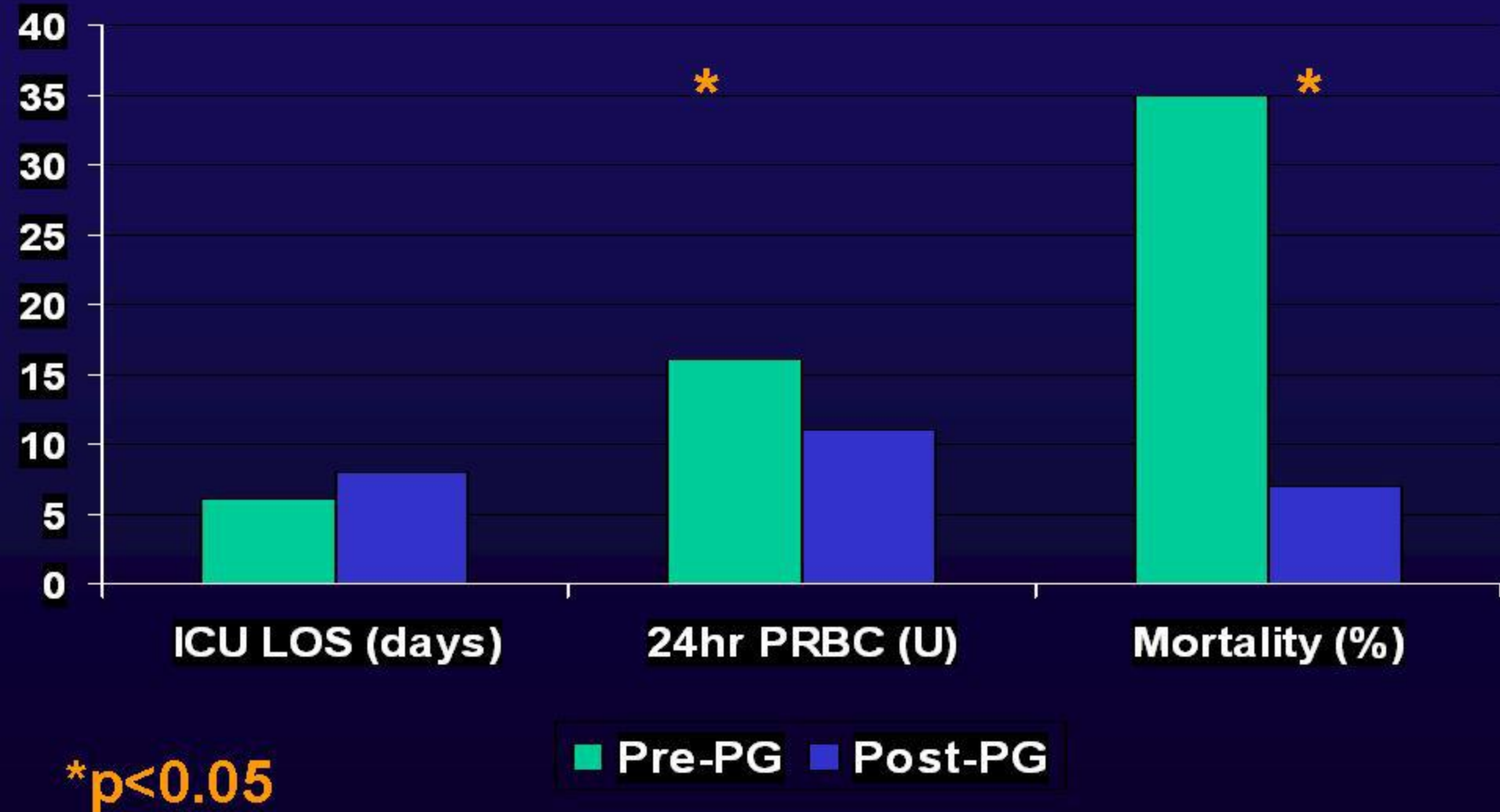
# RESULTS

Group	Age (yrs)	Male %	ISS	BD (mEq/L)	SBP (mmHg)	GCS	PRBC (U/12hrs)
Pre-PG	40±4	71	39±3	9±1	116±7	12±1	9±2
Post-PG	42±6	71	37±4	10±1	112±6	12±1	9±2

## Adherence to Practice Guidelines



# OUTCOMES











# Recombinant Factor VIIa



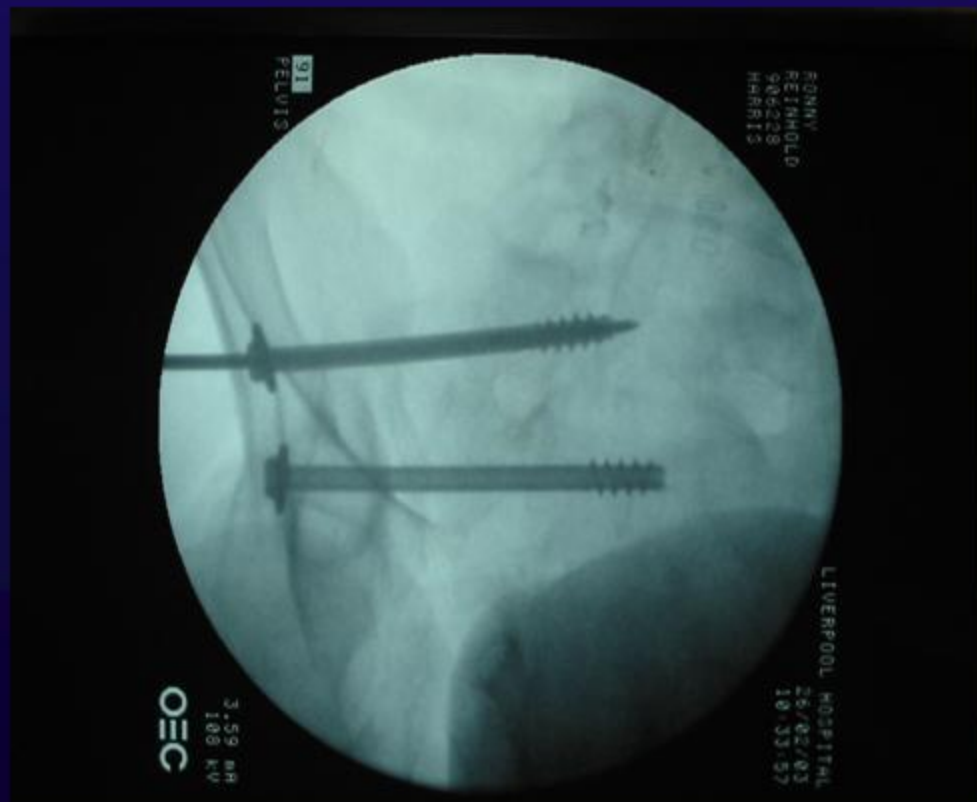


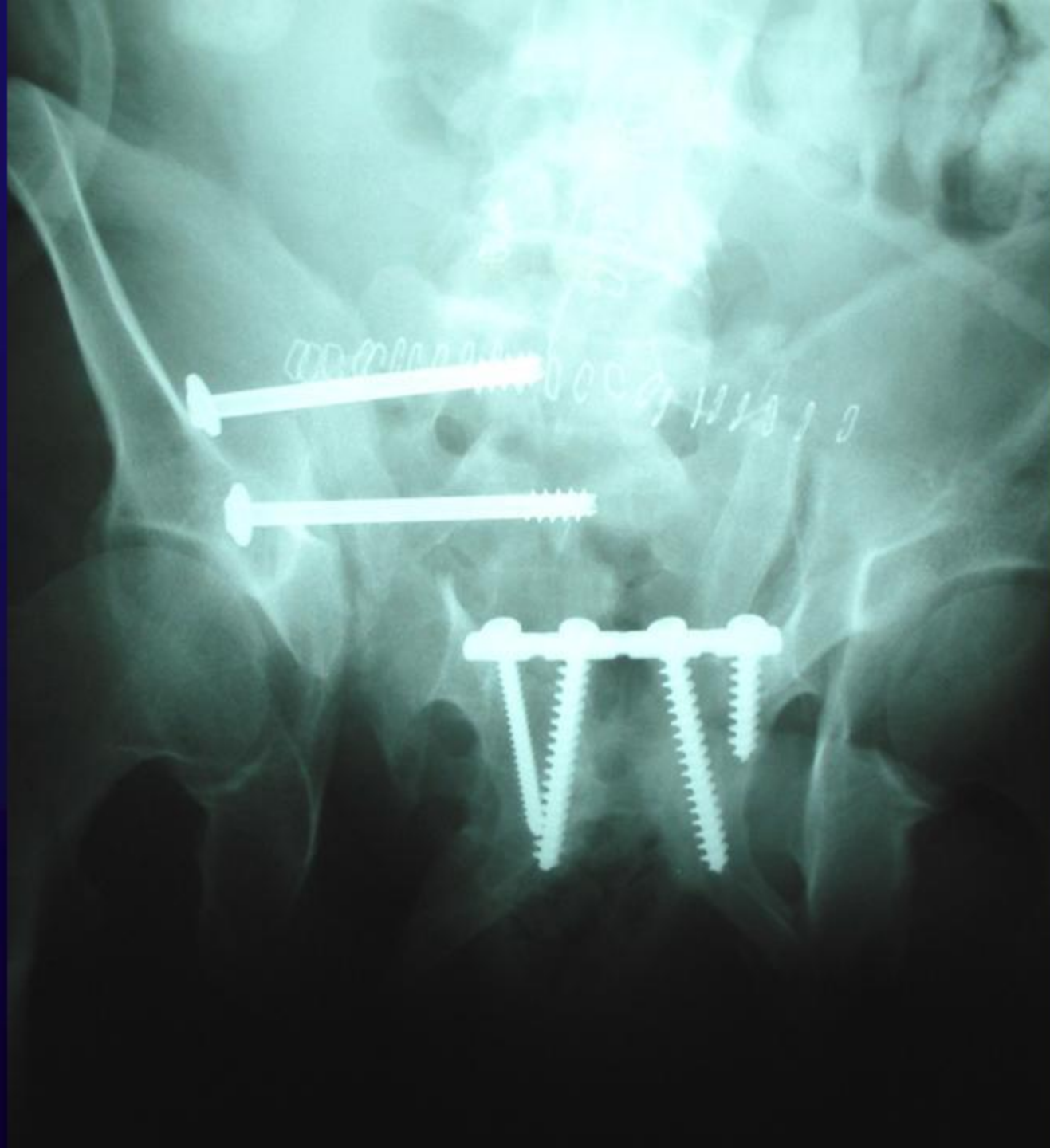
# Biomechanics





- **DAY 1 CT SPINE: #  
T7/T9/RIGHT RIB 6/7/12**
- **DAY 2 RE-  
EXPLORATION,  
IRRIGATION,  
CLOSURE OF  
ABDOMEN/FIXATION  
OF PELVIC SCREWS**

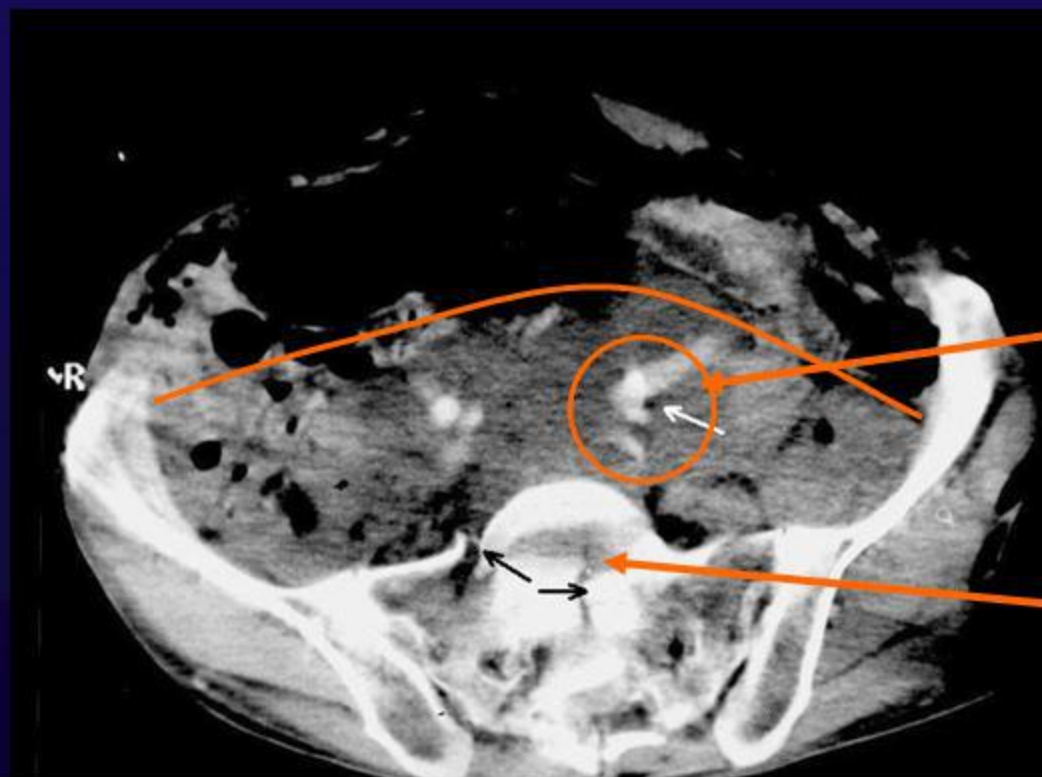




**CT : - head – Multiple contusions**

**- Chest – pulmonary contusion, expanded lungs**

**- Abdomen – negative**



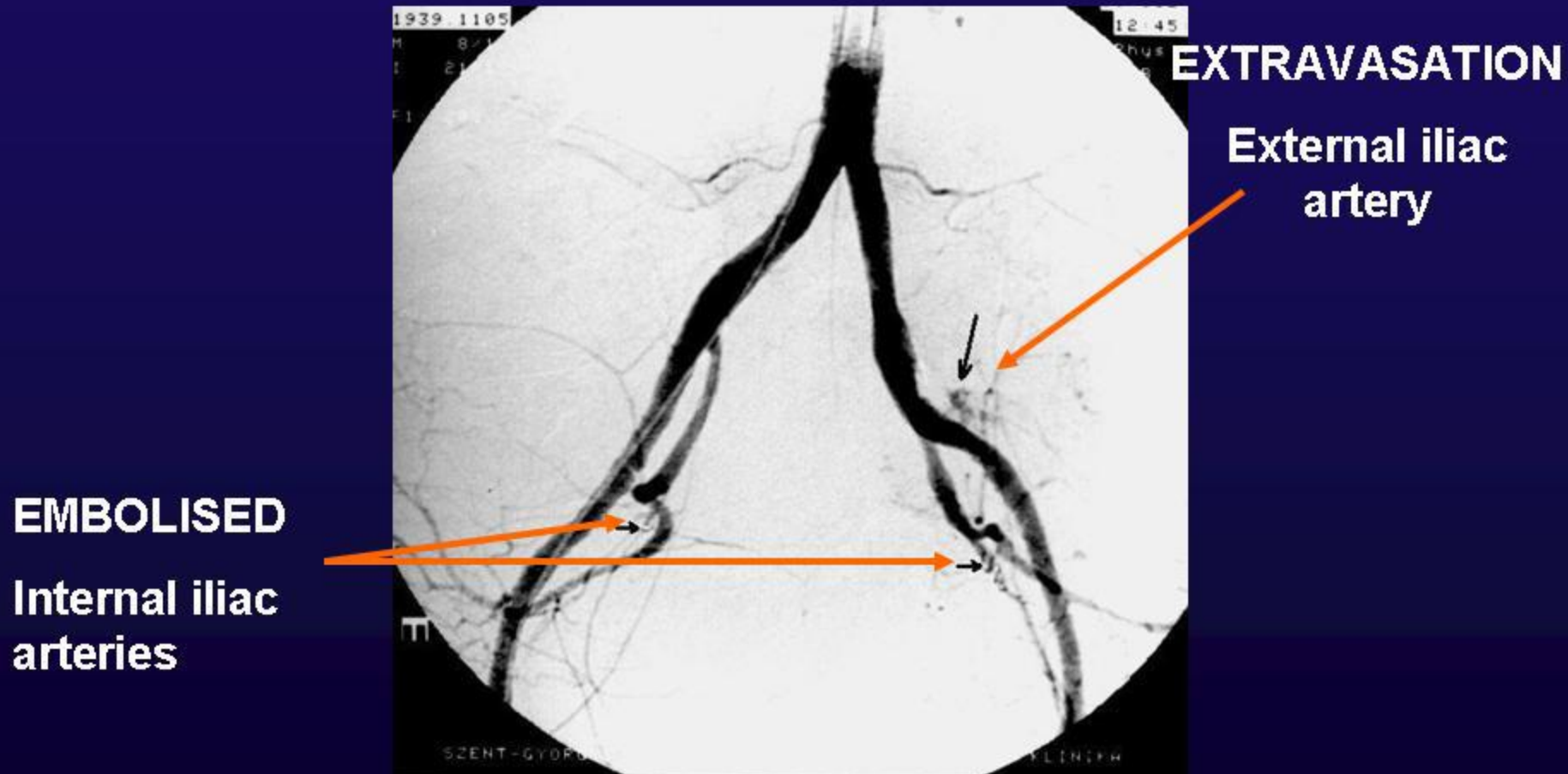
**Contrast  
extravasation**

**Figure of "H"  
fracture of  
the sacrum**

**HAEMODYNAMICALLY UNSTABLE**

**CONTRARY TO TRANSFUSION OF 4 U PACKED CELLS**

# Angiography - Embolization

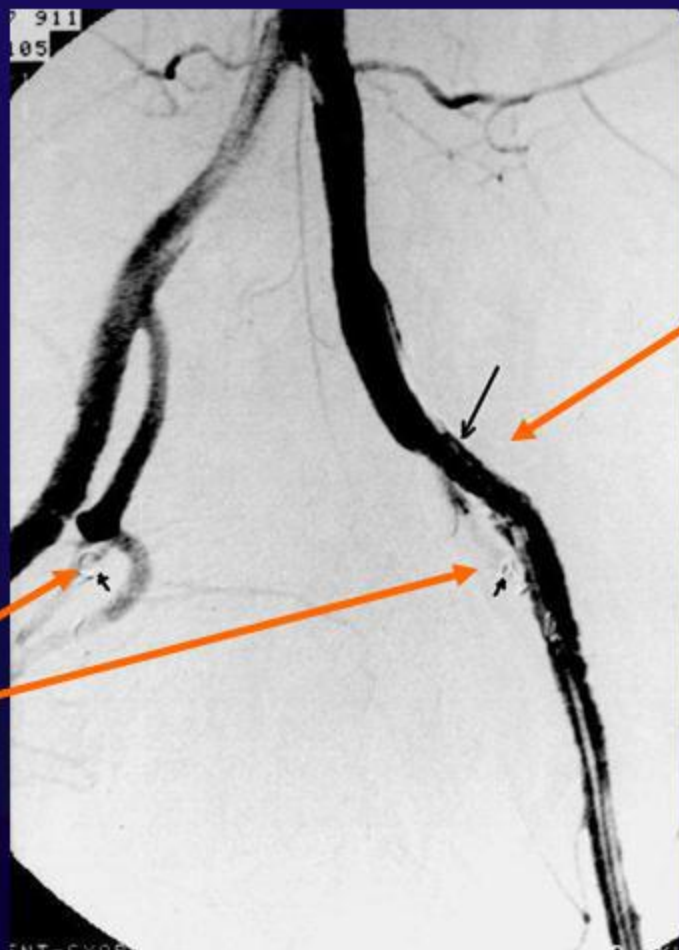


**HAEMODYNAMICALLY UNSTABLE**

**CONTRARY TO TRANSFUSION OF 6 U PACKED CELLS**



# STENTGRAPHY INSERTION



External iliac  
artery stent

The bleeding  
stopped

EMBOLISED  
Internal iliacs

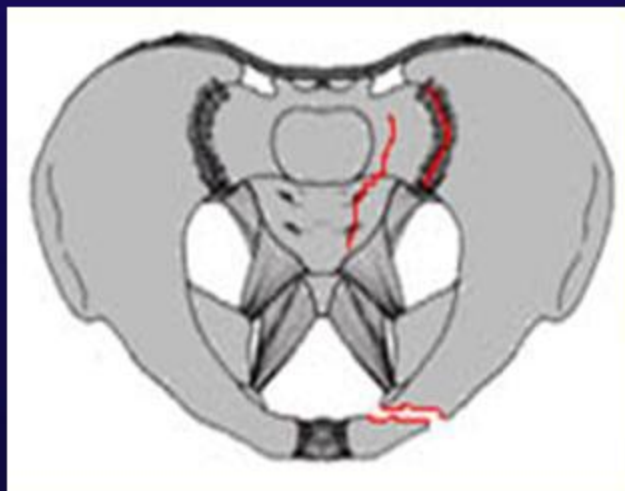
HAEMODYNAMICALLY STABLE

TRANSFUSION: Ø

# Traps

- Non-therapeutic laparotomy
- Missed rectal injury
- Insignificant fractures in elderly
- Underestimation of pelvic displacement because of early binding

# Classification



Tile B

R

Tile B