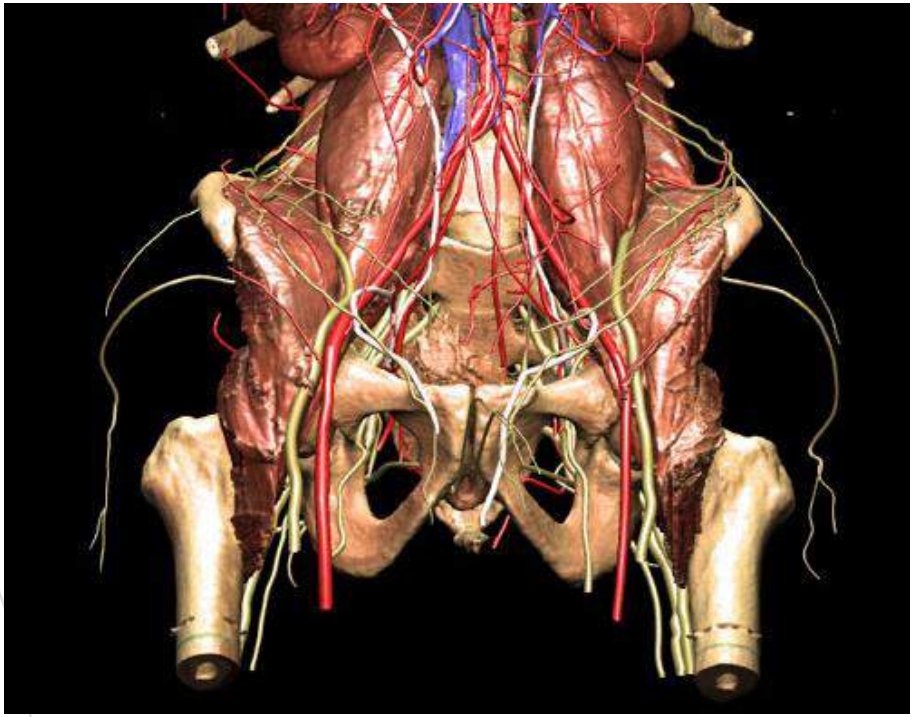
Pelvic and acetabular fractures

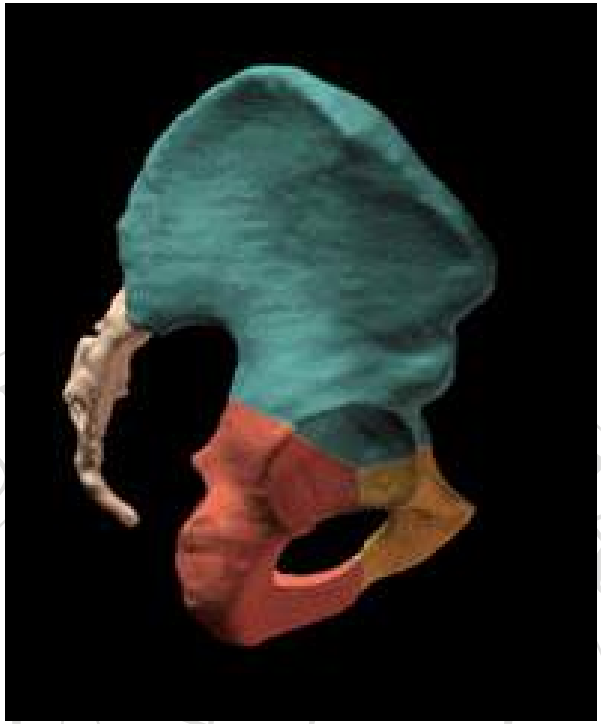
Presenter:
Dr Laszlo G Nöt

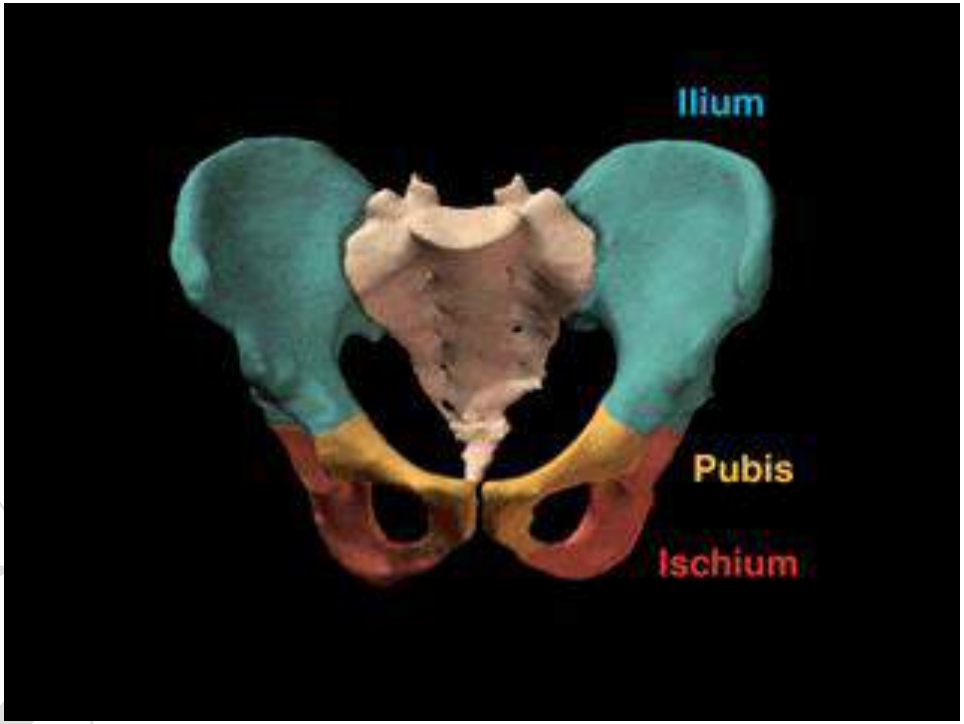
PELVIC RING - ANATOMY

- Bones
- Ligaments
- Vessels
- Nerves
- Visceral organs

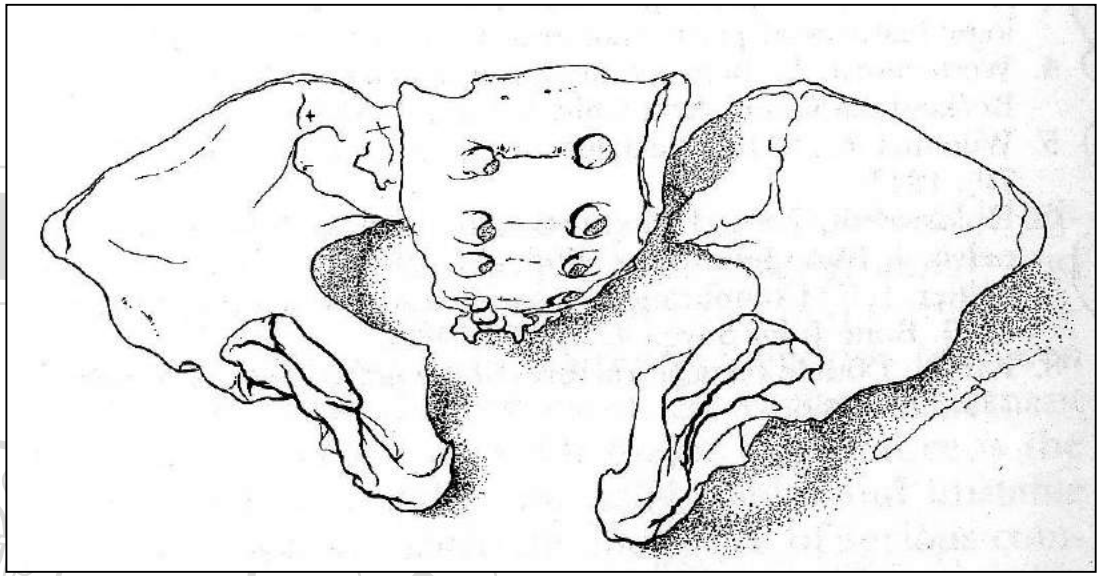


PELVIC RING - ANATOMY





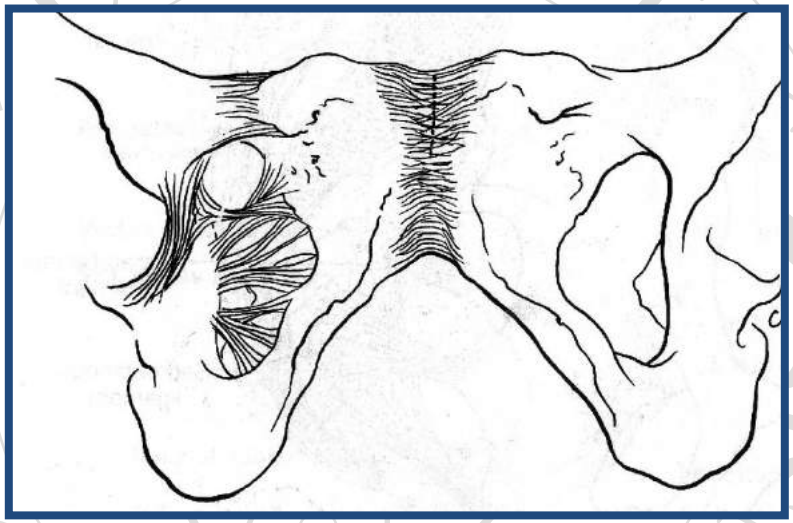
PELVIS WITHOUT LIGAMENTS

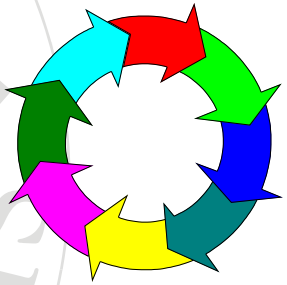


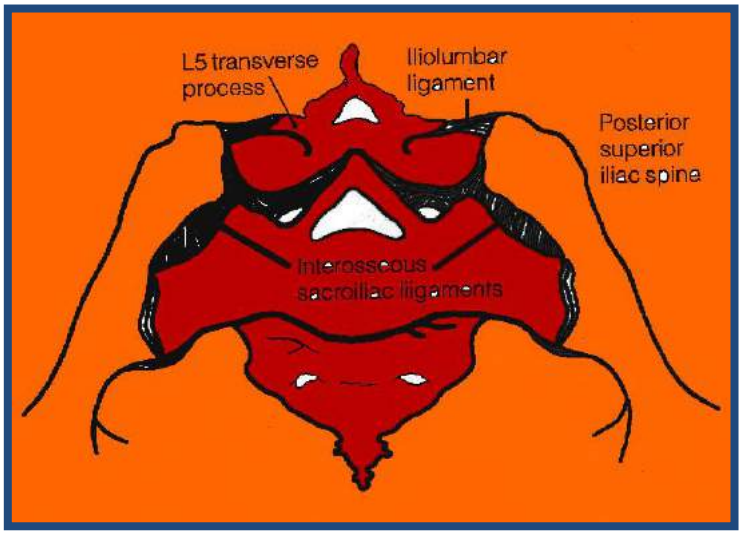
ROLE OF LIGAMENTS

- **Connection - Stabilization**
  - **the bony part of the pelvis**
- **Defending against the torsional, vertical, longitudinal forces**
  - **Weight bearing, injuries etc.**

Front → **stabilizing system** ← **Back**

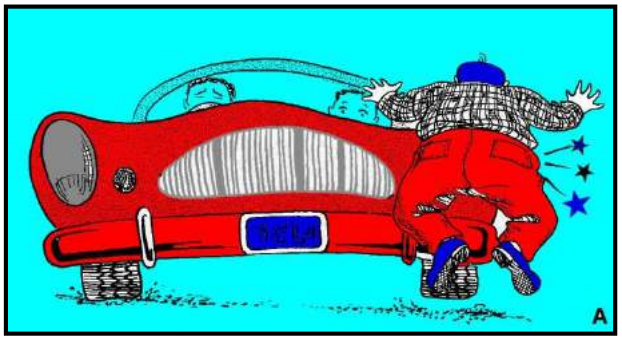


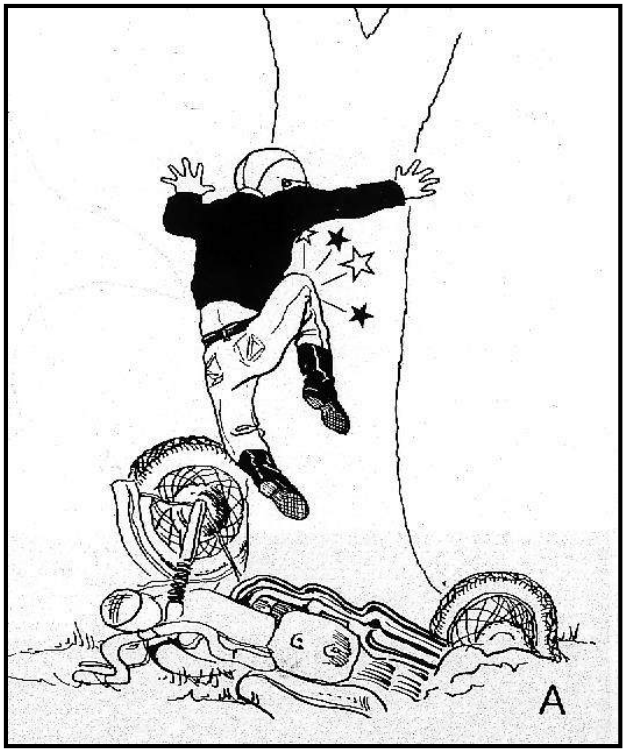


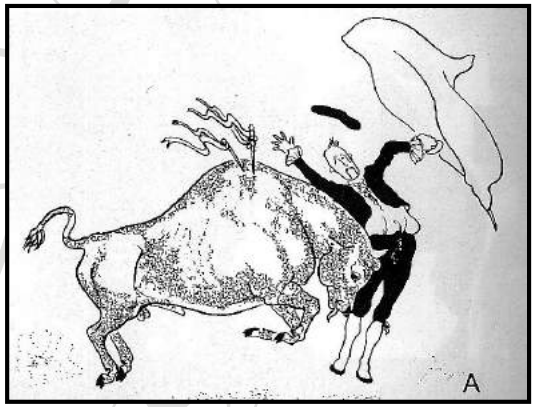


PELVIC INJURIES

- **Accident:** **60%**
- **Fall:** **17%**
- **Crush:** **11%**
- **Sport:** **9%**
- **Other:** **3%**







MORTALITY RATE OF PELVIC FRACTURES

- Closed fracture in childhood 5%
- Closed fracture in adults 10%
- Open pelvic fracture 30%
- Closed fracture with hypotension 50%
- Open fracture with hypotension 60%

MECHANISMS OF INJURY

low-energy fractures: generally resulting in isolated fractures of individual bones

- do not damage the true integrity of the ring structure
- **domestic falls:** "straddle" injury from a fall in the bathtub, an etiology frequently found in the elderly population
- **avulsion injuries** of the muscle apophyses in skeletally immature patients.

MECHANISMS OF INJURY

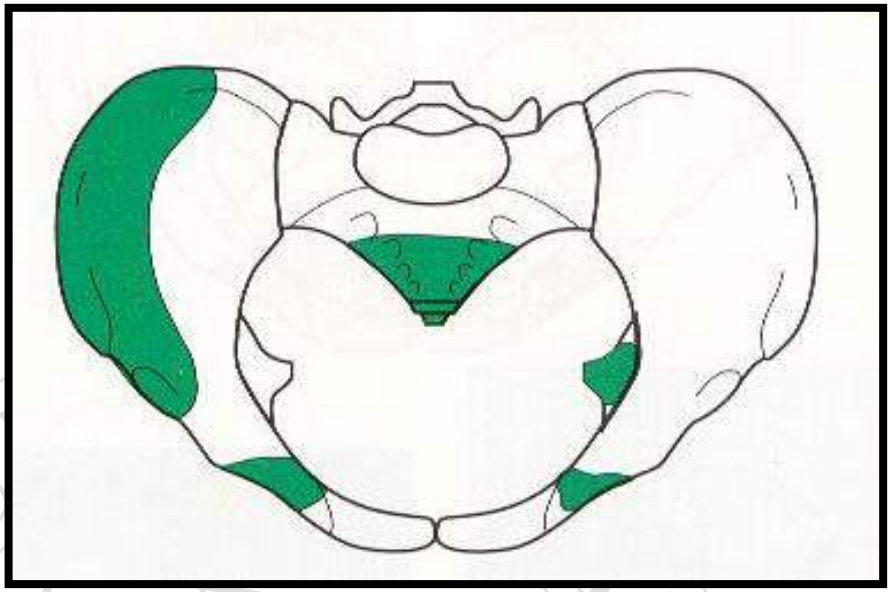
high-energy fractures: generally producing pelvic ring disruption

- **motor vehicle, 57%**; pedestrian, 18%; motorcycle, 9%; falls from heights, 9%; and crush, 4%
- often result in two or more fractures of the pelvic ring
- **AP force, lateral impacts, vertical shear**
- **Penetrating mechanisms:** associated visceral and neurovascular injuries

ASSOCIATED INJURIES

- **Local**
  - ***pelvis is a boney ring – find one fracture, look for another***
  - subluxation/dislocation SI or pubic symphysis
  - acetabulum/femoral head/joint fragments
- **General**
  - Extremities: 43%
  - CNS: 28%
  - Thoracal: 13%
  - Bladder: 8%
  - Periferial nerves: 8%
  - Abdominal: 7%
  - Urethra: 4%

TILE AND AO/ASIF CLASSIFICATION



A type

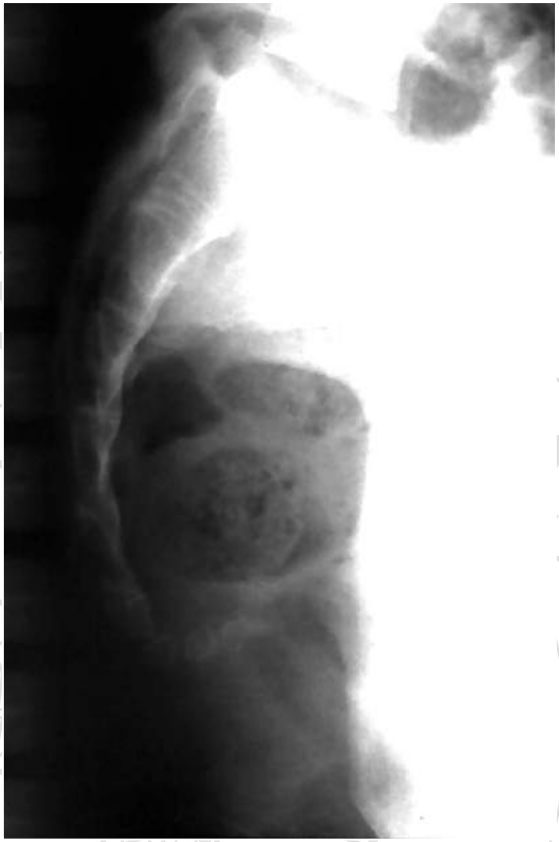
„Stable”

- **The pelvic back side integrity is intact**
- **The pelvic diaphragm is intact**
- **The fiziological loading doesn’t cause dislocation**

TILE AND AO/ASIF CLASSIFICATION

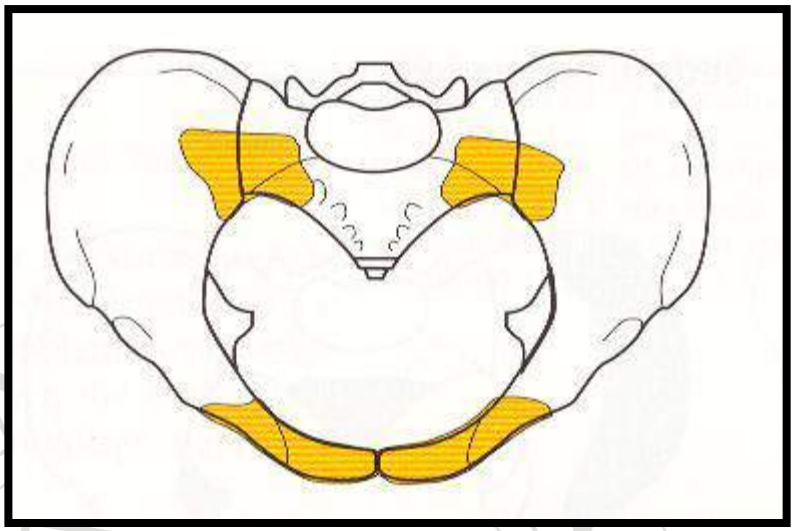
‘TYPE A’ FRACTURES

Os coccygei



Ala ossis ilei

TILE AND AO/ASIF CLASSIFICATION



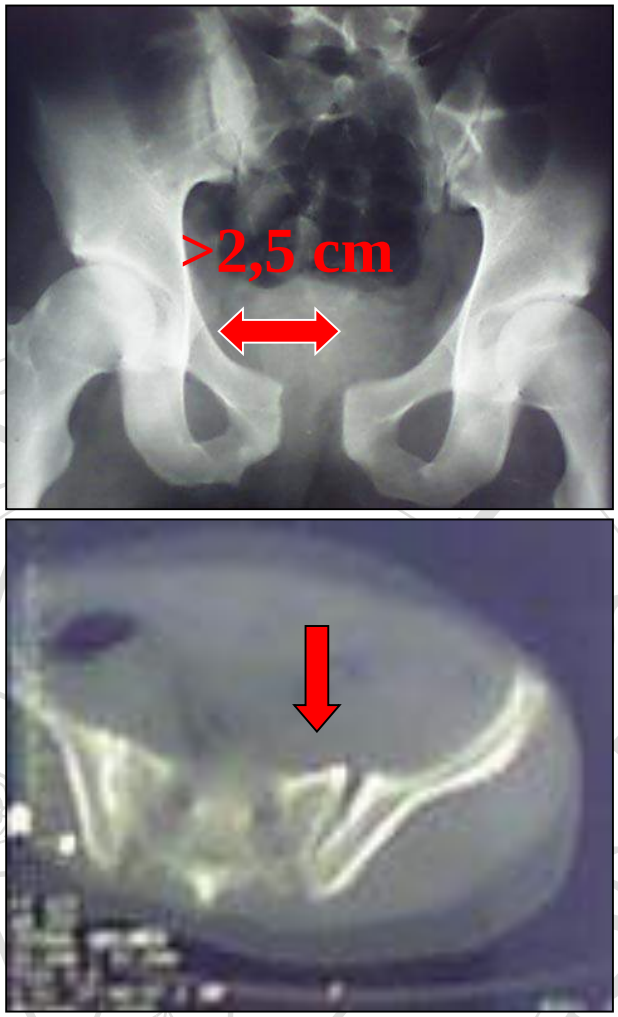
B type

„Partially instable”

- **The back side partially injuried**
- **Instability „only” in the horizontal view**

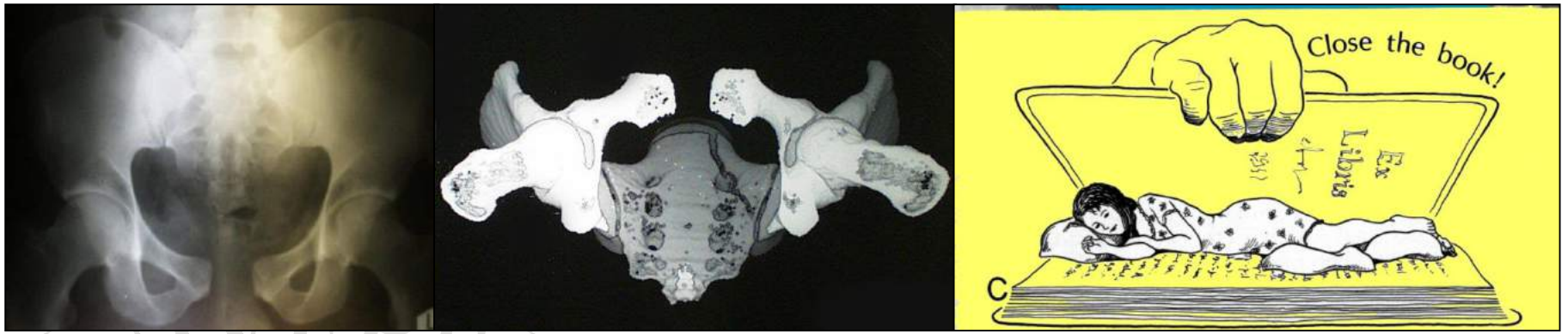
TILE AND AO/ASIF CLASSIFICATION

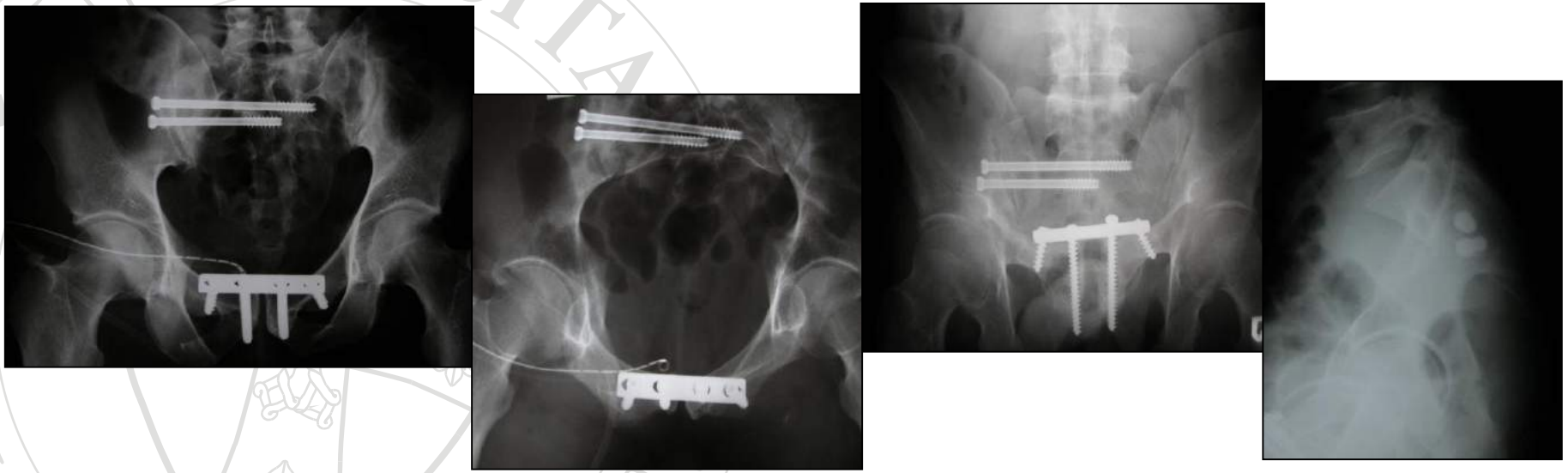
SYMPHYSEOLYSIS



TILE AND AO/ASIF CLASSIFICATION

B1 – ‘OPEN BOOK’ FRACTURE

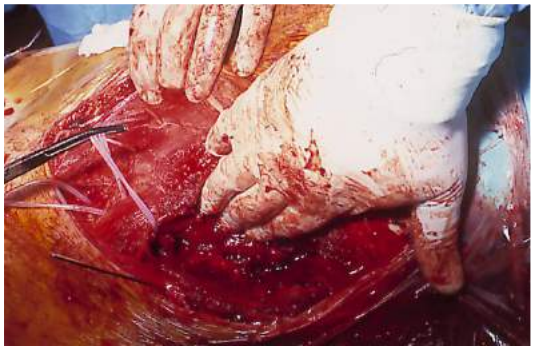




TILE AND AO/ASIF CLASSIFICATION

SURGICAL TREATMENT

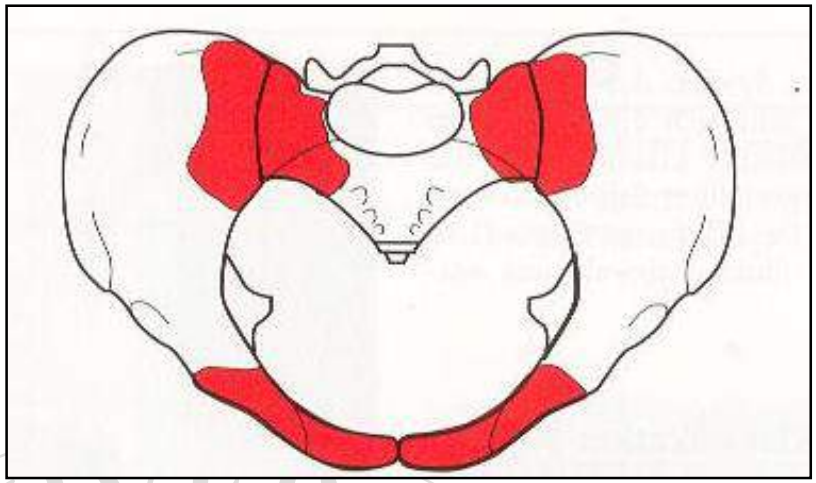
ORIF


PERCUTANOUS



TILE AND AO/ASIF CLASSIFICATION



C type

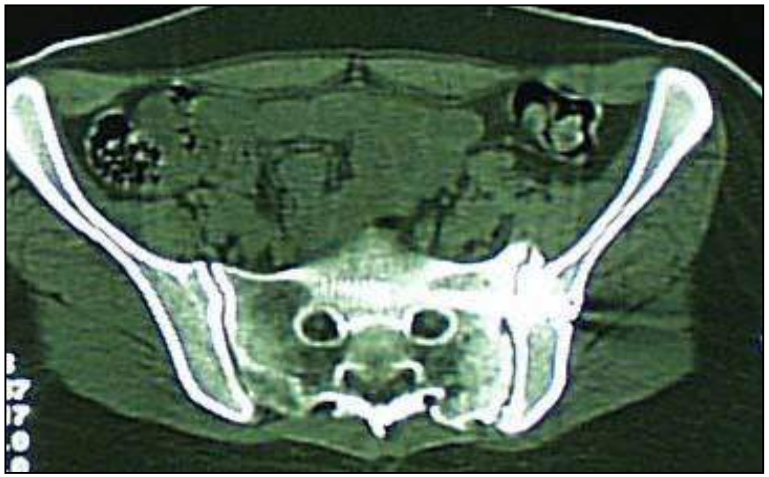
„Unstable”

- **Complete damages of the pelvic back side**
- **3 dimensional Instability**
- **The pelvic diaphragm totally ruptured**
- **Dislocation in the horizontal, vertical, saggital view**

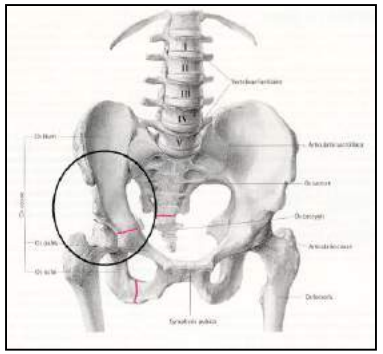
- vertical shearing forces
- SI joint subluxation/dislocation, symphyseal diastasis

TILE AND AO/ASIF CLASSIFICATION

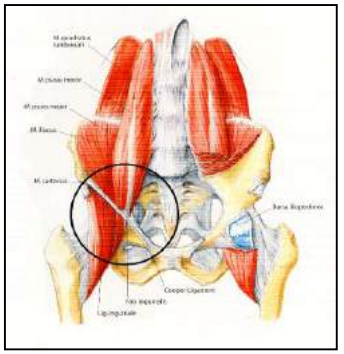
‘C-TYPE’ PELVIC FRACTURE



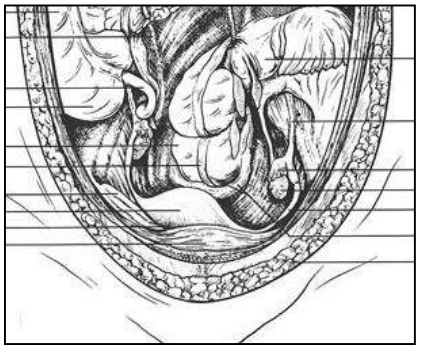
DIAGNOSIS



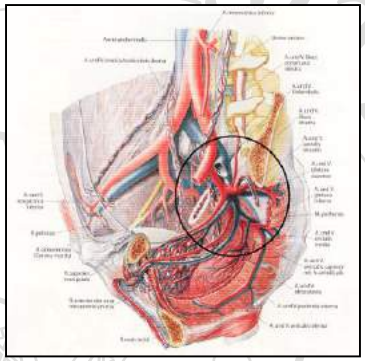
bone



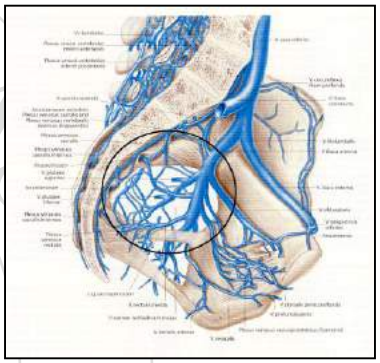
soft tissue



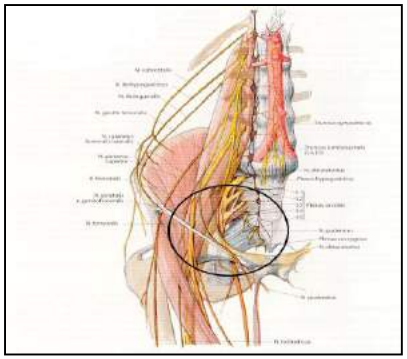
organs



arteries



veins

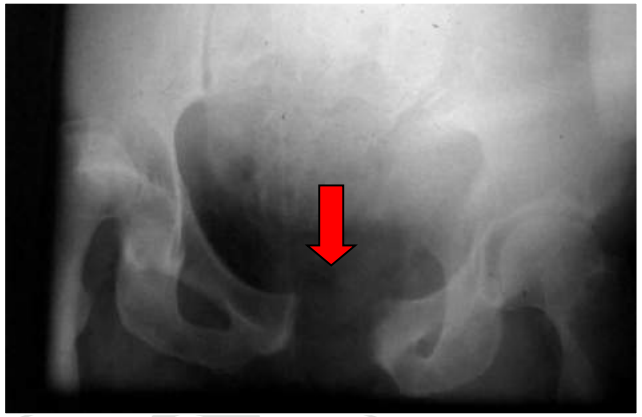


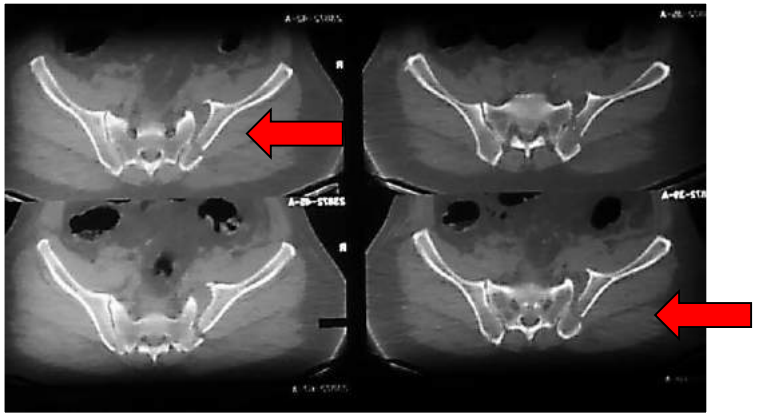
nerves

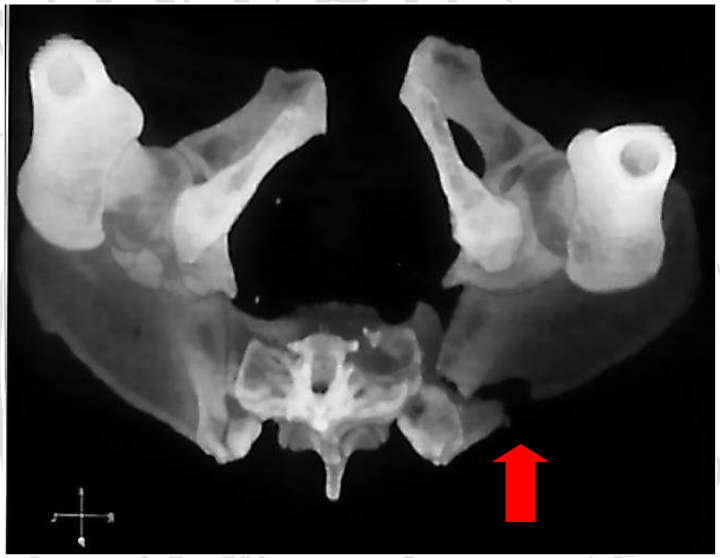
DIAGNOSIS

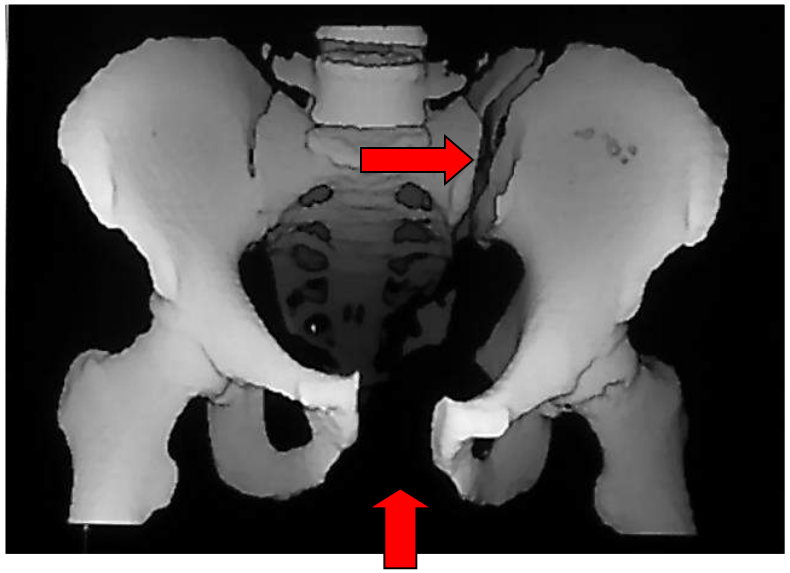
- History
- Physical examination
- CT - 3D CT
- X-ray (AP view, inlet, outlet and Judet view(obturator oblique, iliac oblique)
- US
- Angiography
- EMG - ENG
- MRI

CT - 3D CT









Initial Treatment

- **Resustitation / hemorrhage:**
  - Patients in shock (SBP <90mmhg), mortality rates up to ***10 times*** those of normal patients
  - **Head and thorax injuries**: most common direct cause of mortality in patients with pelvic fracture.
  - Hemorrhage: **65%** of mortality with pelvic fracture
  - The close relationship of the **internal iliac artery**, its tributaries, and their **accompanying veins to the anterior aspect of the SI joint and ligaments** is responsible for the high incidence of vascular injury and associated hemorrhage seen with pelvic fractures

External /Temporary/Treatment

- Sandbags, straps, beanbags, military antishock trousers (MAST)
- Sheet, external fixator, pelvic clamp in ER
  - External stabilization decrease blood loss, providing tamponade, limit motion of soft tissues, not break up initial pelvic clot

Temporary treatment

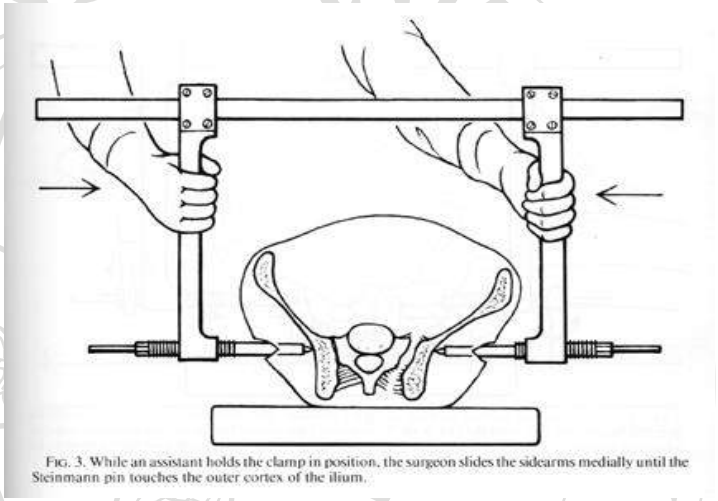


FIG. 3. While an assistant holds the clamp in position, the surgeon slides the sidearms medially until the Steinmann pin touches the outer cortex of the ilium.

ORIF or Percutaneous Fixation

- **ORIF:**
  - useful for reducing and stabilizing the pelvic ring, **but frequently contraindicated acutely** because of the additional risks from the surgical approaches that may **"decompress" the extraperitoneal space**
- **Closed reduction and percutaneous fixation**:
  - primarily used for posterior [eg, SI joint] injuries and frequently combined with anterior ring stabilization, but disadvantages include the need for **specialized equipment and experienced personnel**

Sacral Fractures

- **Most common posterior pelvic injury**
- Most are stable
  - Lateral compression
  - Nonsurgical treatment
- Tile Type C:
  - Close reduction + percutaneous fixation
    - **Risk: Iatrogenic neurologic injury during compression**
  - ORIF + decompression
    - Iliosacral screws, intrasacral plates, transiliac plates + pedicle screw system

Iliosacral Screw Fixation

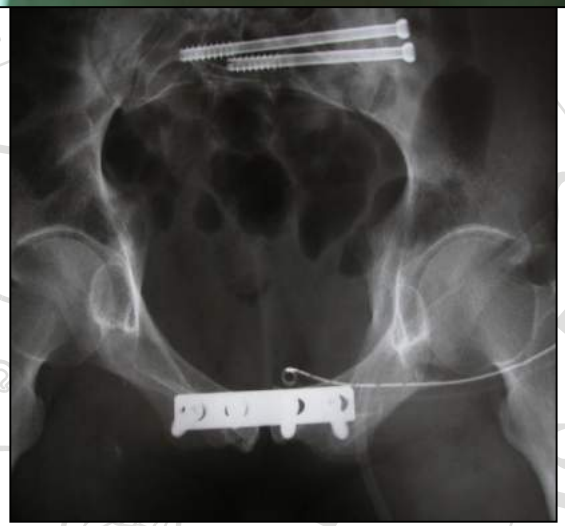
- Iliosacral lag screw:
  - technique demanding
    - Average distance from iliosacral lag screw to S1 neural foramen was only **3 mm**
  - The safest screw placement
    - from **inferior on the outlet view and posterior on the inlet view** to be as close as possible to **center of the narrow portion of sacrum**

Complications

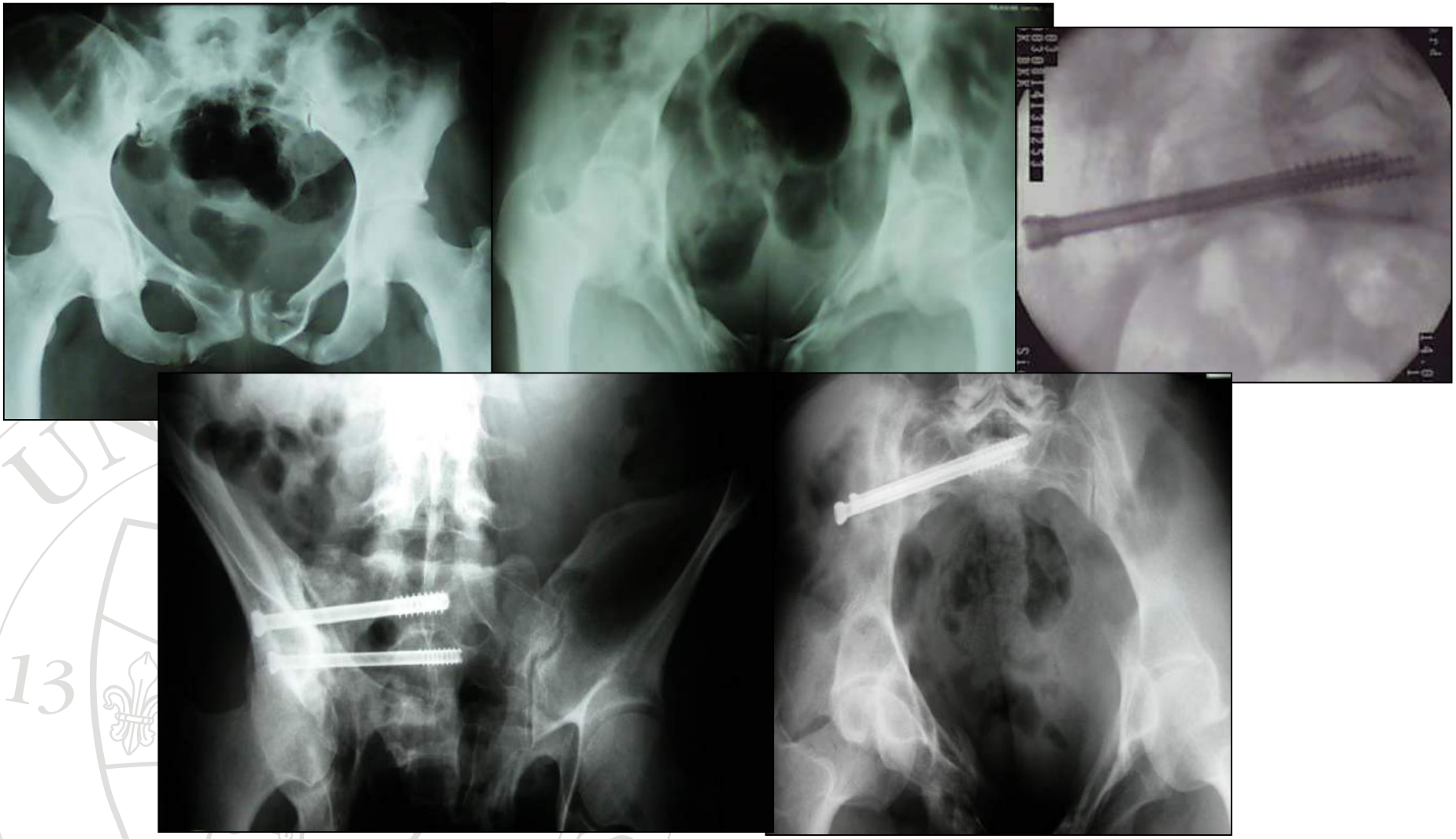
- Infection
- Thromboembolism
- Malunion
- Nonunion

CASE REPORTS

B 1 open book

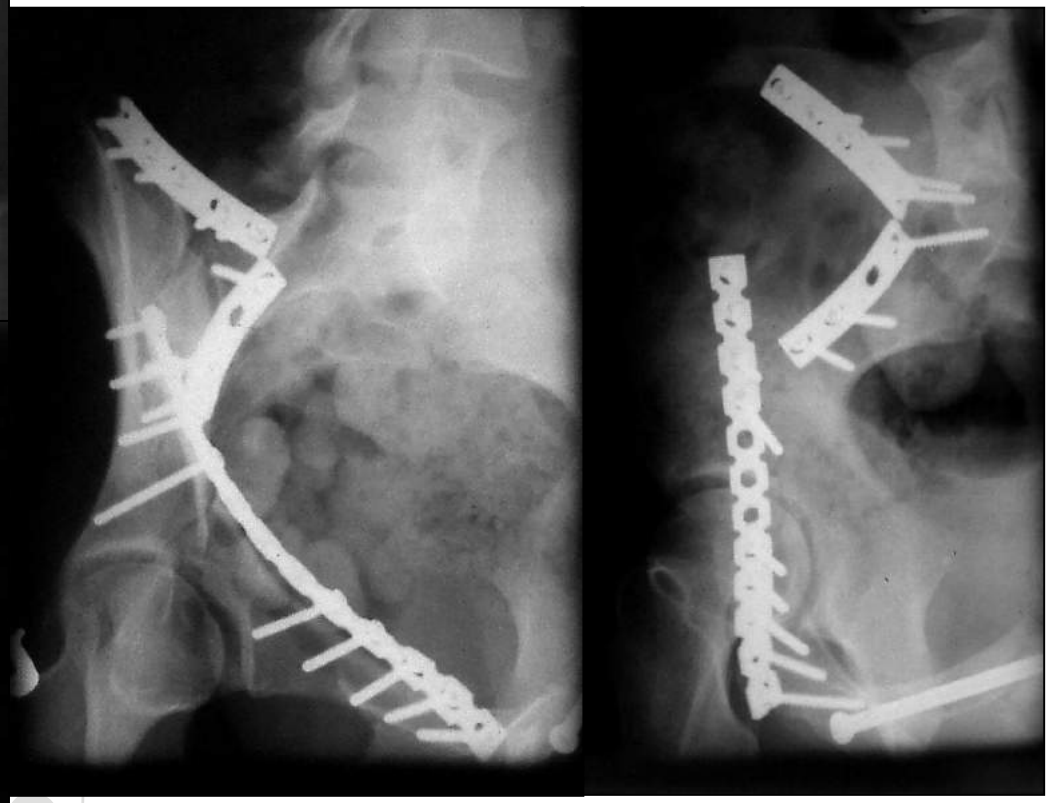


B2:

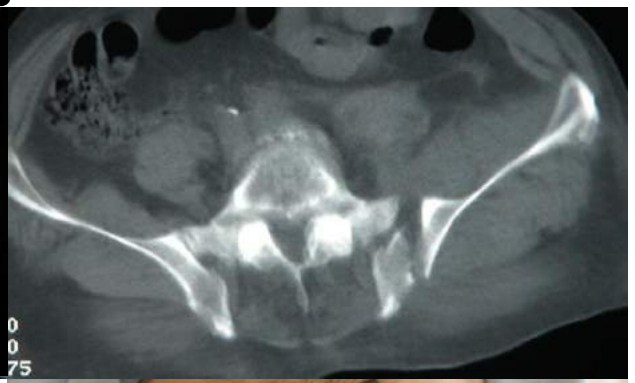


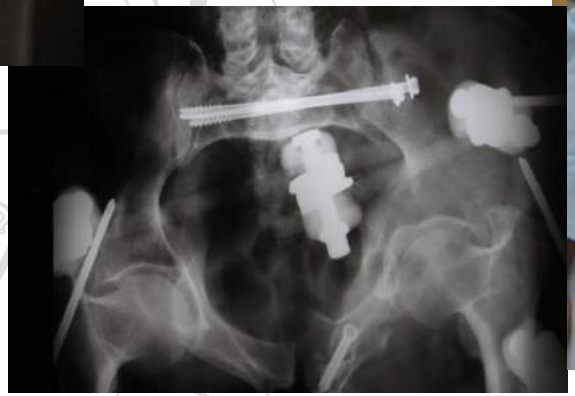
B2 pelvic + B2 acetabulum

ORIF

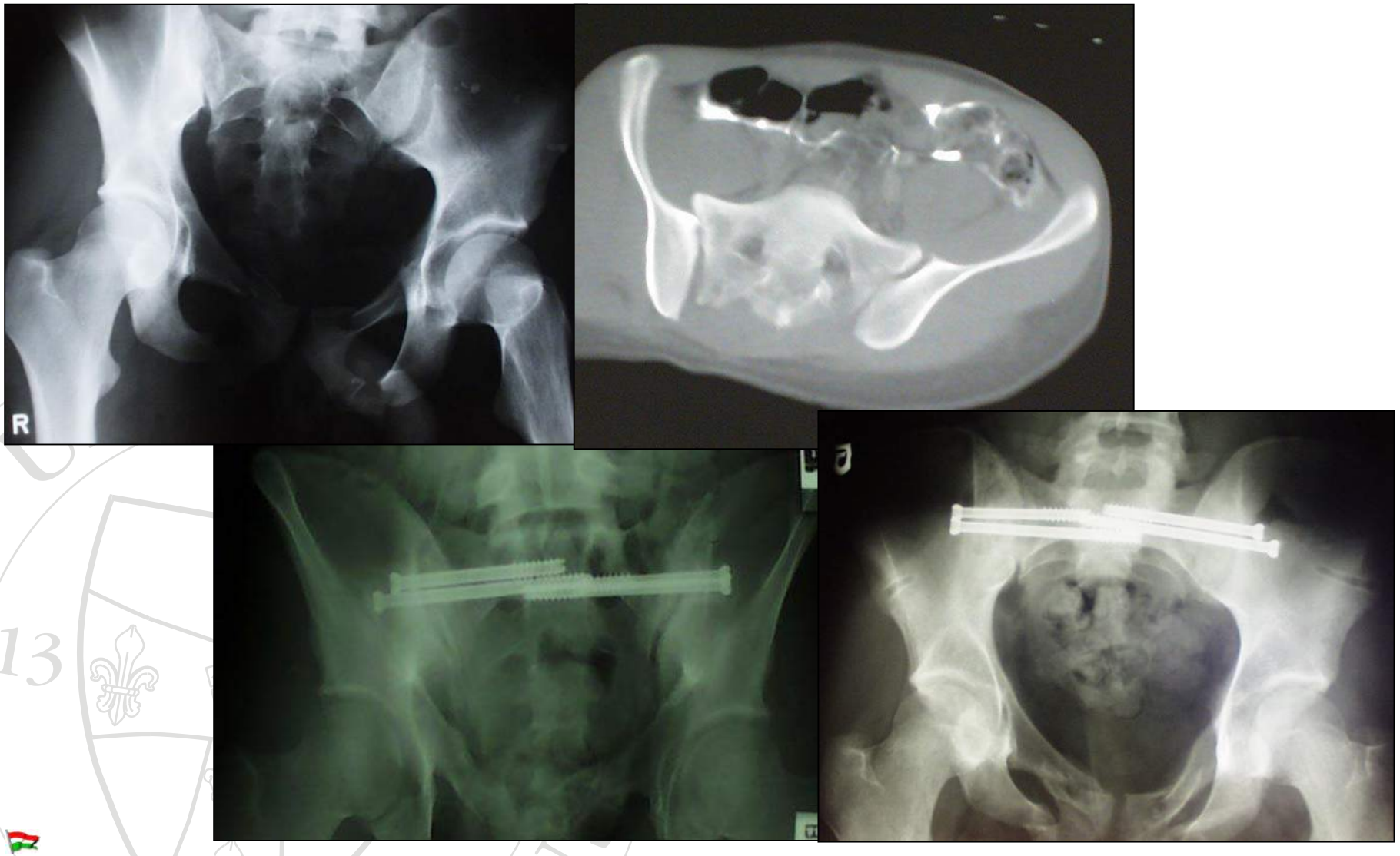


C1 : Screw + Hoffmann II. EXFIX.

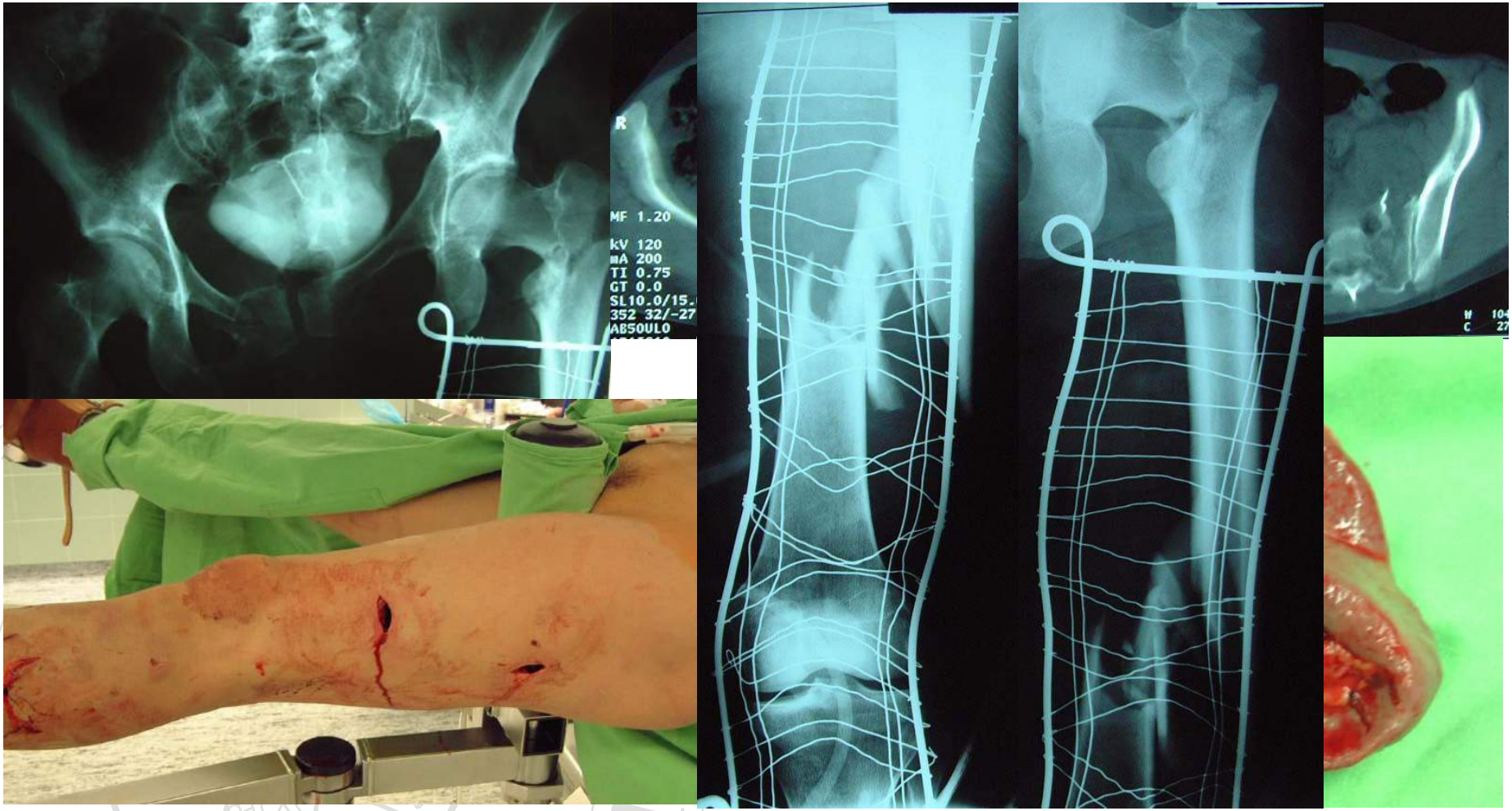




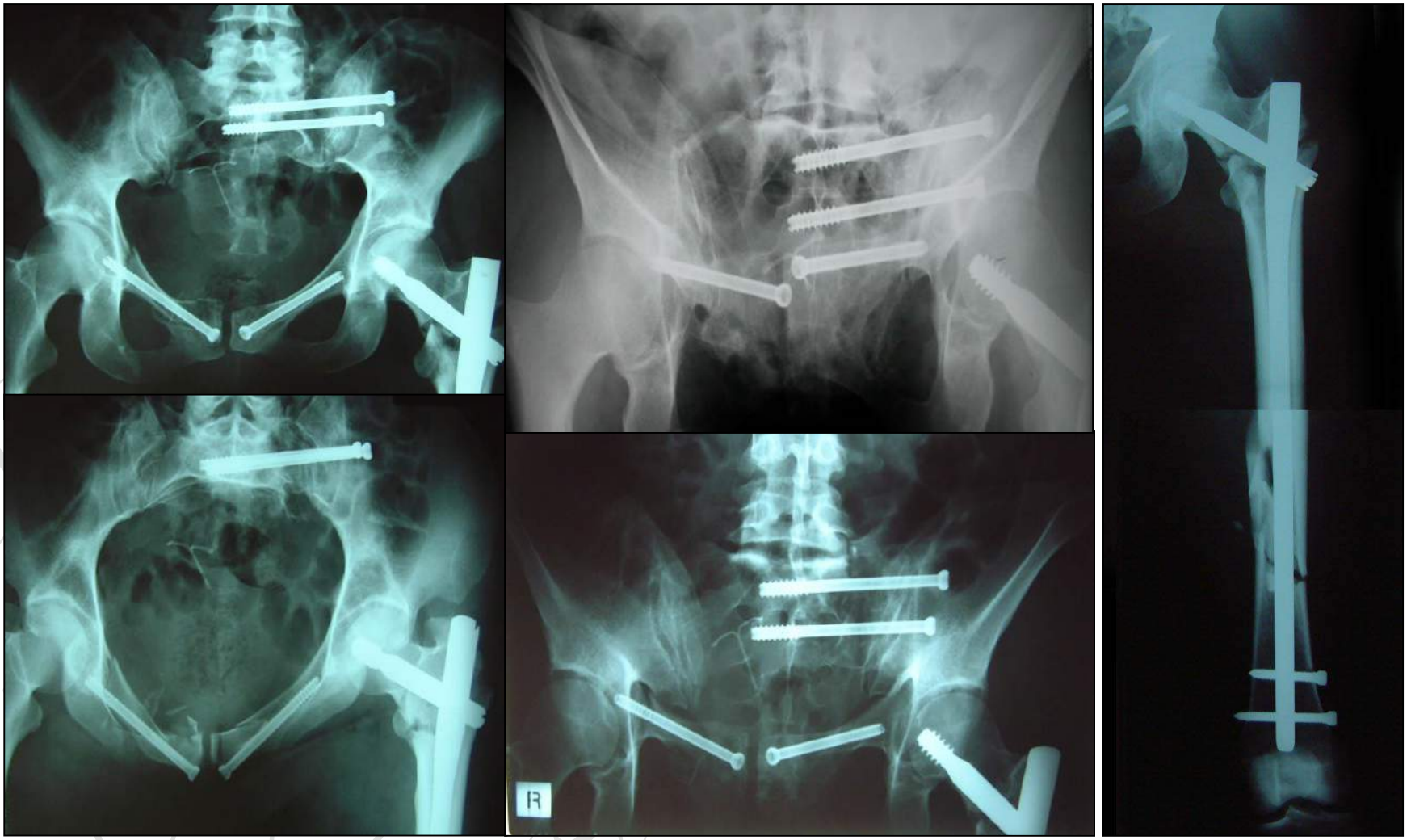
C2: screw



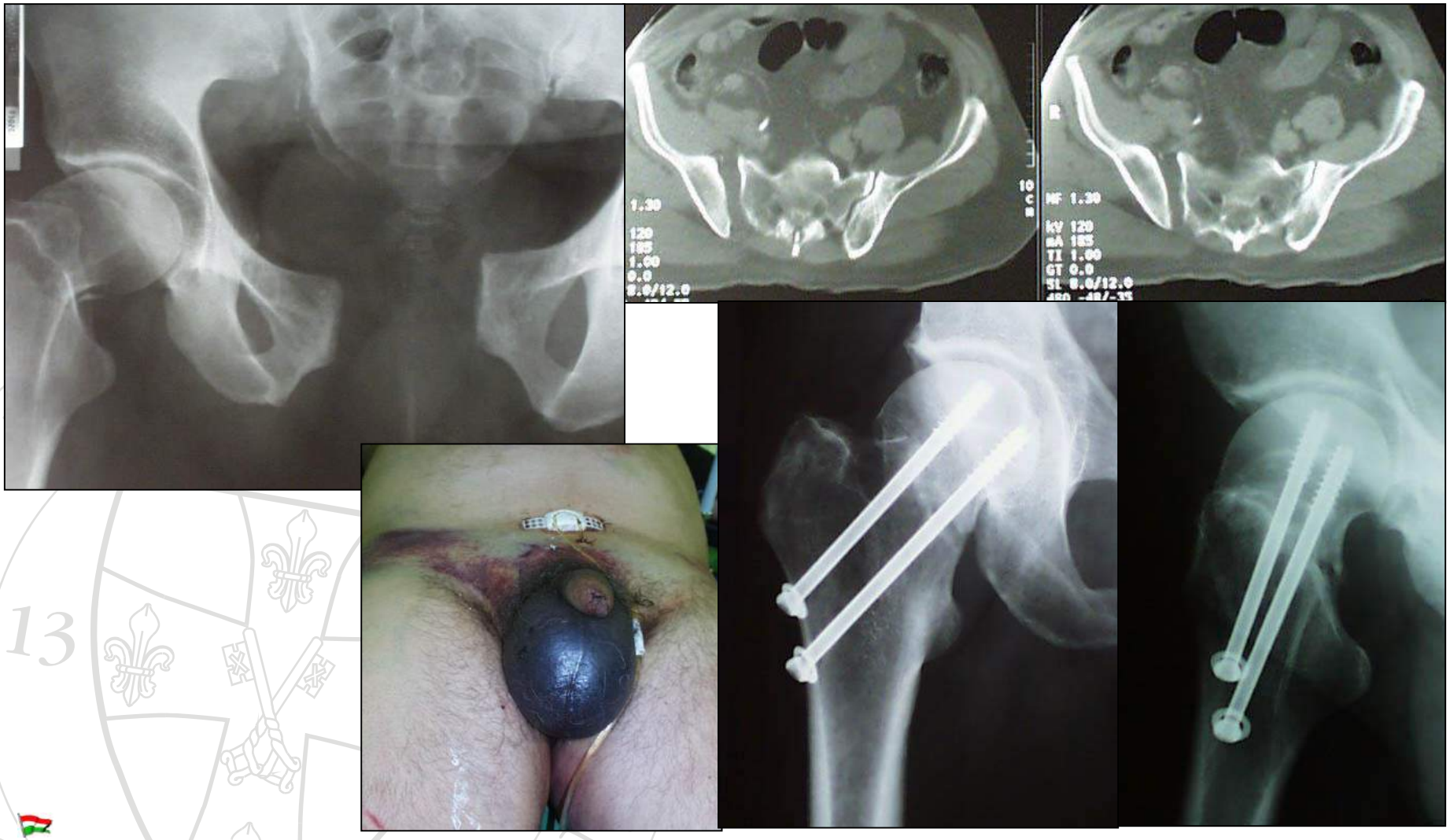
Polytrauma + C1 : Splenectomy, Screw, LGN



Polytrauma + C1 :
Splenectomy, Screw, LGN



Polytrauma + C1:
Screw + Hoffmann II. EXFIX.

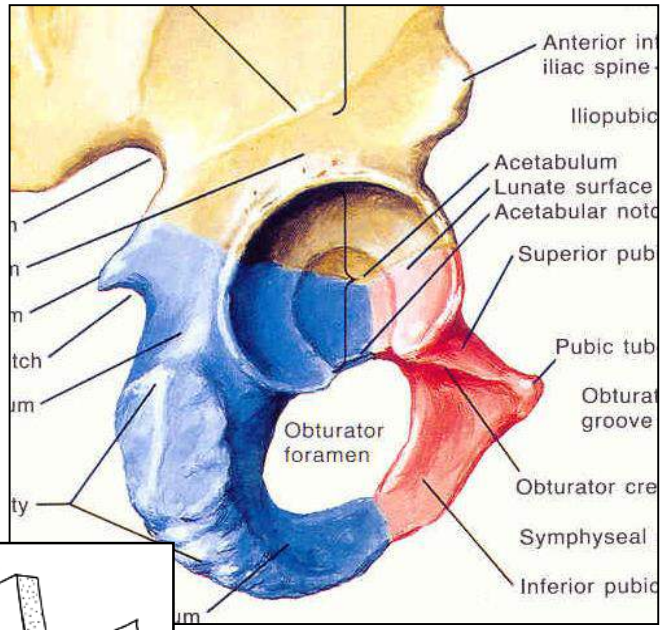


Polytrauma + C1:
Screw + Hoffmann II. EXFIX.

ACETABULAR FRACTURES

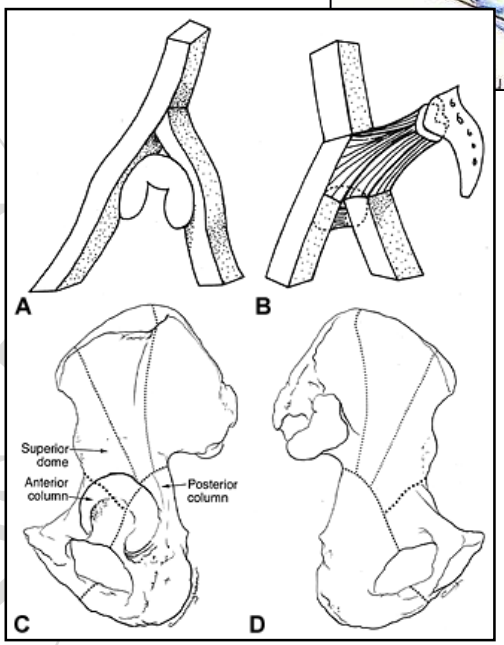
ACETABULUM - ANATOMY

- **<u>Acetabulum</u>** - the bony socket for the head of the femur where the three parts of the os coxae meet.



- **Anterior Column**

- **Posterior Column**



MECHANICAL INJURIES

- **High-energy injuries:**

  motor vehicles or motorbikes, depending on the force direction

  – Comminution with articular impaction fractures are common
  – High incidence of major associated injuries

- **Low-energy injury:**

  older patients with osteopenia may fracture the acetabulum

SIGNS AND SYMPTOMS

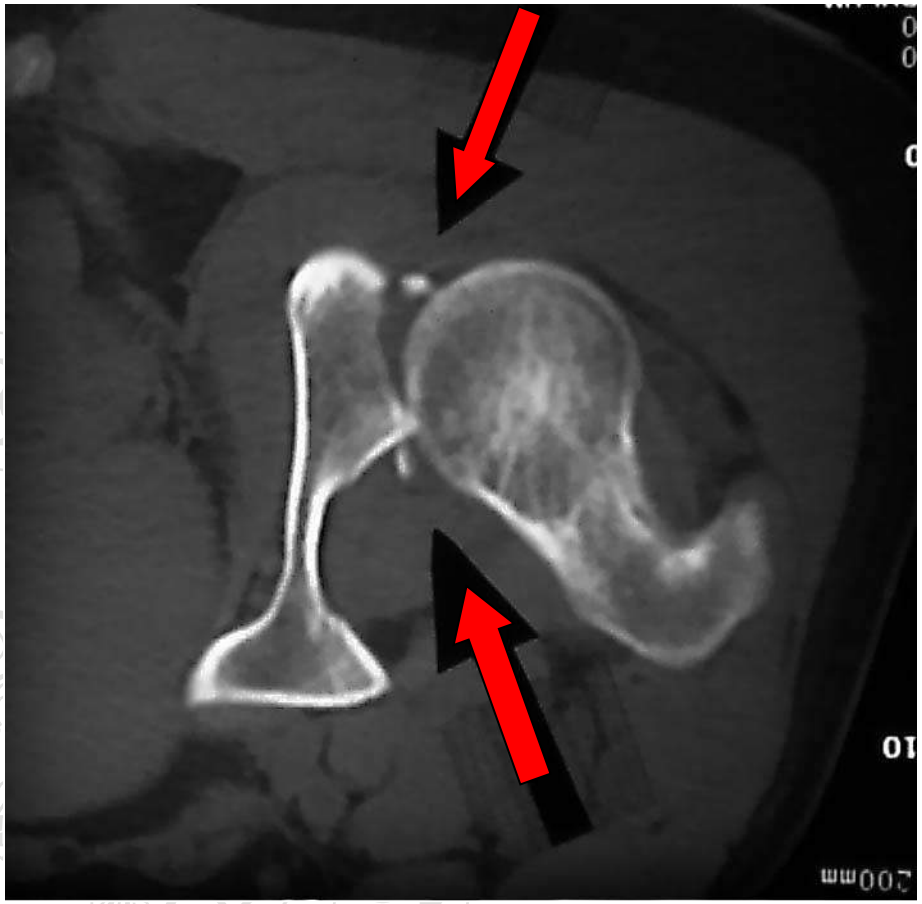
- Physical examination is required
  - Neurovascular injury in the ipsilateral extremity
    - ***Sciatic nerve*** *involvement may be present in up to 40% of posterior types*
    - Femoral nerve involvement with anterior column fractures is rare but not unknown
    - Vascular examination of the limb is mandatory to rule out penetrating injuries to the femoral artery by the anterior column
  - Morel-Lavalle lesion: local bruises in the area of the greater trochanter and areas of massive subcutaneous hemorrhage

RADIOGRPAHIC FINDINGS

- **Conventional X-rays**
  - Anteroposterior inlet and outlet views of the pelvis
  - Standard anteroposterior (AP) view of the hip joint
  - 45 degrees internal rotation view (obturator oblique view)
  - 45 degrees external rotation view (iliac oblique view)
- **CT-scan, 3D (reconstruction) CT**

RADIOGRPAHIC FINDINGS

CT: Retained fragments



CLASSIFICATIONS

- **Letournal & Judet classification**

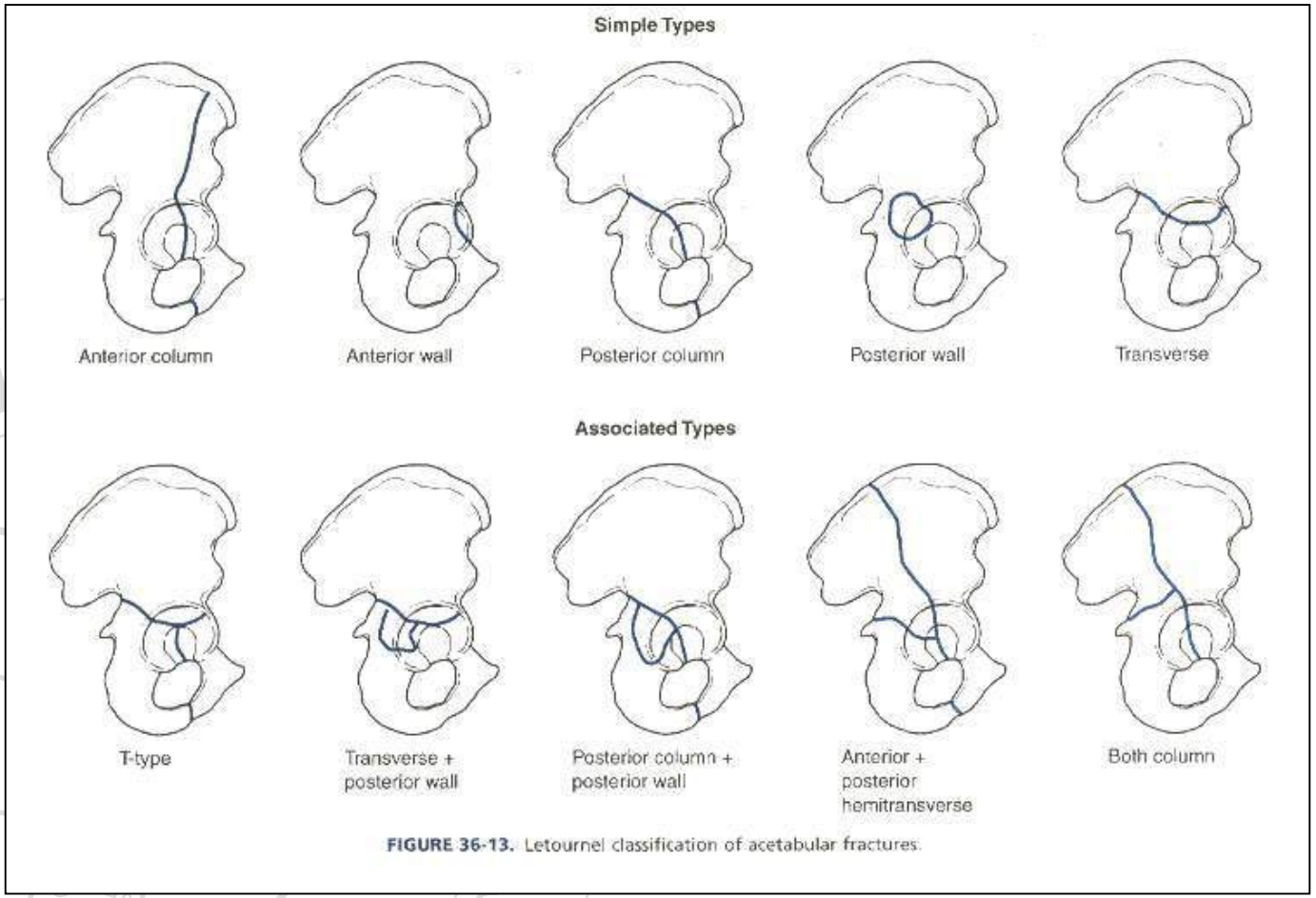


FIGURE 36-13. Letournel classification of acetabular fractures.

AO / ASIF - CLASSIFICATION

TYPE A PARTIAL ARTICULAR ONE COLUMN FRACTURE

A1-posterior wall

A2-posterior column

A3-anterior wall and/or anterior column

TYPE B PARTIAL ARTICULAR TRANSVERSE ORIENTED FRACTURE-

Transverse types with portion of the roof attached to intact illium

B1-transverse + posterior wall

B2-T types

B3-anterior with posterior hemitransverse

TYPE C COMPLETE ARTICULAR, BOTH COLUMN FRACTURE

Both columns are fractured and all articular segments, including the roof, are detached from the remaining segment of the intact ilium, “the floating acetabulum”

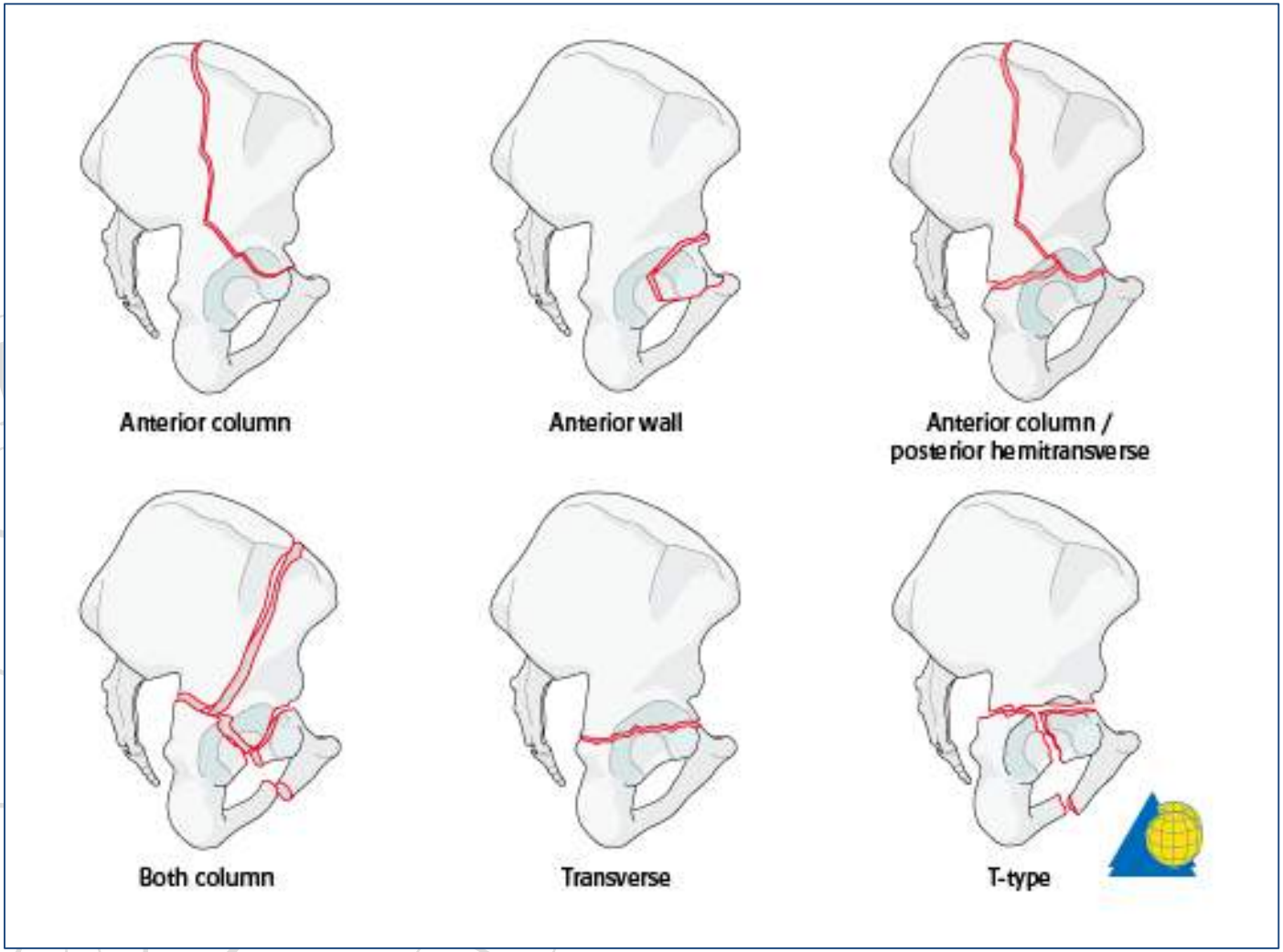
C1-both column: anterior column fracture extends to the iliac crest (high variety)

C2-both column: anterior column fracture extends to the anterior border of the ilium (low variety)

C3-both column: anterior fracture enters the sacroiliac joint

CLASSIFICATIONS

- **AO/ASIF Classification**



TREATMENT OPTIONS

Goals: restore the hip joint stability and congruency of joint surfaces

- Patient's general condition, age, etc.:

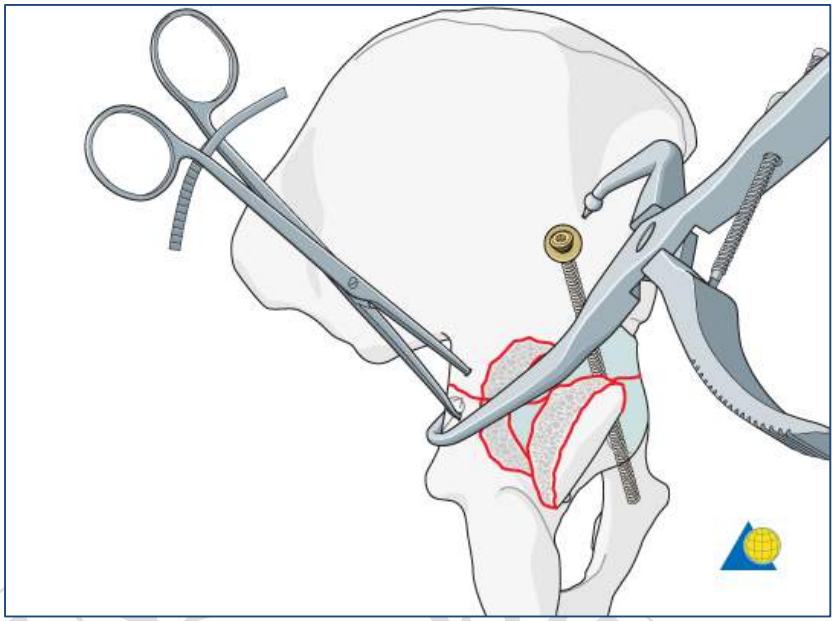
  young patient: ORIF, elderly: THR w ORIF

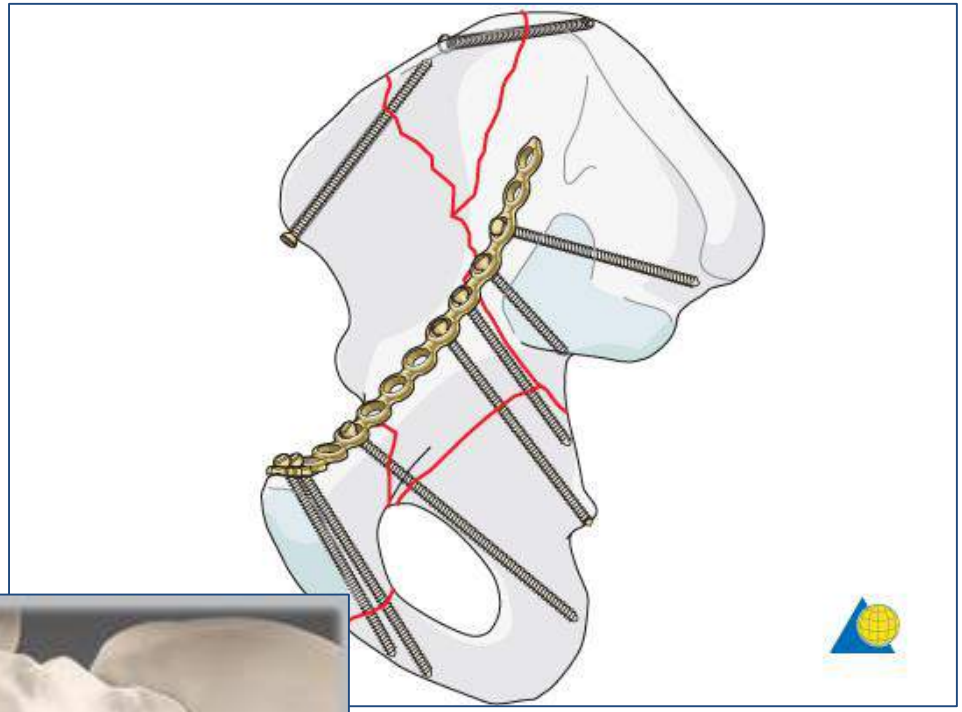
- Fracture type and stability:

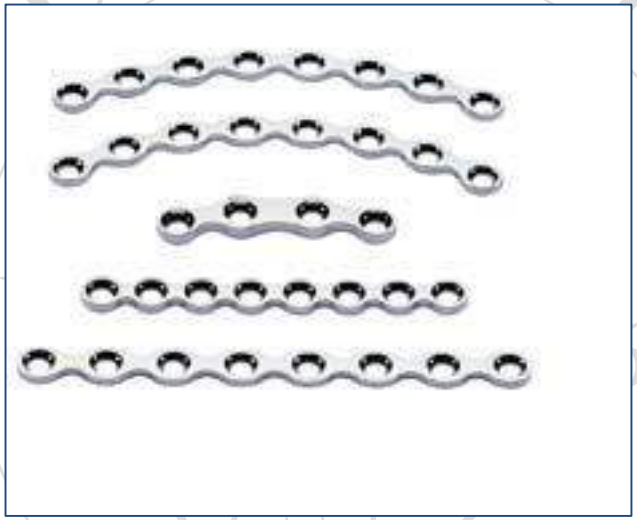
  unstable, incongruent → surgical treatment

- Open fracture with neurovascular injury: urgent surgery

TREATMENT OPTIONS - IMPLANTS





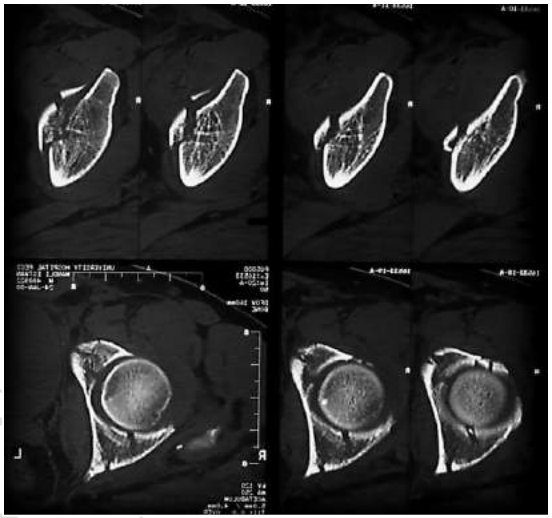


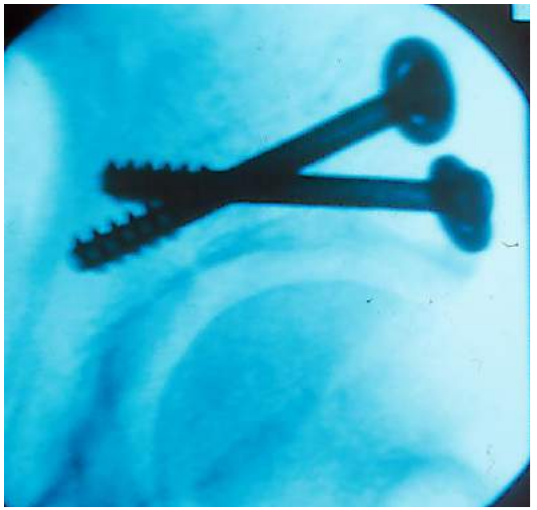
COMPLICATIONS

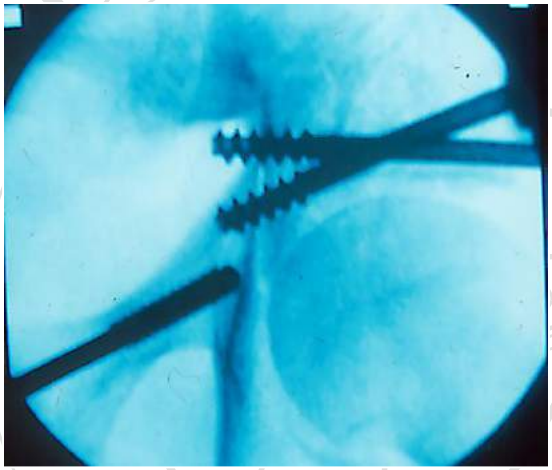
- DVT, PE
- Nerve injury: sciatic nerve, femoral nerve, etc..
- Heterotopic ossification
- Avascular necrosis
- Wound necrosis (extended surgical approach)

CASE REPORTS

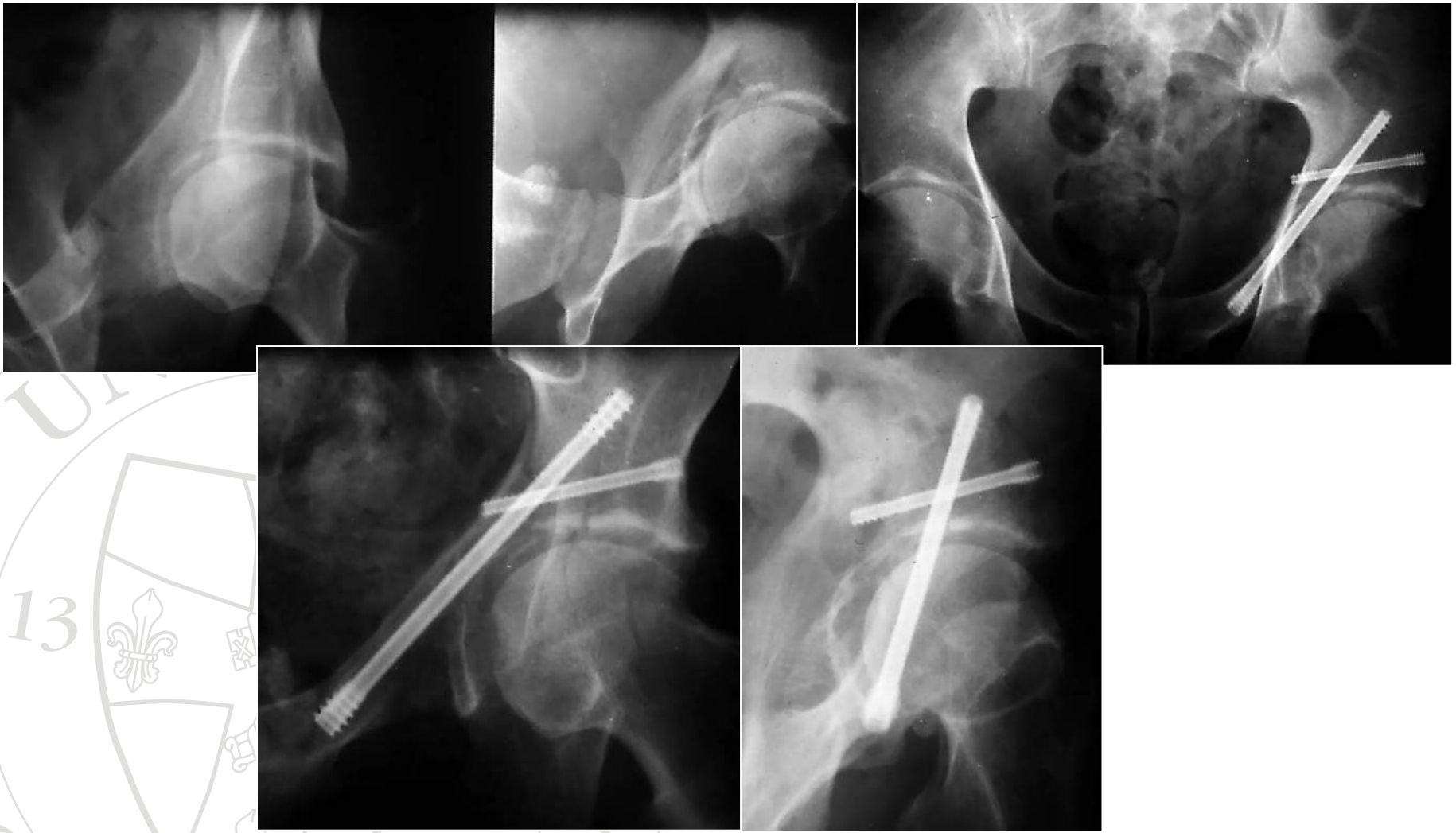
B type percutaneous screwing



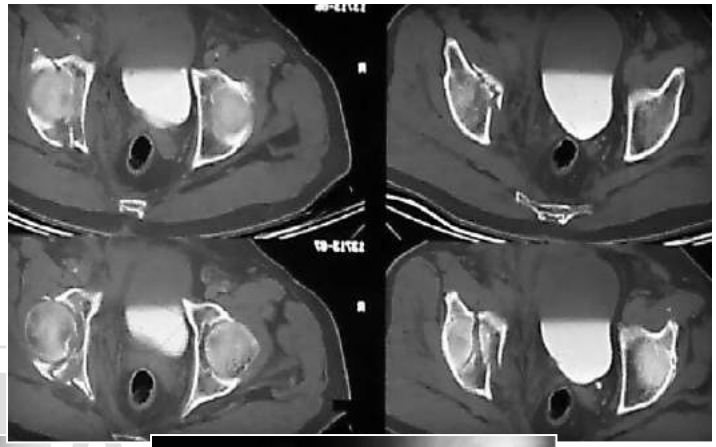


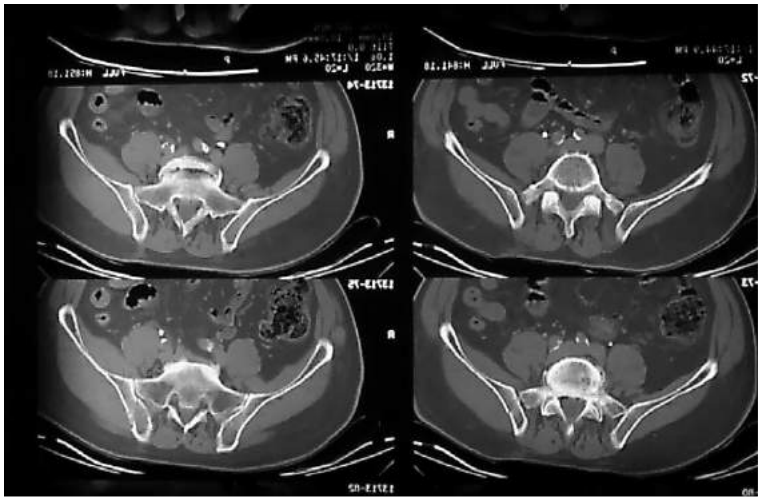


B type percutaneous screwing

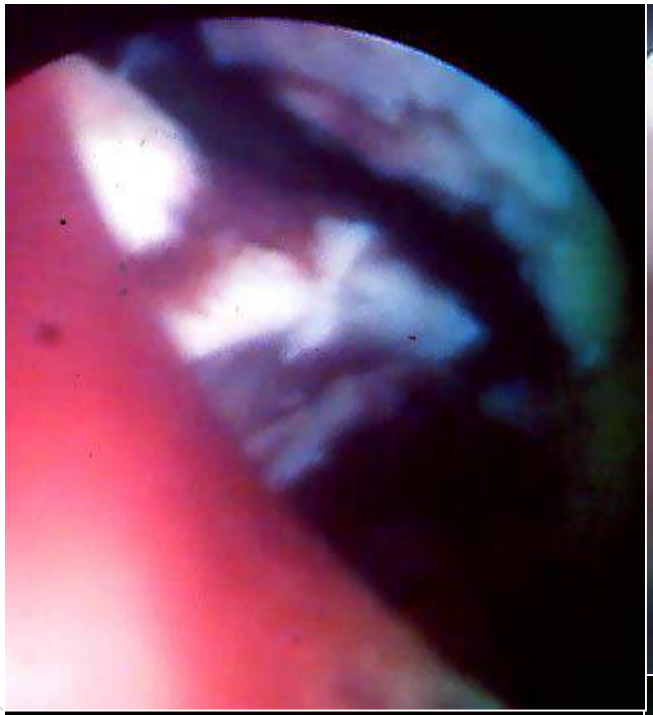


C type percutaneous screwing





Hip arthroscopy

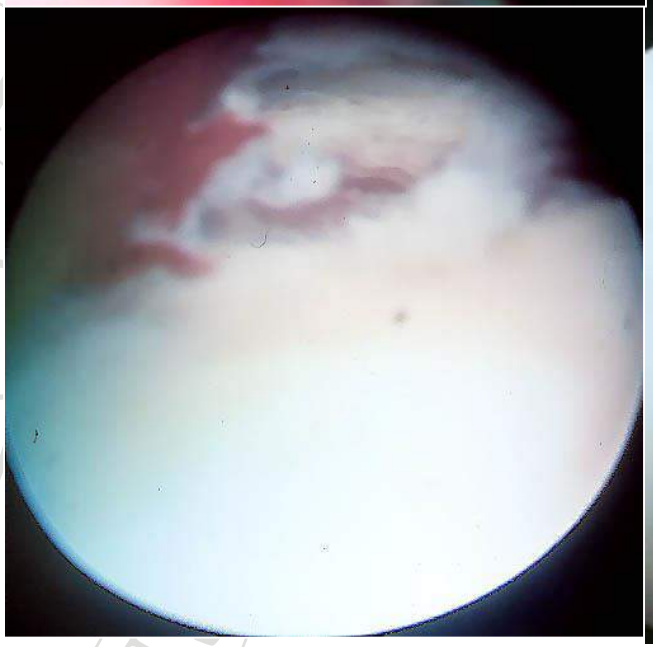


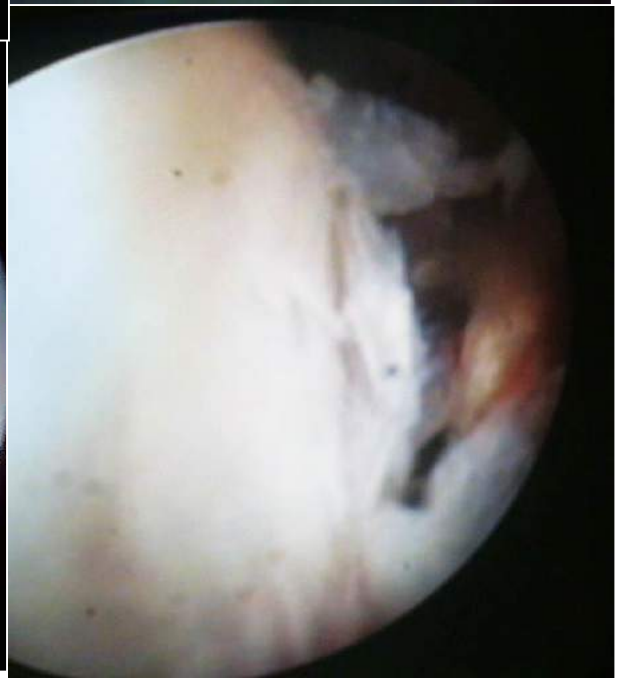
Acetabulum fracture =

Damages of the cartilage

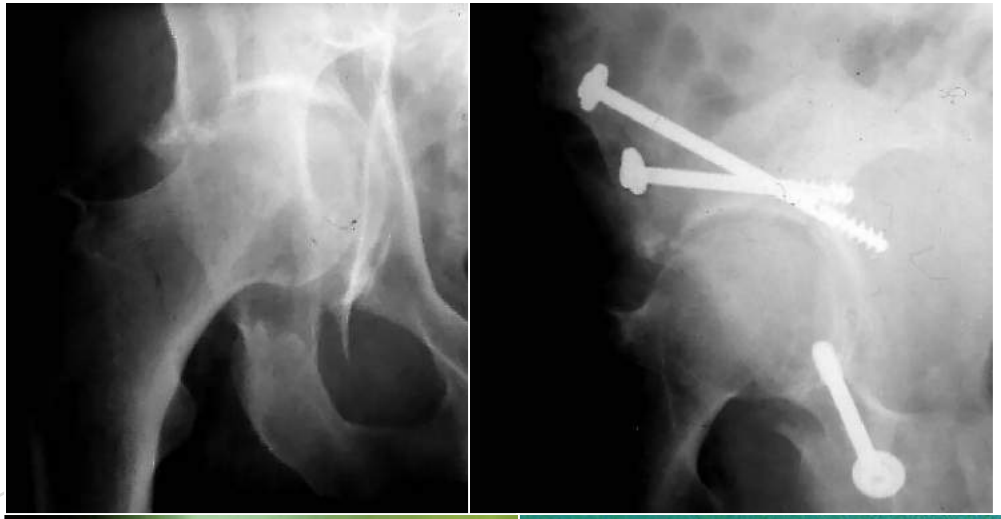
=

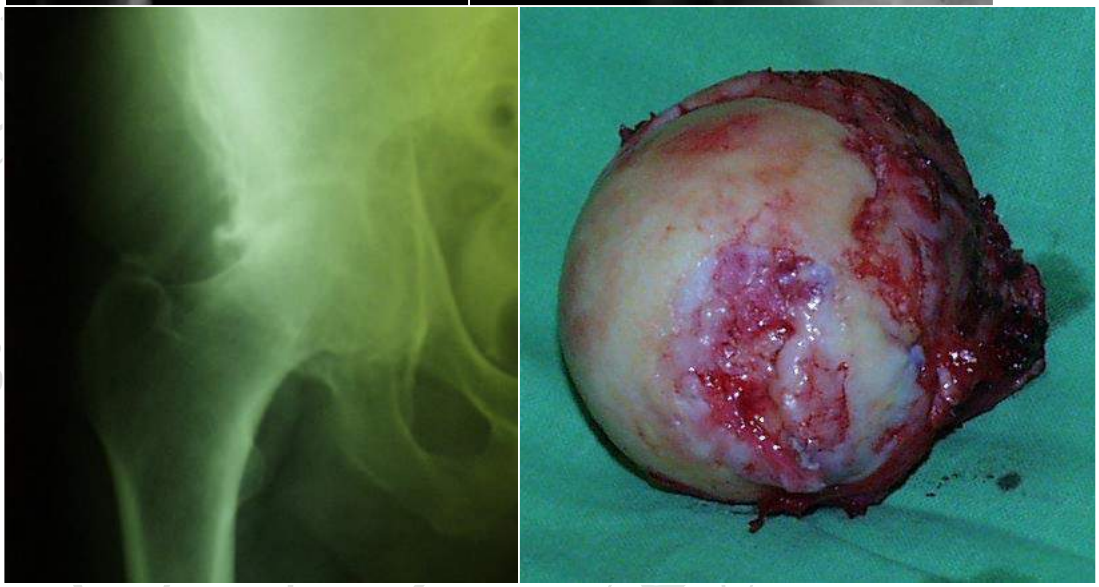
ARTHRITIS !!!





B type fracture





HIP AND FEMUR FRACTURES

Presenter:
Dr Laszlo G Nöt

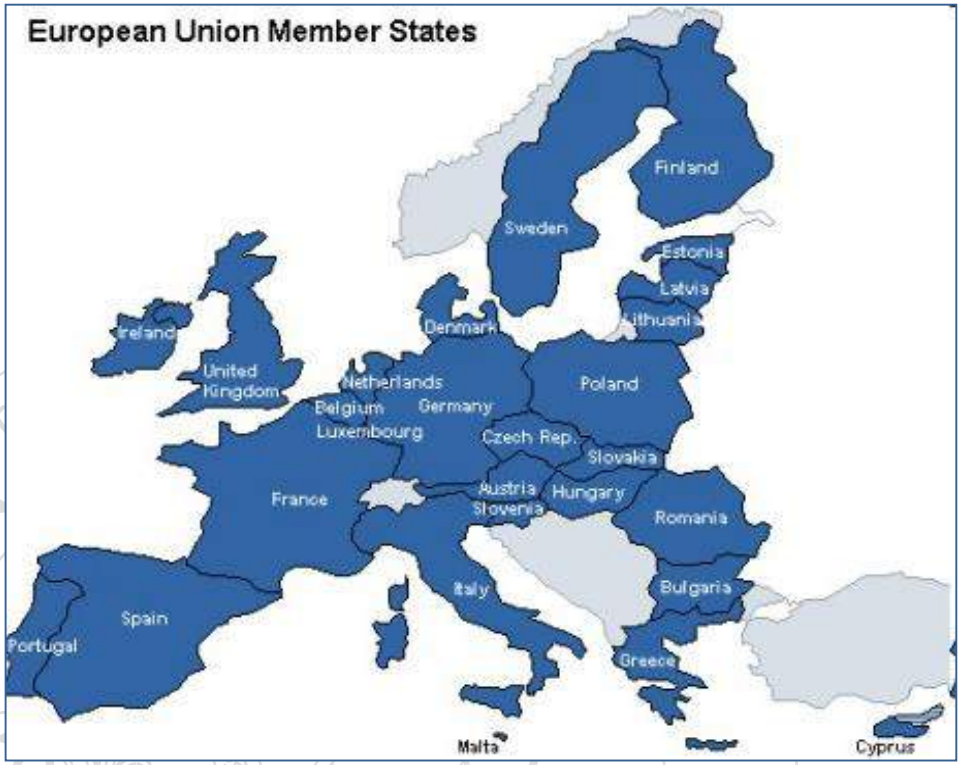
INTRODUCTION

- The hip fractures are one of the most common and very severe fractures of the elderly population.

- There are a lots of risk factors and many postoperative complications can occur.

- Usually we have only one possibility to stabilise the fracture – *importance of primary definitive treatment.*

INCIDENCE AND DEMOGRPAHICS



169 / 100,000

M : F = 1 : 3.5

Incidence among population over age of 50 years in the EU

European Multicentric Study (MEDOS - Mediterranean Osteoporosis Study 1993)

INCIDENCE AND DEMOGRPAHICS

- 1950: 1.66 million
- 2050: 6.26 million

Cooper et al. Osteoporos Int 1992; 2:285-289

Melton LJ, 3rd. Hip fractures: a worldwide problem today and tomorrow. Bone1993;1Suppl1:S18.

INCIDENCE AND DEMOGRPAHICS

COMPLICATIONS

General

- cardiovascular insufficiency
- pulmonary insufficiency
- number of metabolic diseases
- dehydration
- malnutrition
- malignant tumors
- thrombosis
- pulmonary embolism
- bedsore

Local

- implant failure
- redislocation
- bleeding
- Malunion
- Nonunion
- AVN
- postoperative stresses

INCIDENCE AND DEMOGRPAHICS

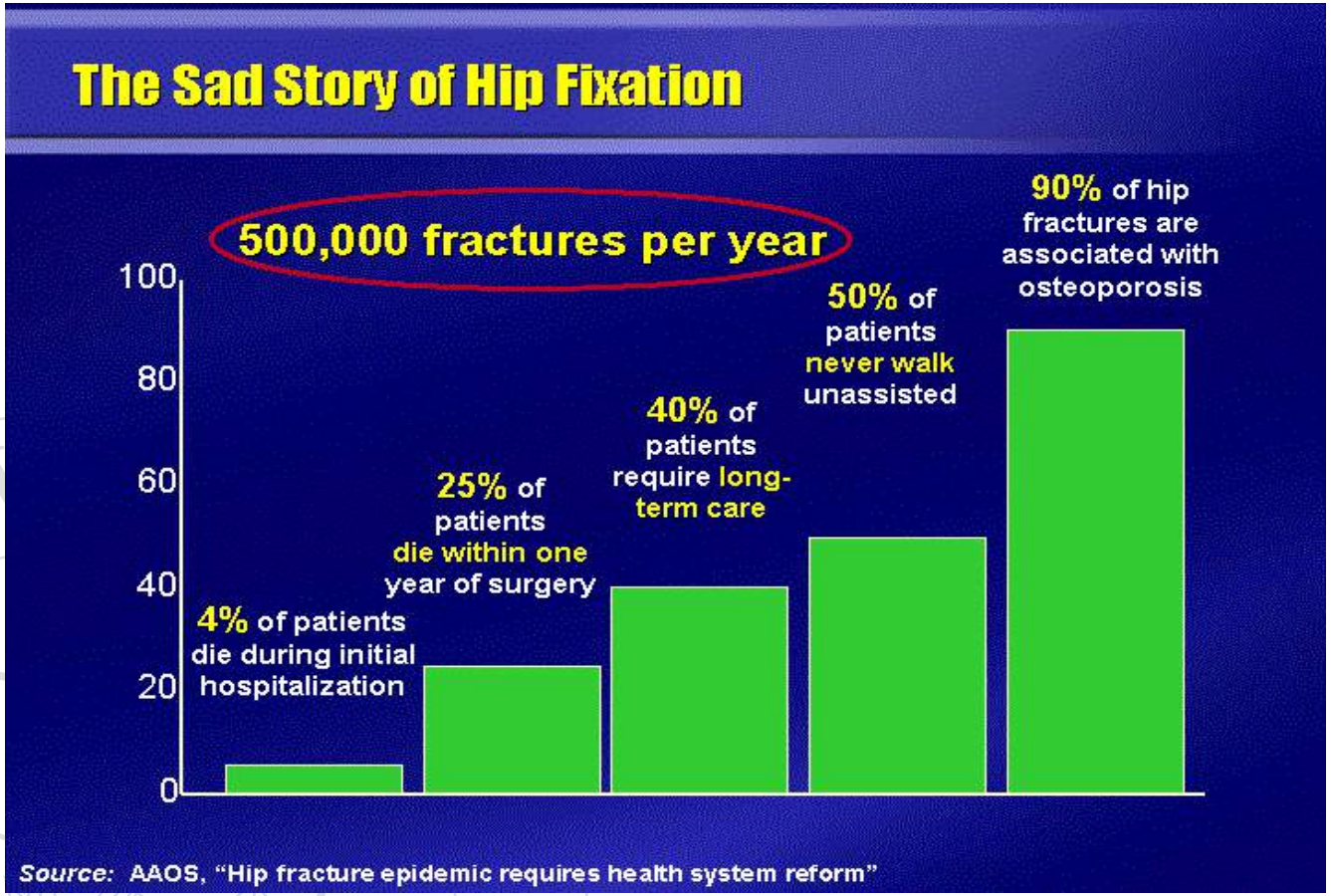
MORTALITY

- < **30 days** 9%
- < **1 year** Female: 17%
- < **1 year** Male: 31%
- < **5 years** 62%

50% of patients: need help for everyday activity

25% of patients: need long-term (nursery) care

INTRODUCTION

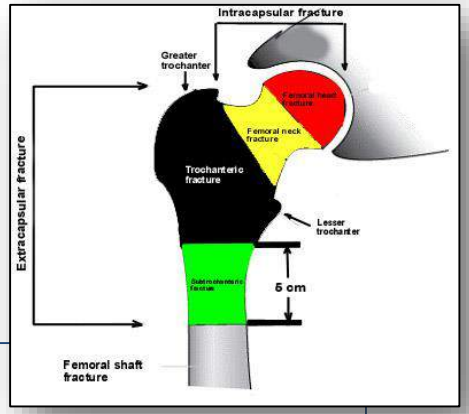


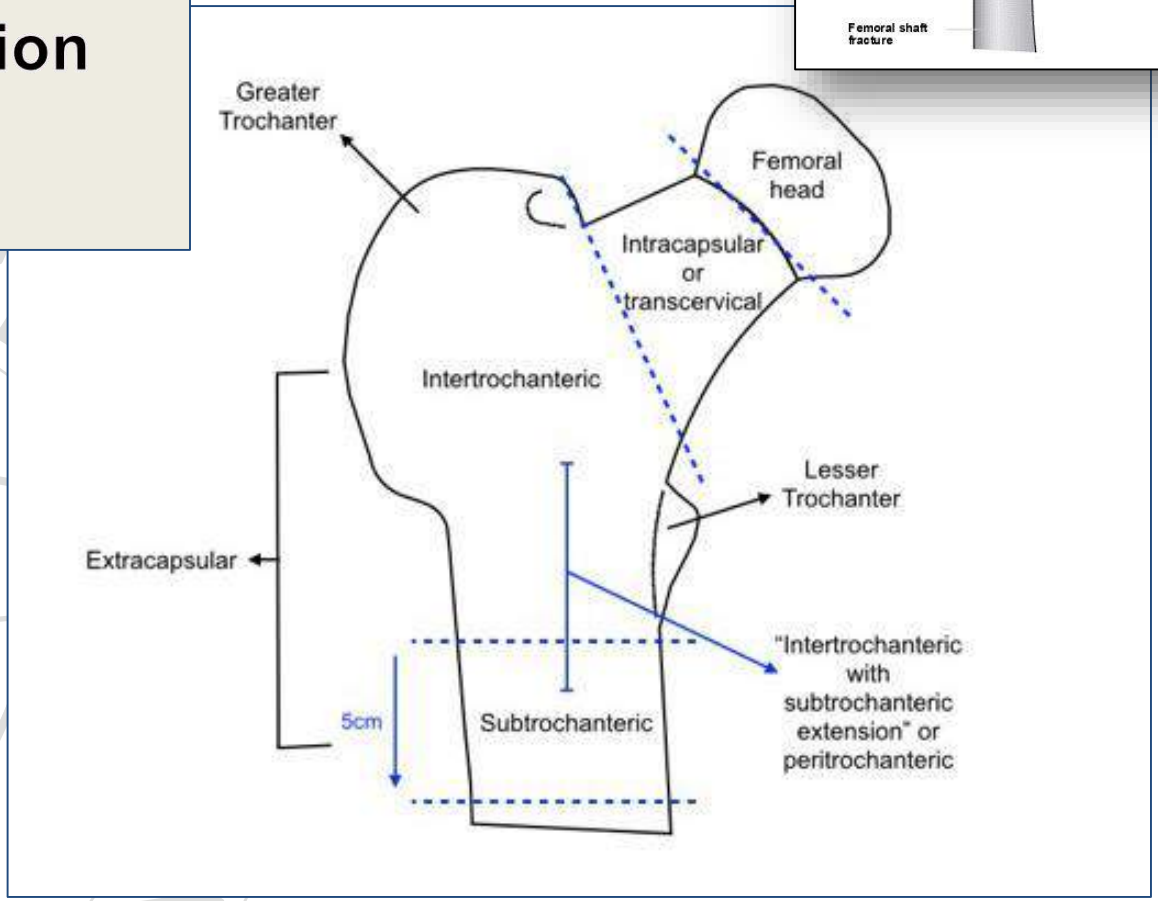
*S. S. Jameson, J. Kyle, P. N. Baker, J. Mason, D. J. Deehan, I. A. McMurtry, and M. R. Reed**: Patient and implant survival following 4323 total hip replacements for acute femoral neck fracture: A retrospective cohort study using National Joint Registry data** *J Bone Joint Surg Br November 2012 94-B:1557-1566.*

** Martyn J. Parker, Glyn Pryor, Kurinchi Gurusamy : **Hemiarthroplasty versus internal fixation for displaced intracapsular hip fractures: A long-term follow-up of a randomised trial** Injury, Int. J. Care Injured 41 (2010) 370–373

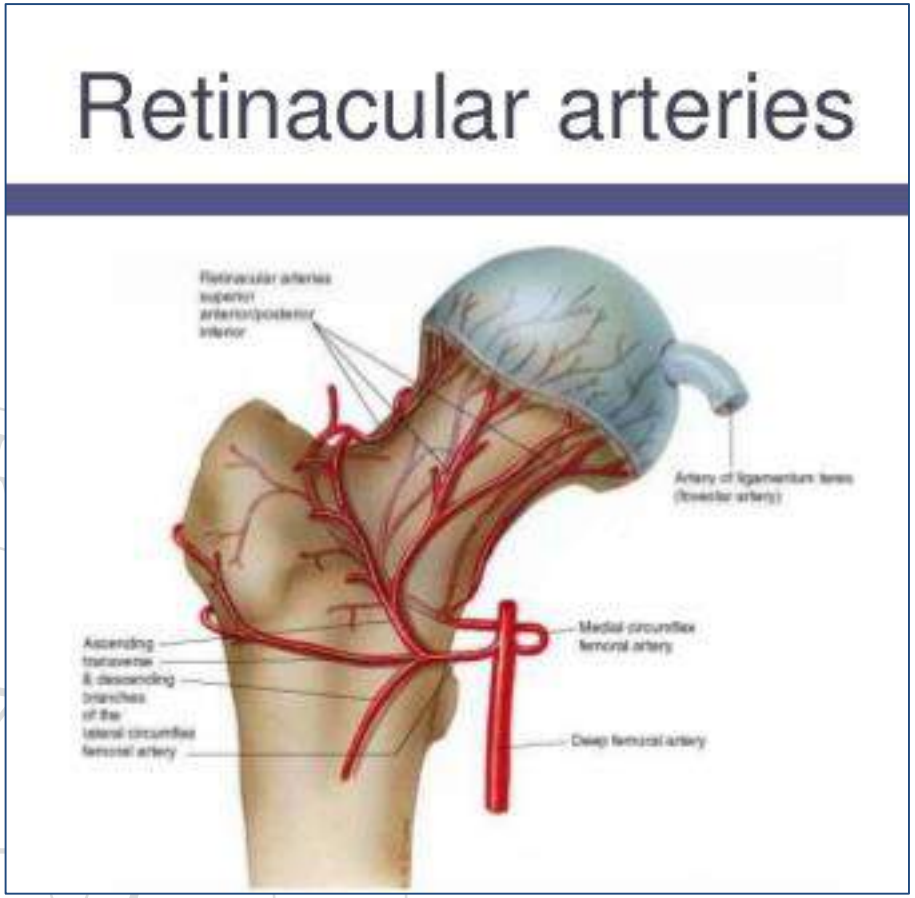
PROXIMAL FEMORAL FRACTURES

Femoral head
Femoral neck
Trochanteric region
Subtrochanteric region

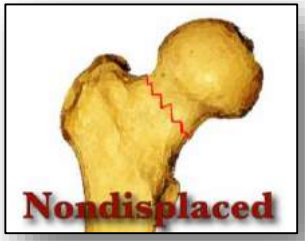


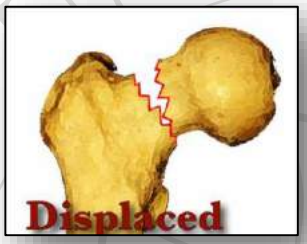


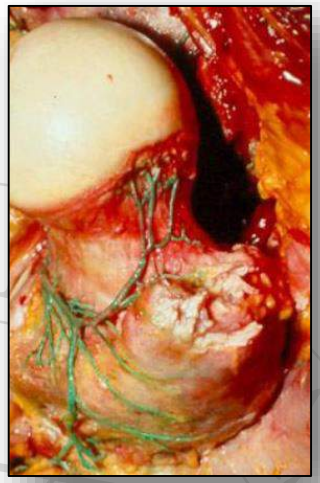
MEDIAL FEMORAL NECK FRACTURES

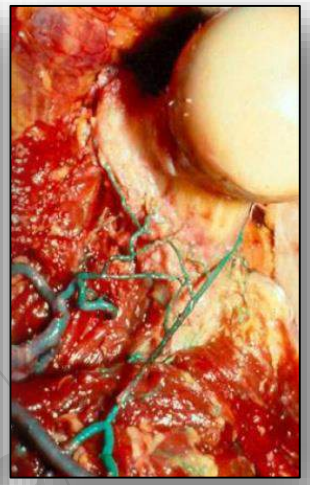


PROGNOSTIC FACTORS: TIME AND BLOOD SUPPLY



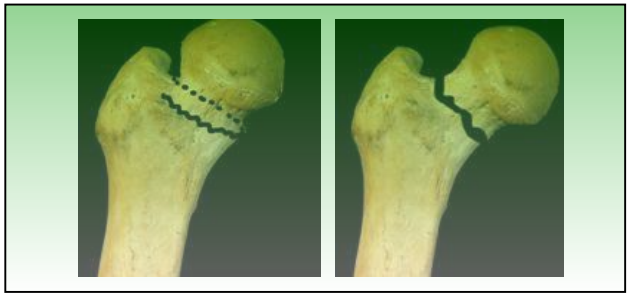






MEDIAL FEMORAL NECK FRACTURES - CLASSIFICATION

Garden

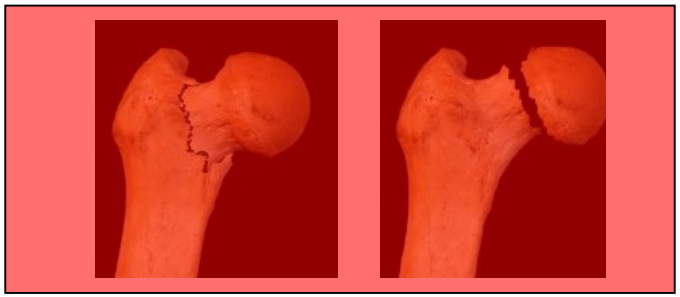


I II

III IV

AO

B 1



B 2 B 3

MEDIAL FEMORAL NECK FRACTURES - CLASSIFICATION

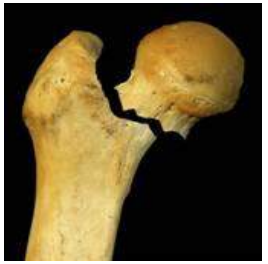
GARDEN CLASSIFICATION

Garden I: impacted, valgus

Garden II: without displacement

Garden III: displacement with contact, varus

Garden IV: displacement without contact, varus



MEDIAL FEMORAL NECK FRACTURES - TREATMENT

NO CONSERVATIVE TREATMENT IN 2018!!

MEDIAL FEMORAL NECK FRACTURES - TREATMENT

Garden I: screw fixation (cancellous, cannulated ASNIS screw, Manninger-screw)

Garden II: screw fixation (Manninger / Uppsala screw)

Garden III: age ≤ 55 – 65 years

within 6 (24) hours: screw fixation

after 6 (24) hours: primary arthroplasty

age ≥ 55 – 65 years

primary arthroplasty

Garden IV: hip replacement (total- or hemiarthroplasty)

MEDIAL FEMORAL NECK FRACTURES - TREATMENT

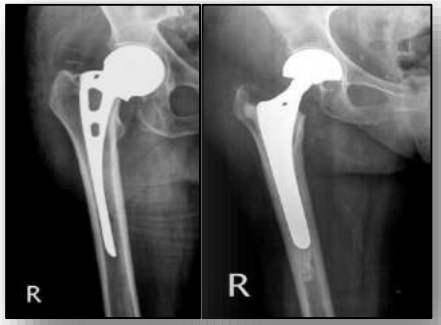
THERAPEUTIC ALGORYTHM

Dislocation

< 55

55 - 70

‘Gray zone’



> 70 - 75

Age

MEDIAL FEMORAL NECK FRACTURES

COMPLICATIONS

- Avascular necrosis
- Non-union
- Arthritis
- Deformity (shortening, varus)
- Re-dislocation

MEDIAL FEMORAL NECK FRACTURES

DEBATE: ARTHROPLASTY VS. SCREW FIXATION…

LEVEL II. Evidence

- Fx without dislocation: osteosynthesis (screw fixation)
- Young patients, dislocated fx: osteosynthesis (screw fixation)

  Age < 55 – 60 years (?) – *further studies*

  Age > 55 – 60 years (?) – cemented total arthroplasty

  Uni or bipolar HEP (hemiarthroplasty) – *further studies*
- Elderly patients, dislocated fx, expecting long survival: cemented THR

MEDIAL FEMORAL NECK FRACTURES

DEBATE: ARTHROPLASTY VS. SCREW FIXATION…

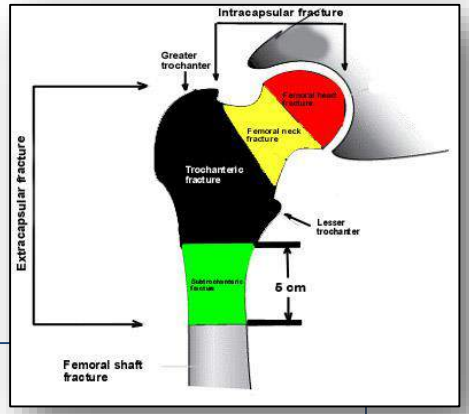
LEVEL I. Evidence

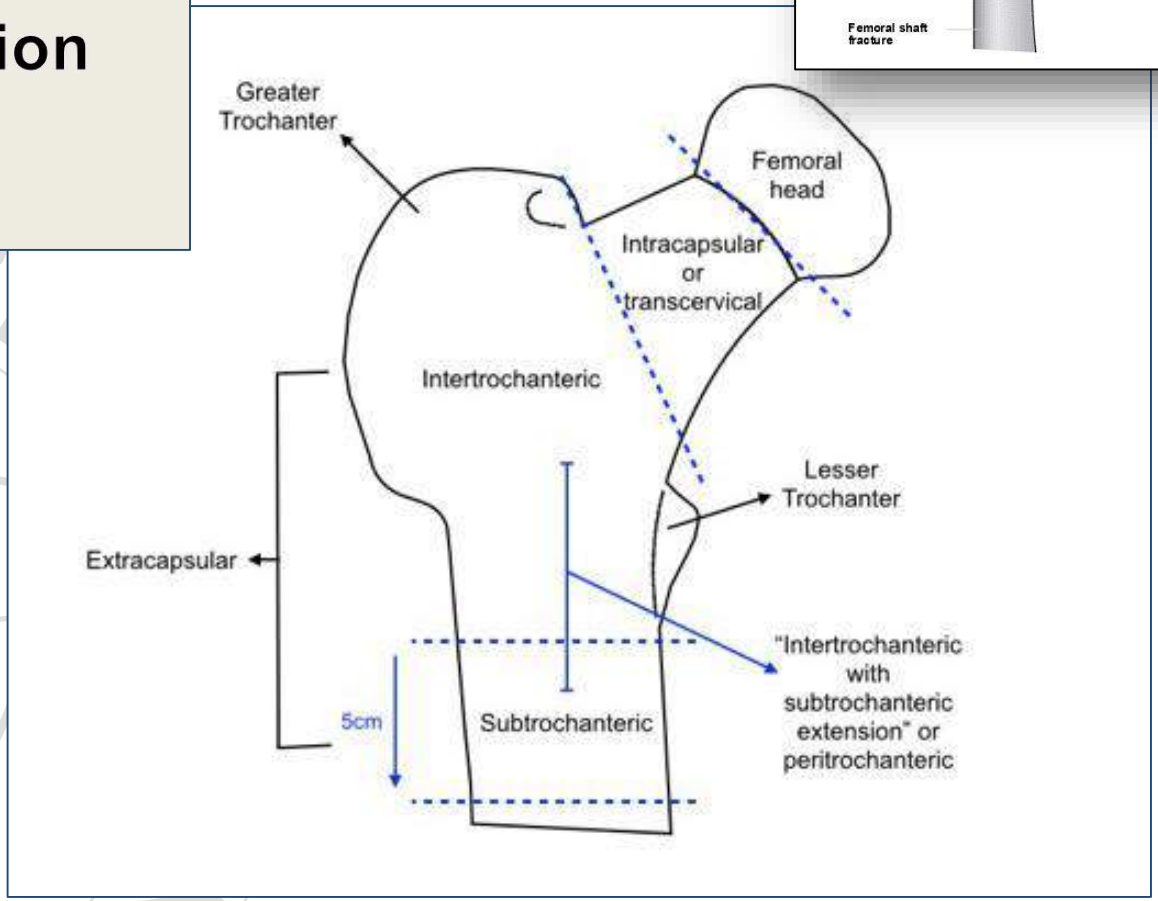
‘In comparison with internal fixation, *arthroplasty* for the treatment of a displaced femoral neck fracture significantly *reduces the risk of revision surgery*, at the *cost of greater infection rates, blood loss*, and *operative time* and possibly an increase in *early mortality rates*.’

Bhandari M et al: Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. A meta-analysis. *J Bone Joint Surg Am. 2003 Sep;85-A(9):1673-81.*

PROXIMAL FEMORAL FRACTURES

Femoral head
Femoral neck
Trochanteric region
Subtrochanteric region





TROCHANTERIC FRACTURES

INCIDENCE AND DEMOGRAPHICS

Pertrochanteric fracture	
percentage of all hip fractures	**30-40 %**
Subtrochanteric fracture	
percentage of all hip fractures	**10-20 %**
Greater trochanteric (avulsion) fracture	
percentage of all hip fractures	**2 - 6 %**
Lesser trochanteric (avulsion) fracture	
percentage of all hip fractures	**1 - 2 %**

PERTROCHANTERIC FRACTURES

INCIDENCE AND DEMOGRAPHICS

- Large patient population
- Elderly patients
- Osteoporosis
- Comorbidities
- Rehabilitation
- Cost
- General complications
- High incidence of local and general complications in case of inadequate surgery/implant

PERTROCHANTERIC FRACTURES

INCIDENCE AND DEMOGRAPHICS

Author	Year	Mortality %
Watson	1964	19,0%
Fielding	1966	20,9%
Waddell	1979	20,8%
Zickel	1976	8,3%
Bergman	1987	11,2%
Melly	1998	24,9%
Naumov	2001	13,9%

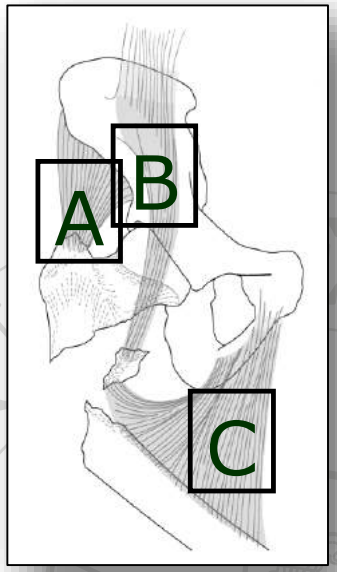
PER/SUB TROCHANTERIC FRACTURES

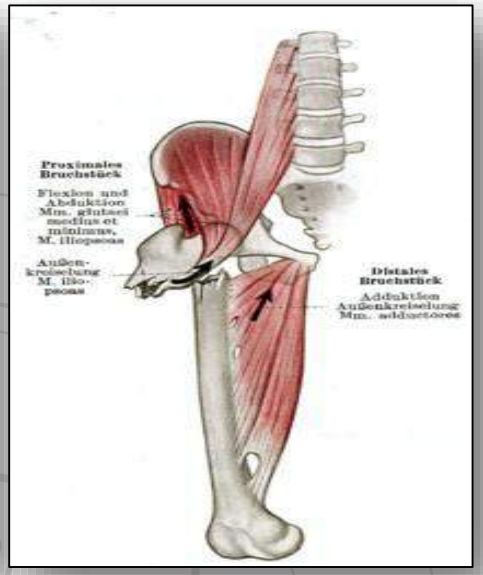
DIAGNOSTICS – TYPICAL SYMPTOMS

- Lower extremity externally rotated
- Shortened
- Flexion
- Abduction
- ***Cadaver position***
- Pain, Swelling, Hematoma, Suffusion
- Loss of function: unable to stand up or walk

PER/SUB TROCHANTERIC FRACTURES

DIAGNOSTICS – TYPICAL DISLOCATIONS





A: gluteus medius
B: ileopsoas
C: adductor group

Gluteal muscle ➡ abduction

Iliopsoas muscle ➡ flexion + external rotation

Adapted from Russell TA, Taylor JC: subtrochanteric fractures of the femur in: Browner BD, Jupiter JB and Levine AM editors. Skeletal trauma 2nd edition Philadelphia PA, WB Saunders 1992, p1836, drawing by Hella Thun)

PER/SUB TROCHANTERIC FRACTURES

DIAGNOSTIC PROTOCOL

- Anamnesis
- Physical examination
- Conventional X-ray
- CT
- MRI

} ***ACUT***

CHRONIC

PERTROCHANTERIC FRACTURES

AO – CLASSIFICATION (1979)

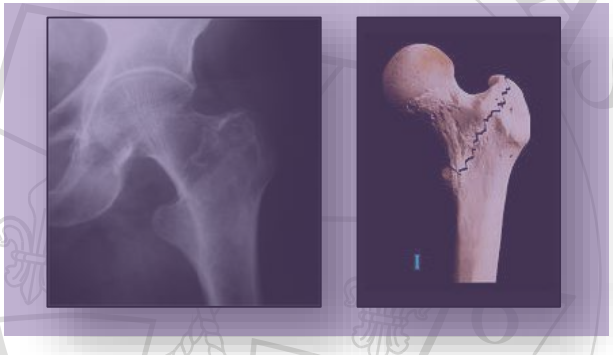
31 – A

PERTROCHANTERIC FRACTURES

EVANS – CLASSIFICATION (1949)

STABLE FRACTURE

Only one fracture line on Adam-arch



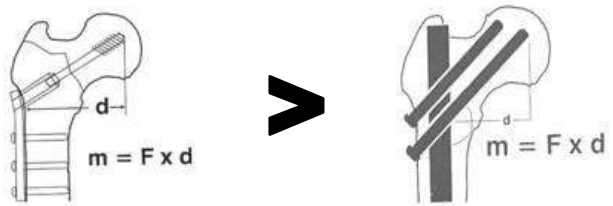
UNSTABLE FRACTURE

More, than one fracture line on the Adama-arch; no medial support (lesser trochanter fracture)

Evans E M. The treatment of trochanteric fractures of the femur. J Bone Joint Surg (Br) 1949; 31: 190-203.

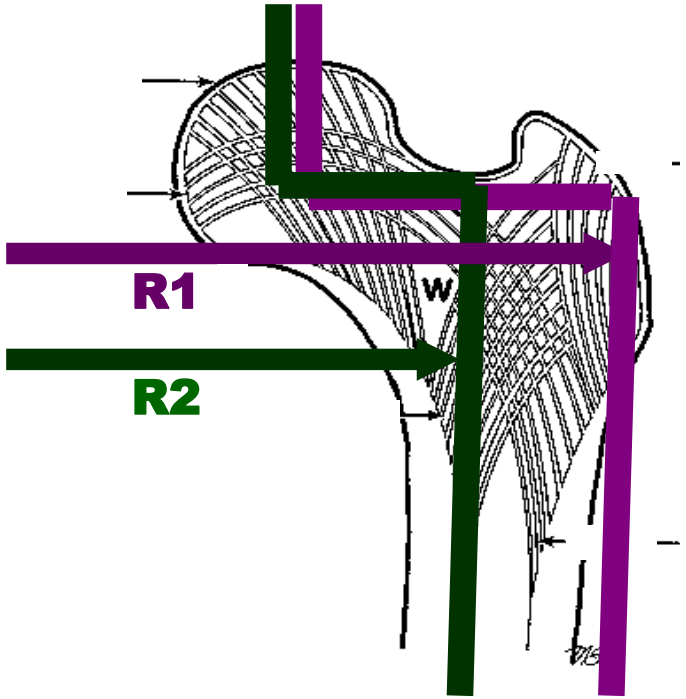
PERTROCHANTERIC FRACTURES

BIOMECHANICS



Extramedullary fixation

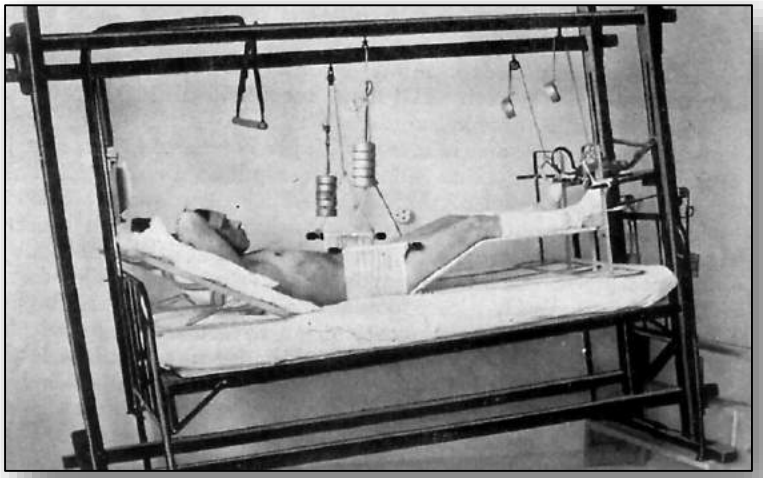
Intramedullary fixation



R1 > R2

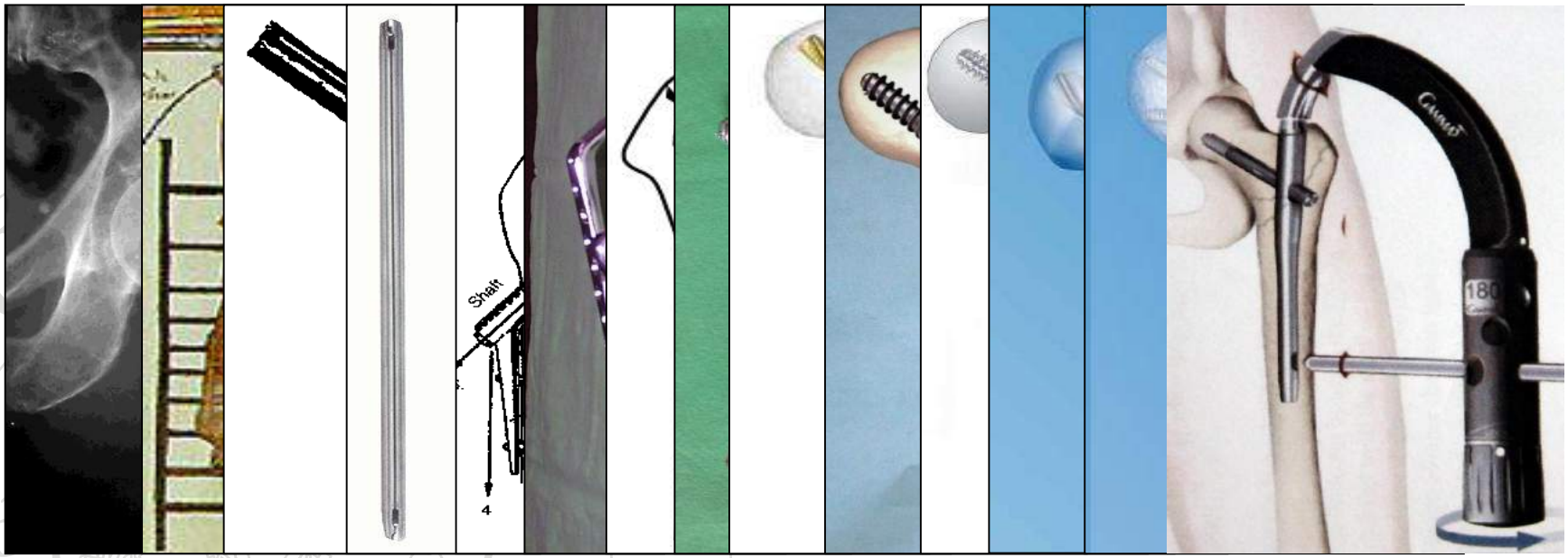
PER/SUBTROCHANTERIC FRACTURES - TREATMENT

NO CONSERVATIVE TREATMENT IN 2018!!



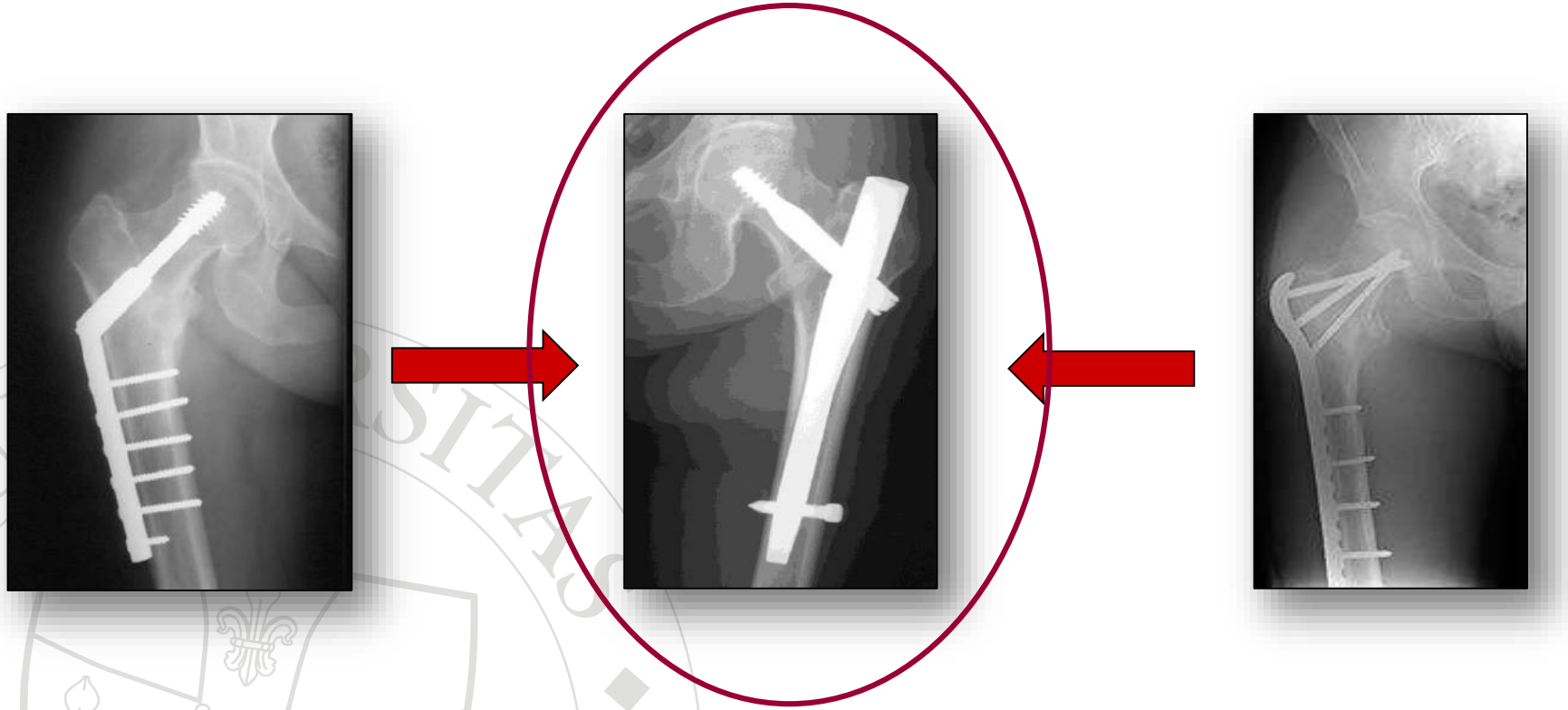
PERTROCHANTERIC FRACTURES

EVOLUTION OF TREATMENT



PER /SUB TROCHANTERIC FRACTURES

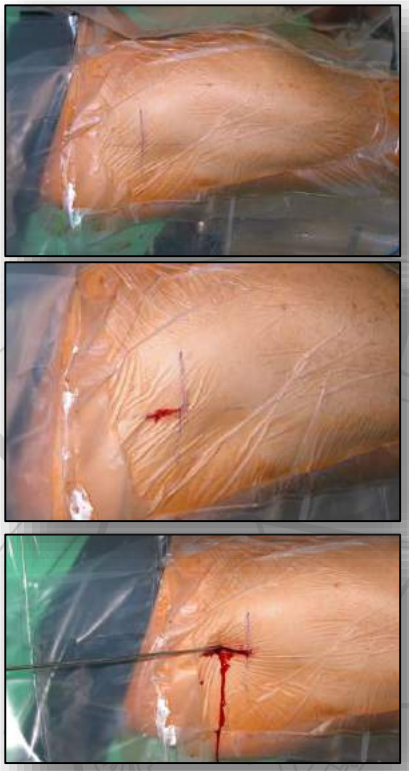
‘GOLD STANDARD’ – GAMMA-NAILS

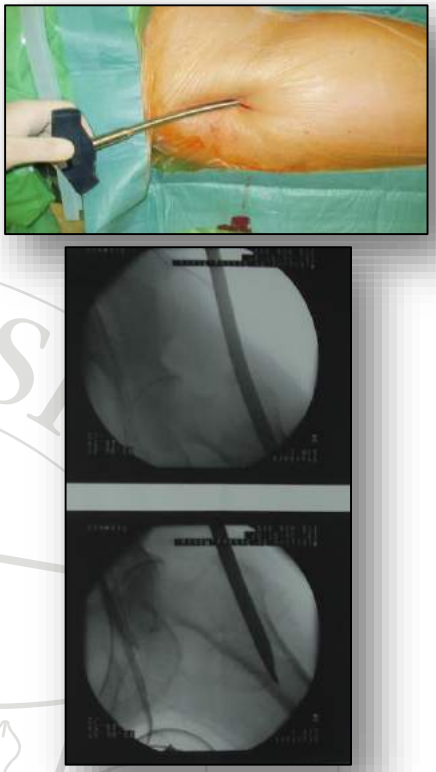


ADVANTAGE: LOAD-STABLE, IMMEDIATE FULL WEIGHT-BEARING

PER /SUB TROCHANTERIC FRACTURES

‘GOLD STANDARD’ – GAMMA-NAILS

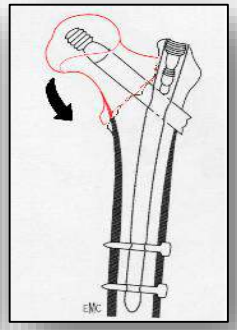


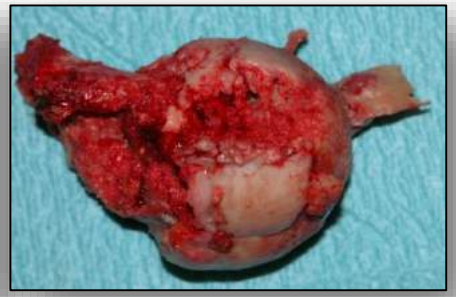


PER /SUB TROCHANTERIC FRACTURES

COMPLICATION – ‘CUT-OUT’






SUMMARY

If you are interested in, please, check the following links for further information:

1. AO / ASIF AO Foundation Transforming Surgery–Changing Lives
www.aotrauma.org: AO Surgery Reference & Online Education

2. Orthopaedic Trauma Association (OTA)
http://ota.org/about/

3. trauma.org
http://www.trauma.org/archive/traumabank.html

4. AAOS: www.aaos.org AAOS American Academy of Orthopaedic Surgeons / American Association of Orthopaedic Surgeons

5. ATLS: http://www.facs.org/trauma/atls/ American College of Surgeons Trauma Programs

AO Foundation Transforming Surgery–Changing Lives

THANKS FOR YOUR ATTENTION!