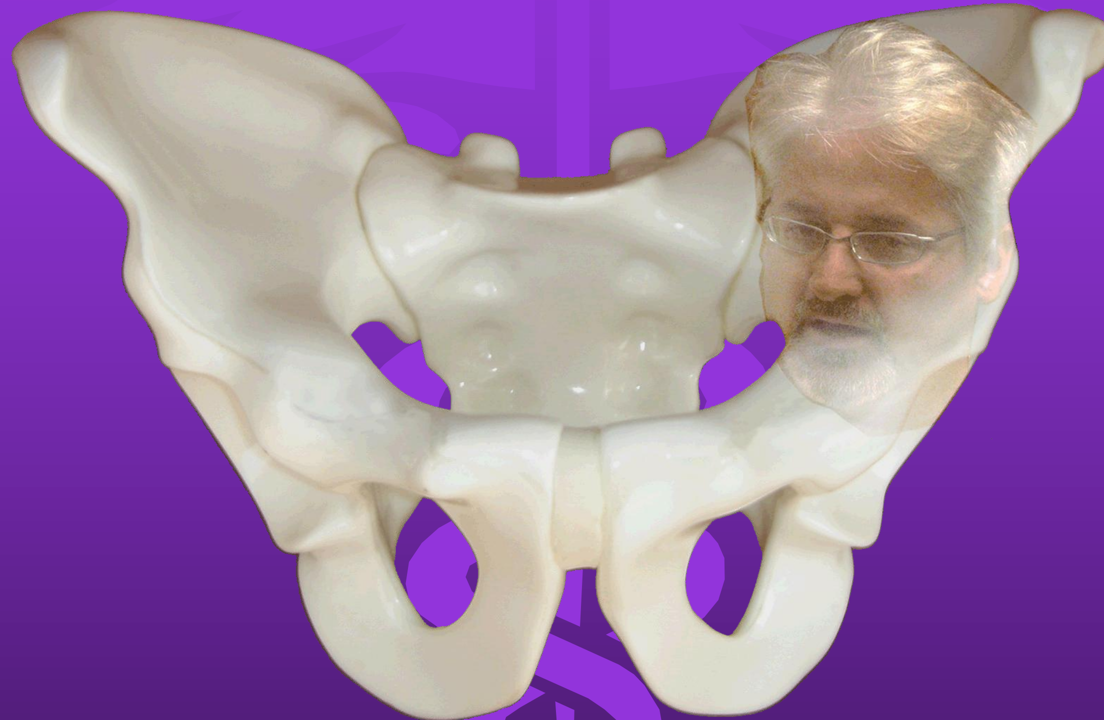
Kyle F. Dickson, M.D. M.B.A.



Professor Baylor College of Medicine
Southwest Orthopaedic Group, Houston, Texas
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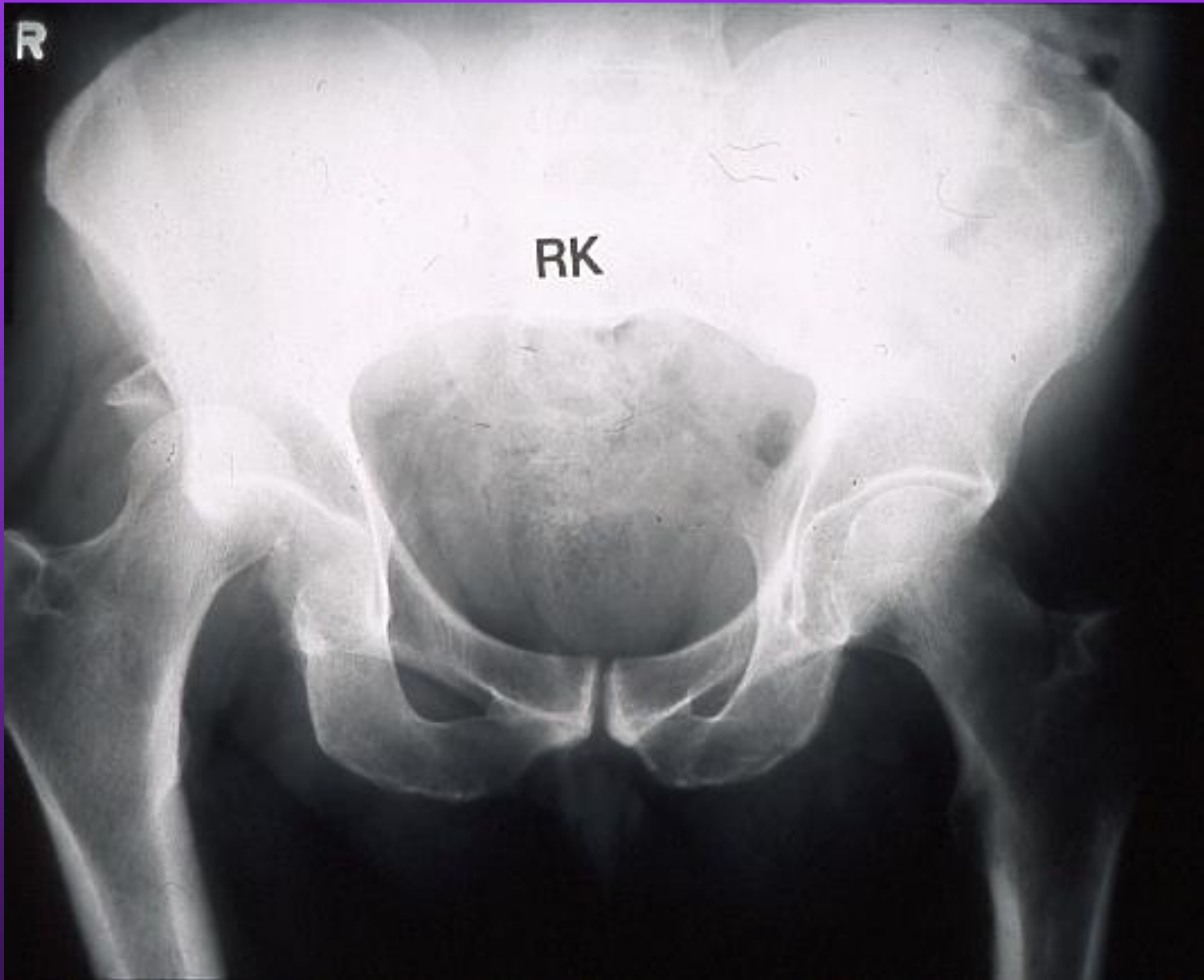
Case Presentation

Kyle Dickson MD, MBA
Clinical Professor Baylor University
Southwest Orthopadic Group, Houston, Texas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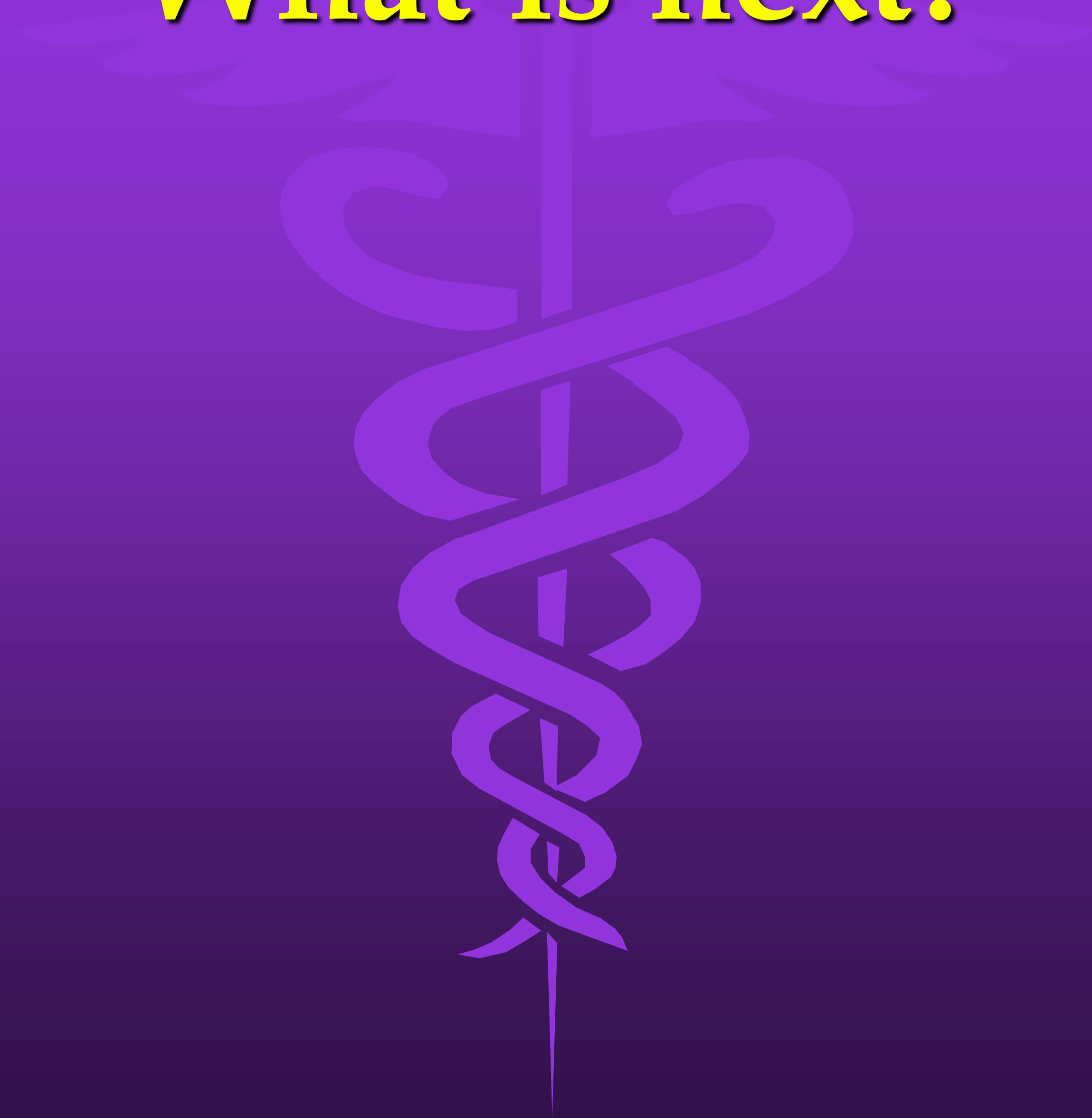
What is next?



What is next?

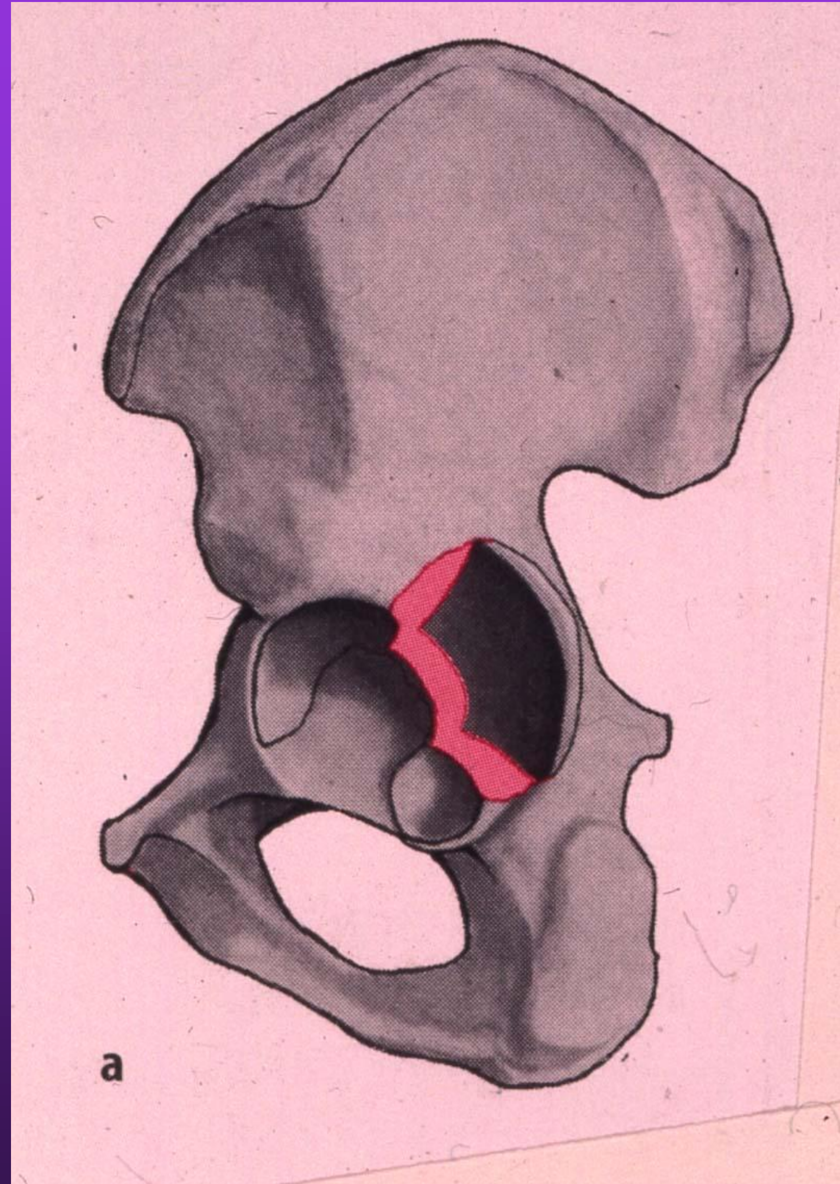
- Dislocation? What? How?
- Soft tissue issues?
- Further work up?

Letournel

- 223-23.72% of Fractures (not including associated injuries ie Tr, T-type, BC, etc.)
- 175-78.5% Simple Fracture Dislocation
- 48-21.5% Marginal Impactions Capsular Attachment (ie preserve capsule)
- 82% Good to Excellent

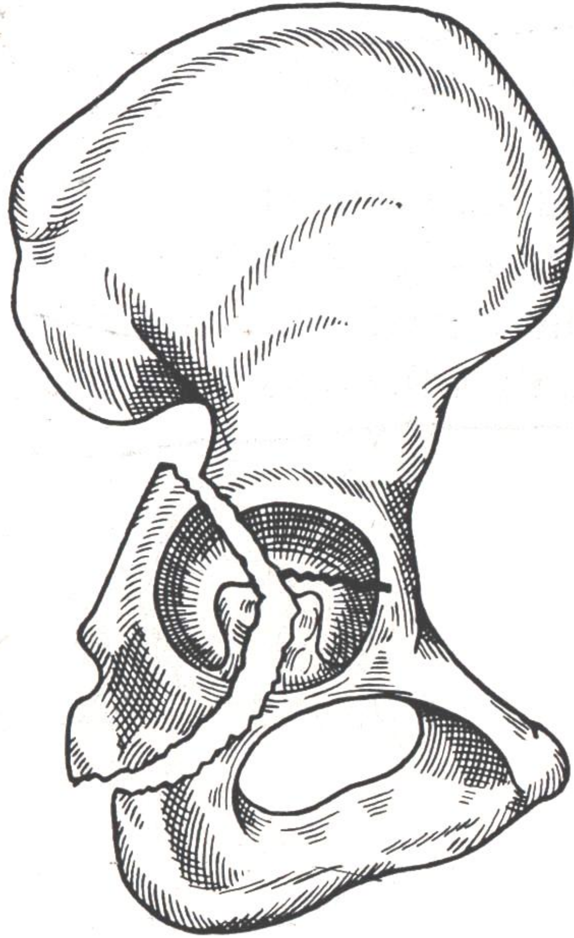
PW

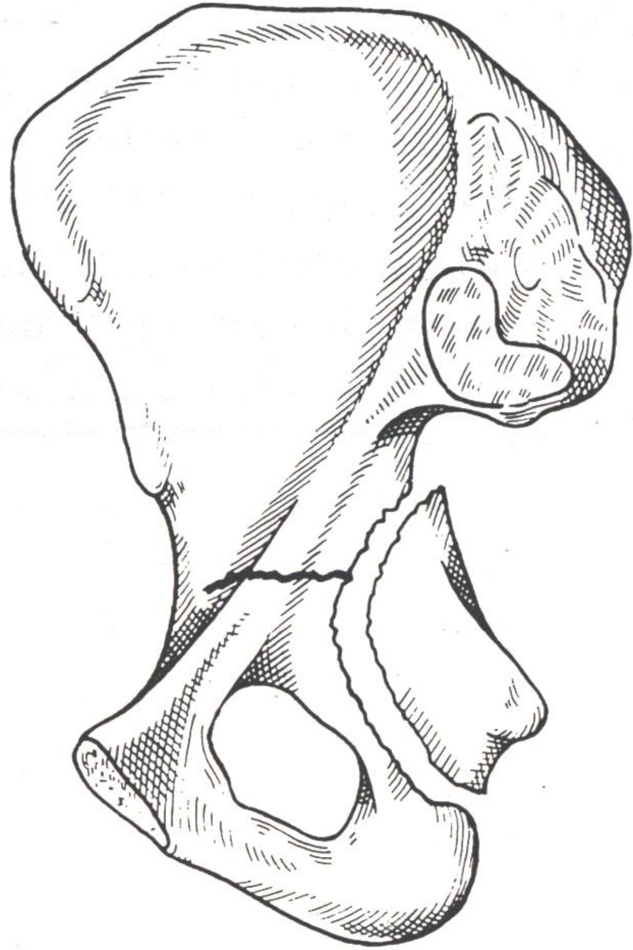
- Evaluation
- Approach
- Reduction
- Fixation
- Outcomes


a

Posterior Wall Fractures

- Involves a separation of posterior articular surface
- Majority of the posterior column is undisturbed
- Usually associated with posterior femoral head dislocation





A

Posterior Wall Fracture/Dislocation

- Sciatic nerve cut, bruised or in the fracture line
- More likely to have abnormal pre-op somatosensory evoked potentials (SSEP)
- Reflex Sympathetic Dystrophy (RSD)

Avascular Necrosis (AVN) of Femoral Head

- Reported as high as 30%
- Letournel and Matta 3-4%
- Wear can cause rapid destruction of the head
- Need head collapse with maintenance of joint space for AVN

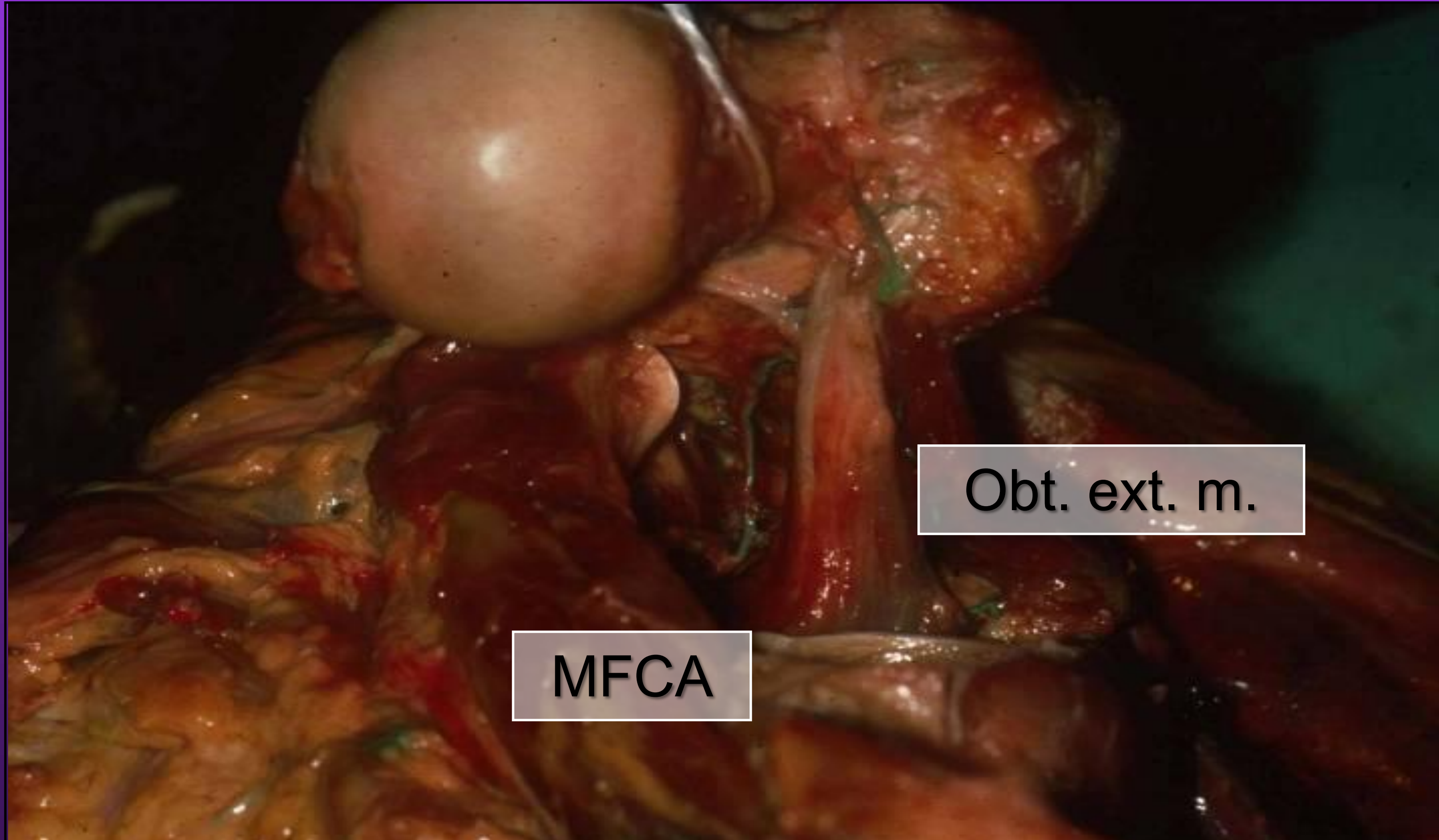
Vascular Anatomy

- Ascending branch of medial circumflex
  - Main blood supply to femoral head
  - Deep to quadratus, obt. internus, and piriformis, superficial to obt. externus

Vascular (cont.)

- Can be damaged with
  - Dislocation of femoral head
  - Taking down quadratus from femur instead of ischium
  - Not leaving 1 cm tag for piriformis and obt. internus

Obt. ext. muscle protects MFCA

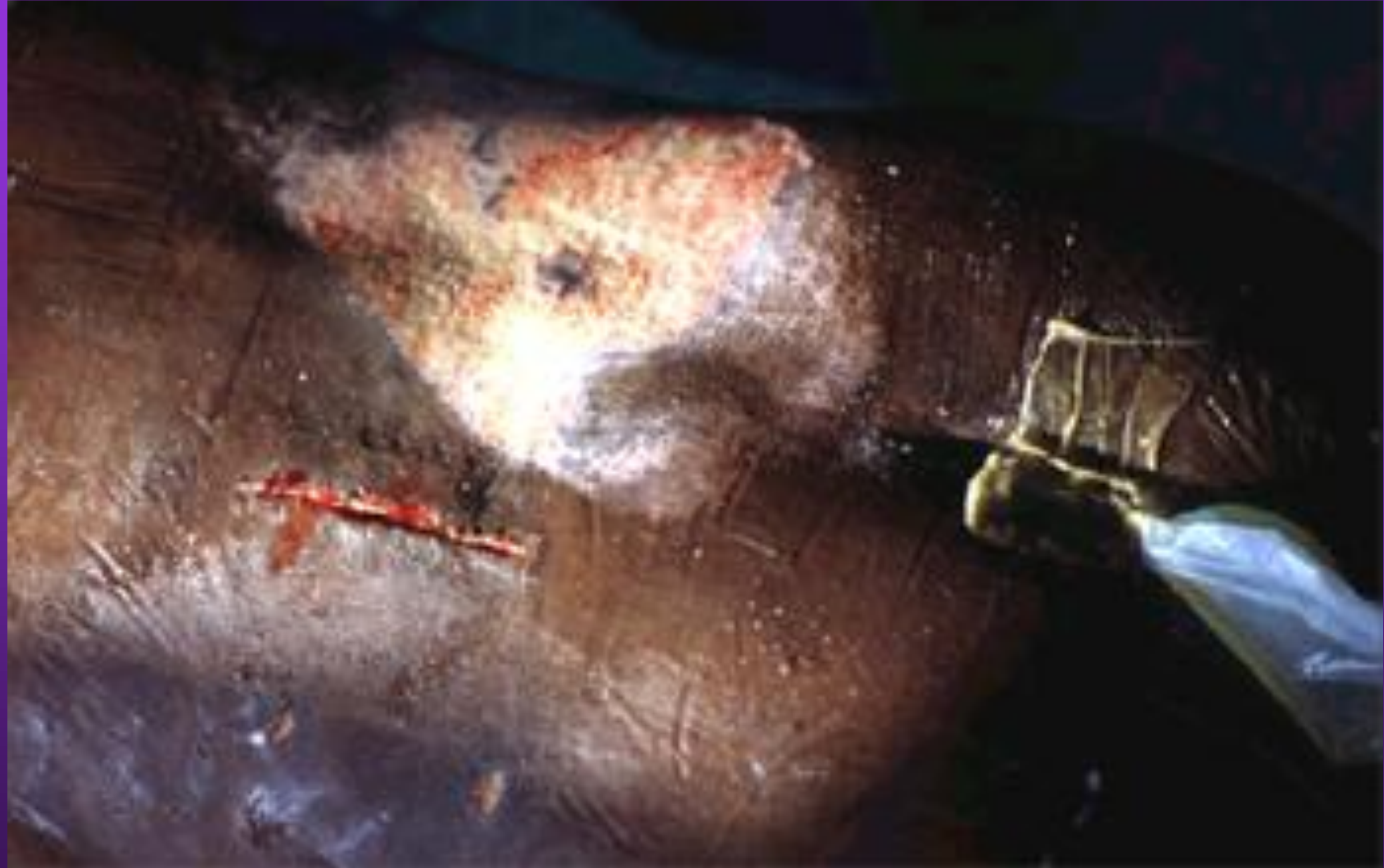


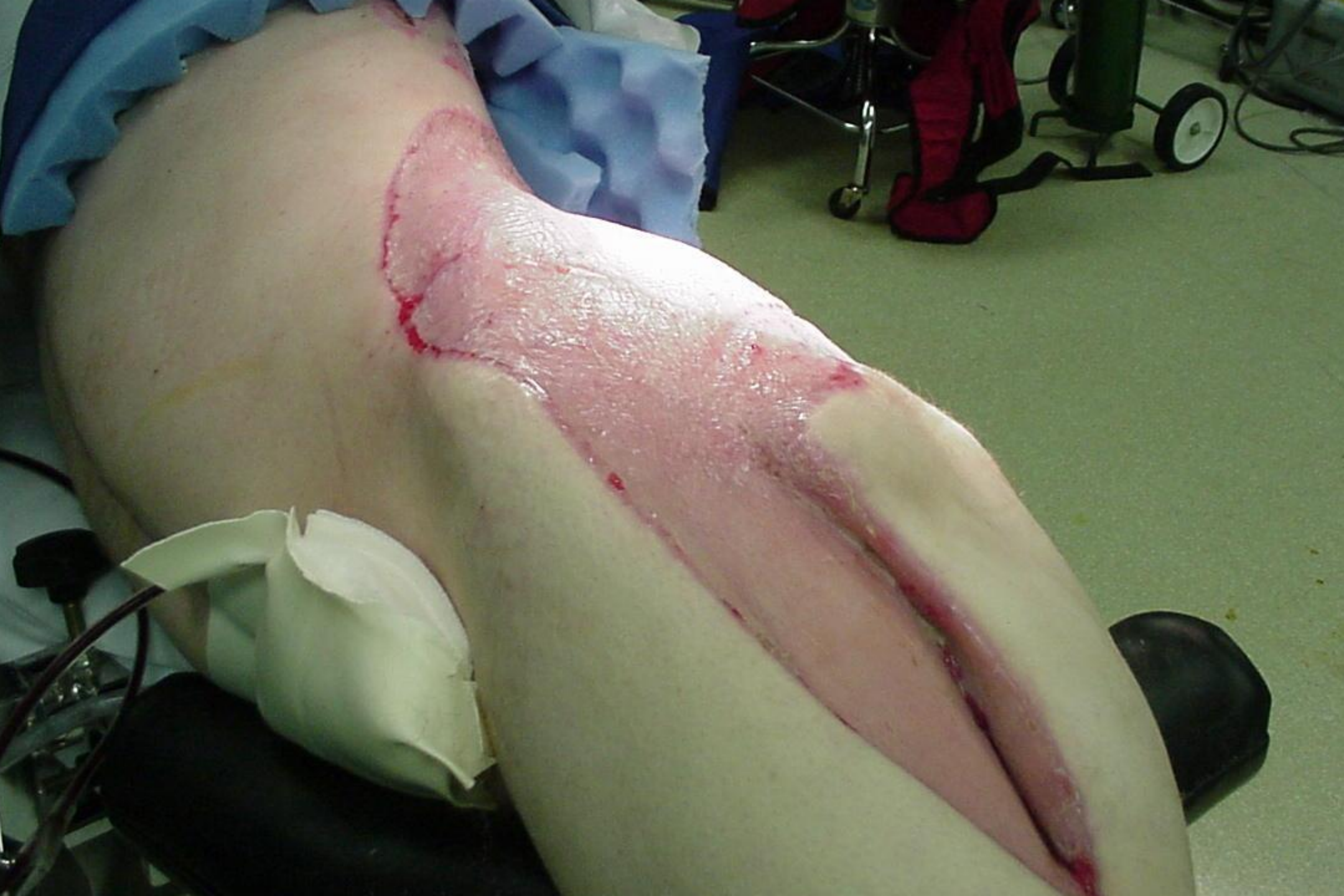
Gautier et al., *JBJS*, **82-B:**679, 2000.

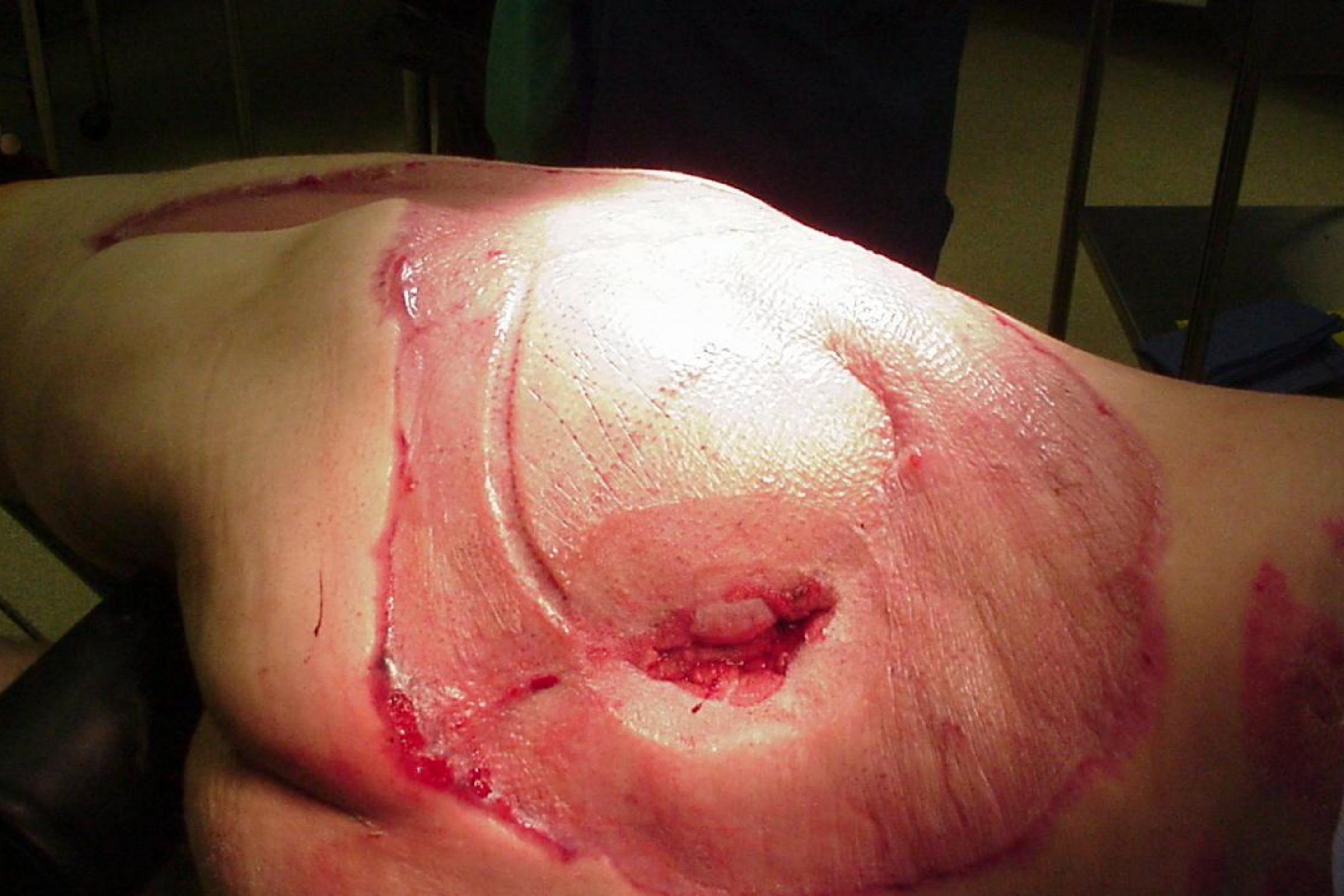
MOREL – LAVALLE’ LESION (Skin Degloving)

- Infected in 1/3 of cases
- Require thorough debridement prior to definitive surgery

Example of Small Inadequate Debridement with Subsequent Infection

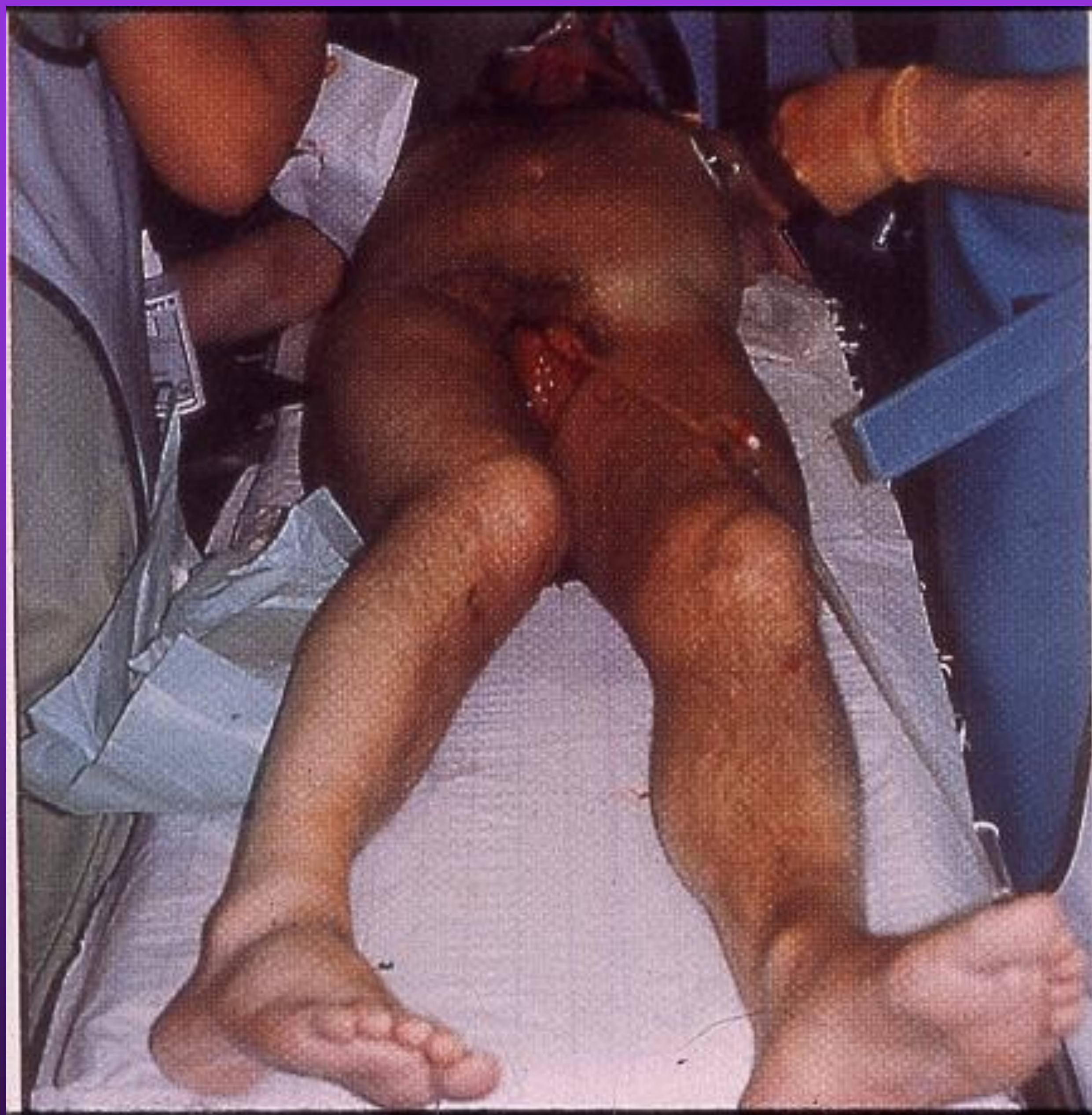


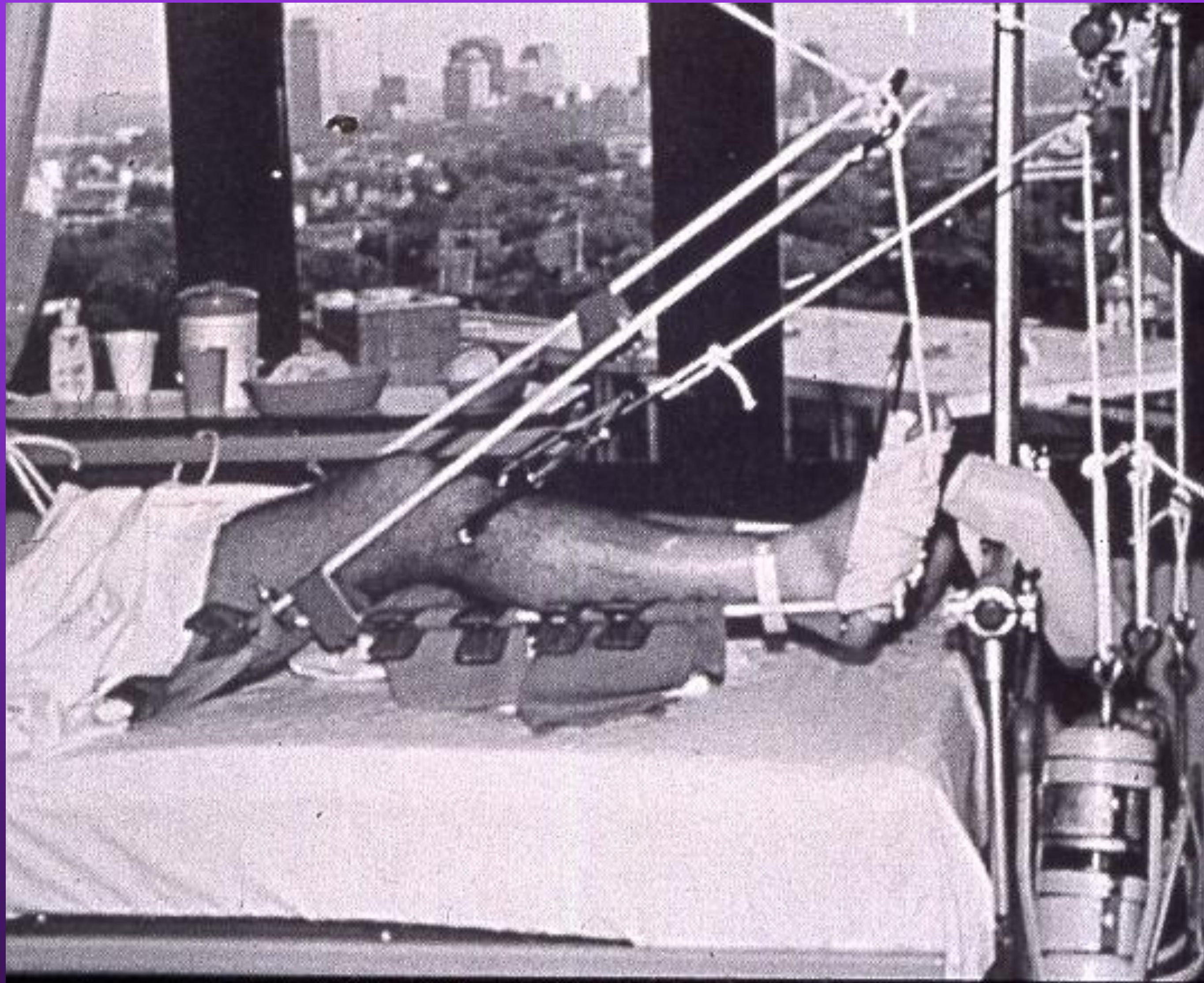




Clinical Evaluation

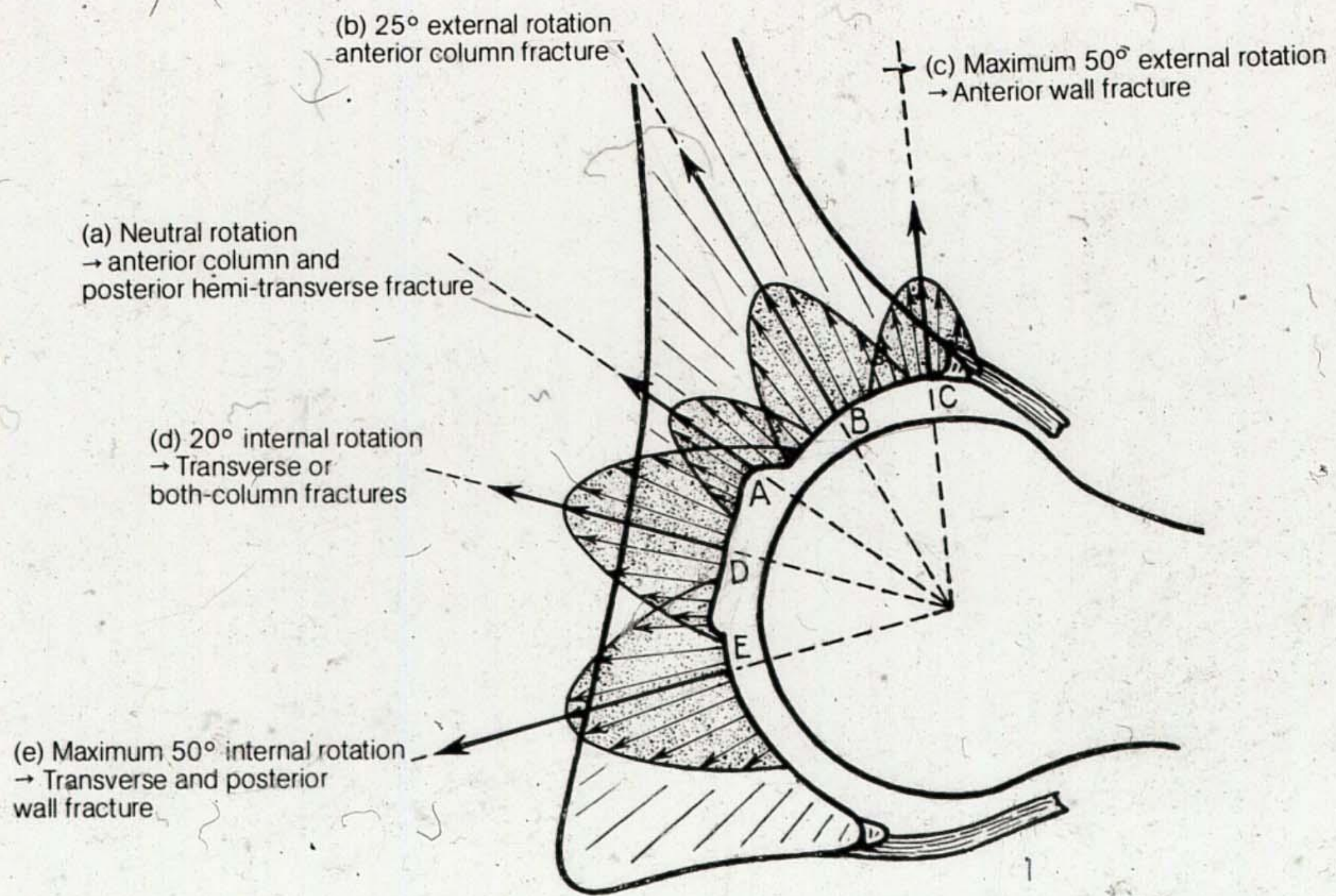
- Nerve Injury
  - Damage to sciatic nerve with posterior wall, posterior column, or transverse fractures
- Dislocation
  - ? Stretch on the ascending branch of medial circumflex artery

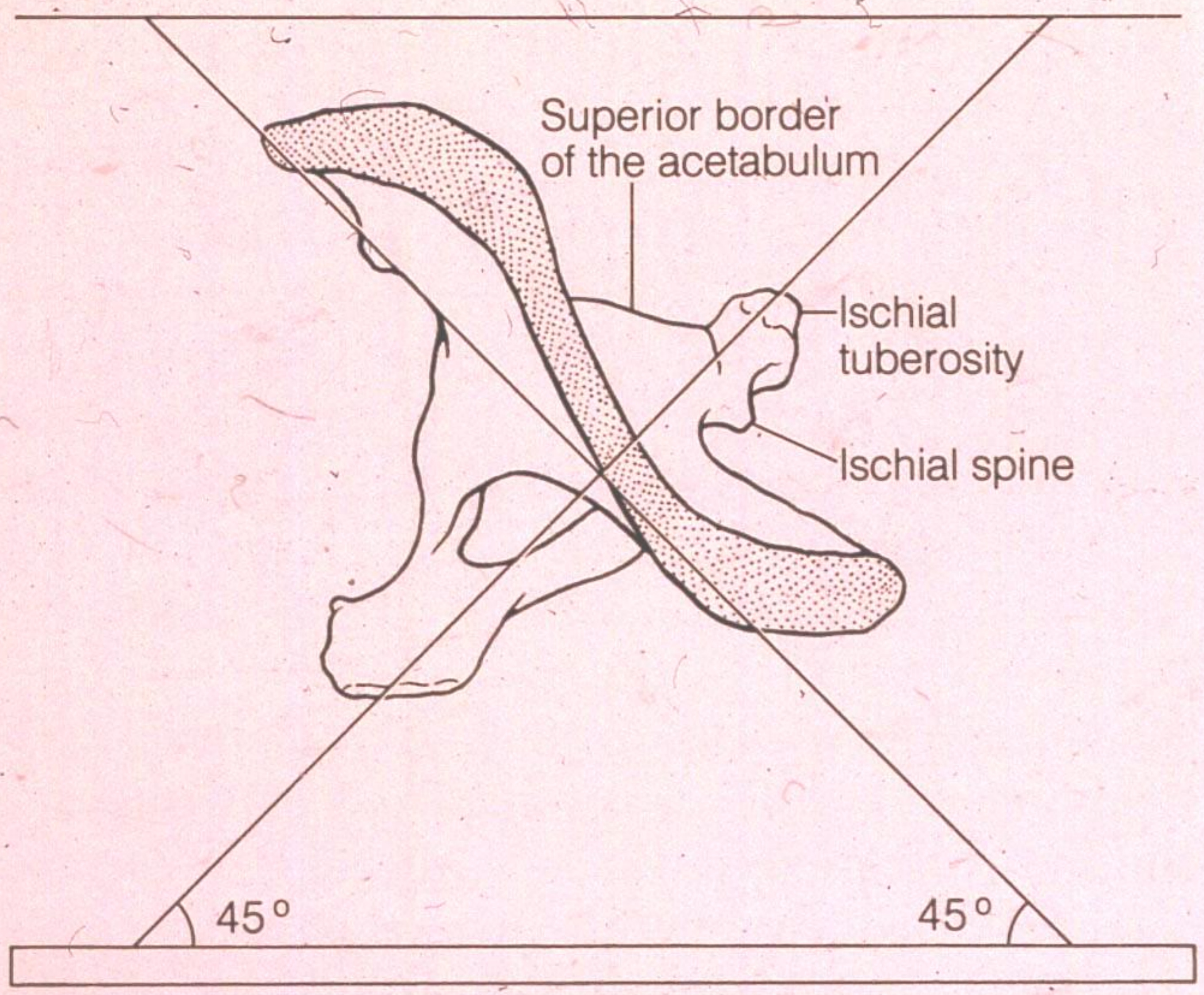


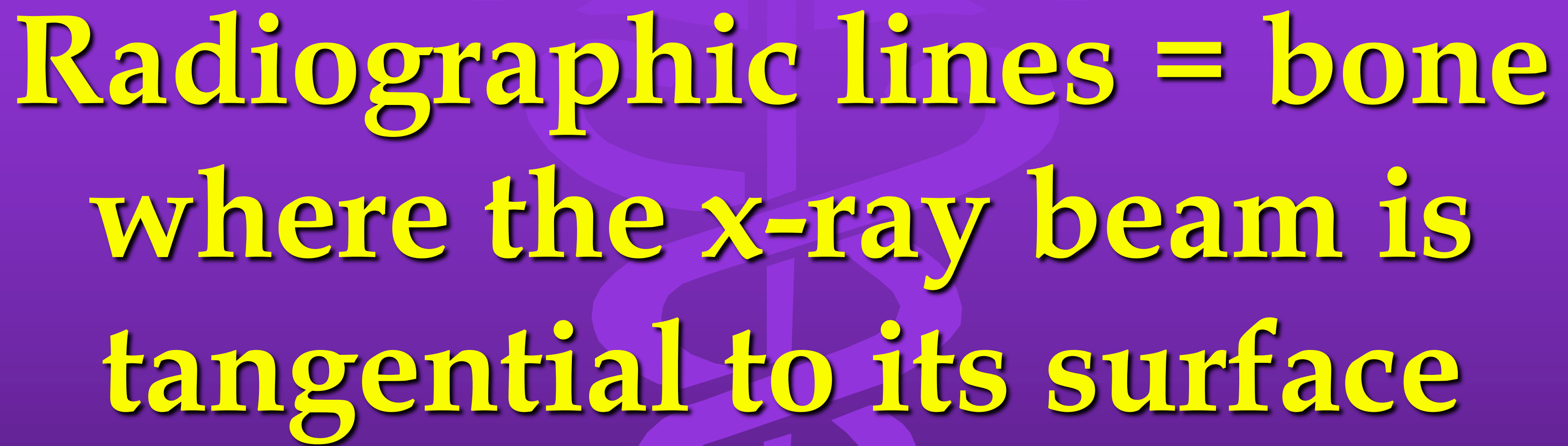


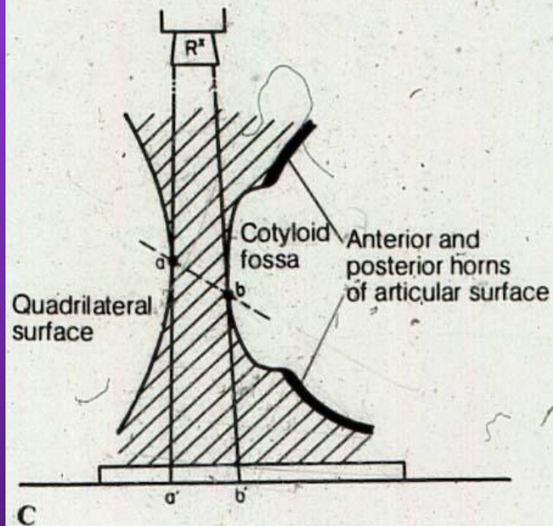
Anatomy

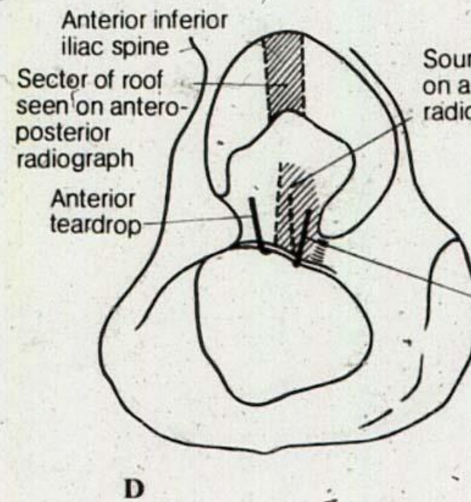
- Judet and Letournel, JBJS 1965
  - Inverted "Y" two column concept
  - Classification system

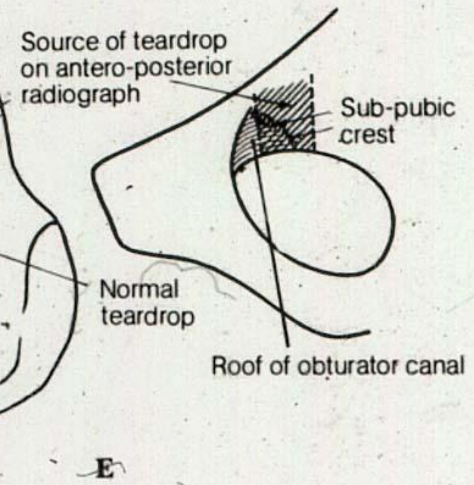

(b) 25° external rotation
anterior column fracture
(c) Maximum 50° external rotation
→ Anterior wall fracture
(a) Neutral rotation
→ anterior column and
posterior hemi-transverse fracture
(d) 20° internal rotation
→ Transverse or
both-column fractures
(e) Maximum 50° internal rotation
→ Transverse and posterior
wall fracture
A
B
C
D
E

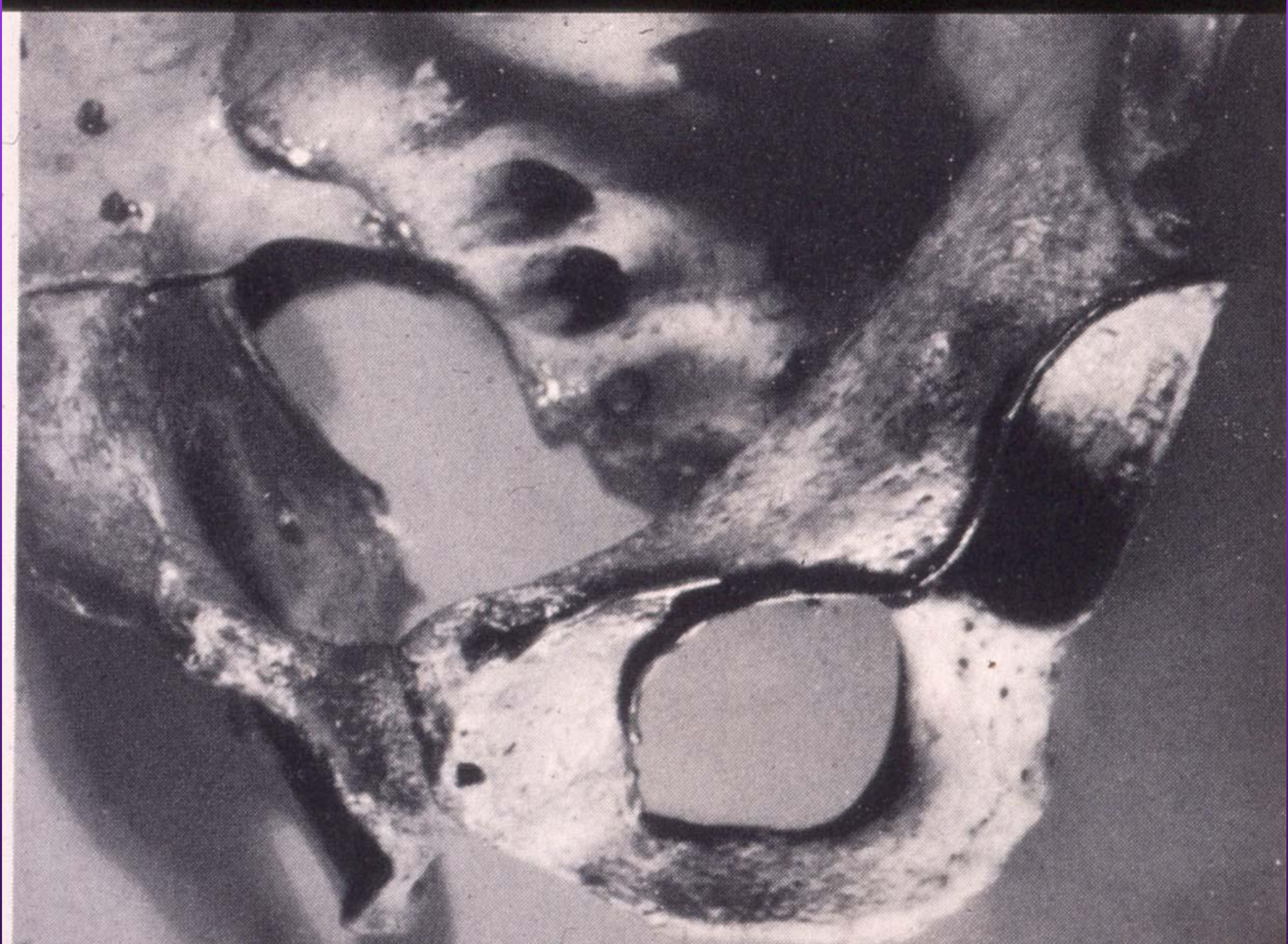

Superior border
of the acetabulum
Ischial
tuberosity
Ischial spine
45°
45°

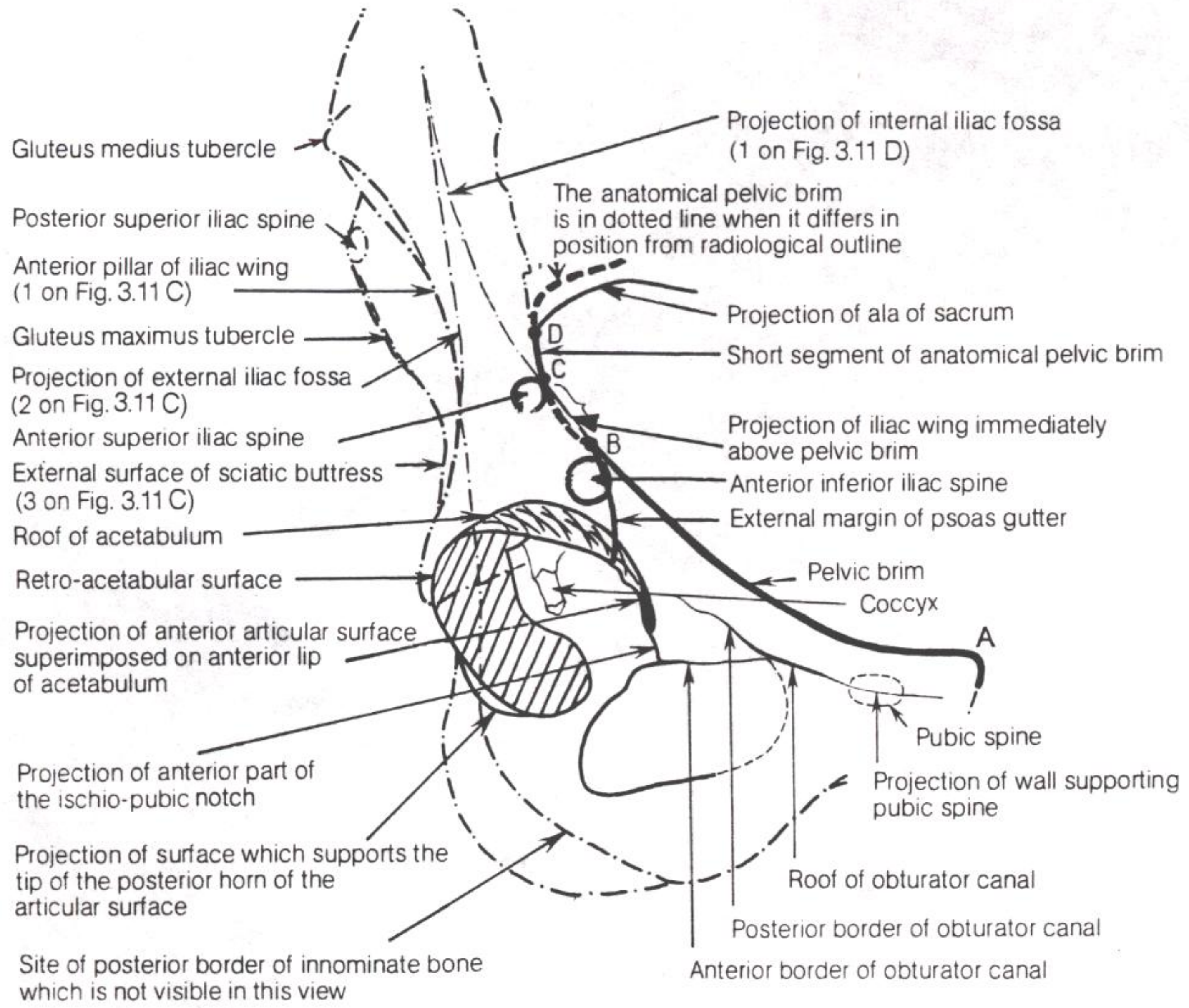

Radiographic lines = bone where the x-ray beam is tangential to its surface


R^x
Cotyloid fossa
Anterior and posterior horns of articular surface
Quadrilateral surface
a
b
a'
b'
C

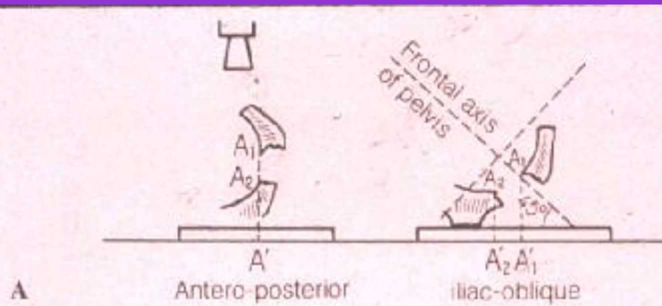

Anterior inferior iliac spine
Sector of roof seen on antero-posterior radiograph
Anterior teardrop
Normal teardrop
D

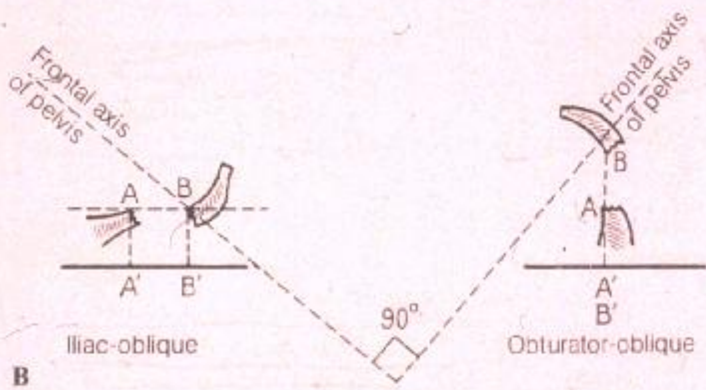

Source of teardrop on antero-posterior radiograph
Sub-pubic crest
Roof of obturator canal
E

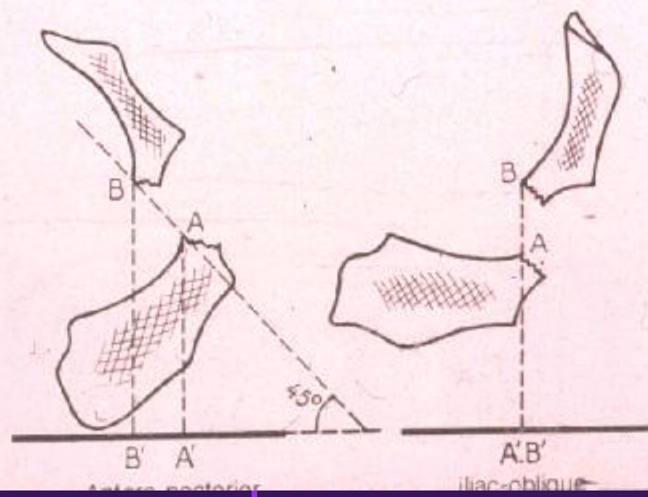


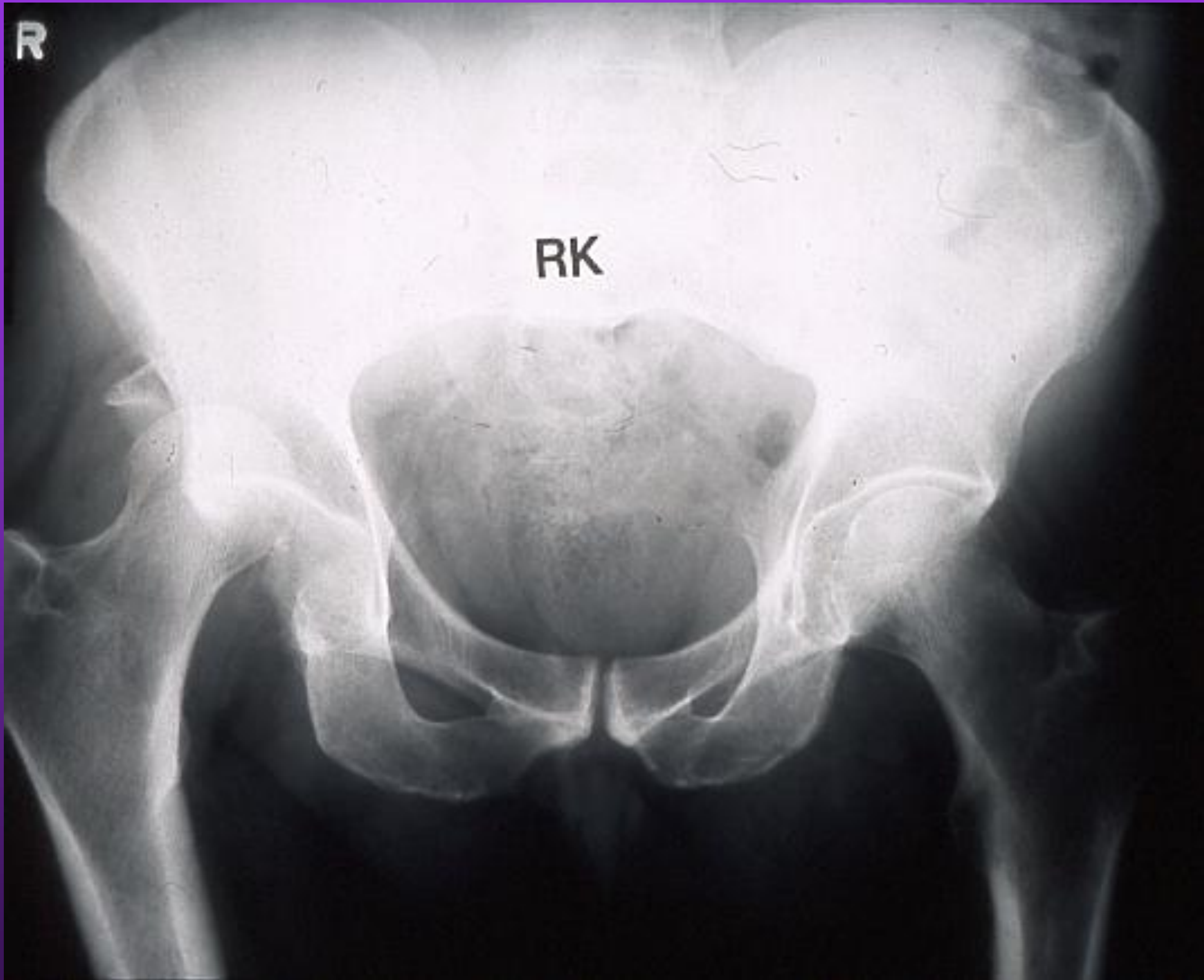


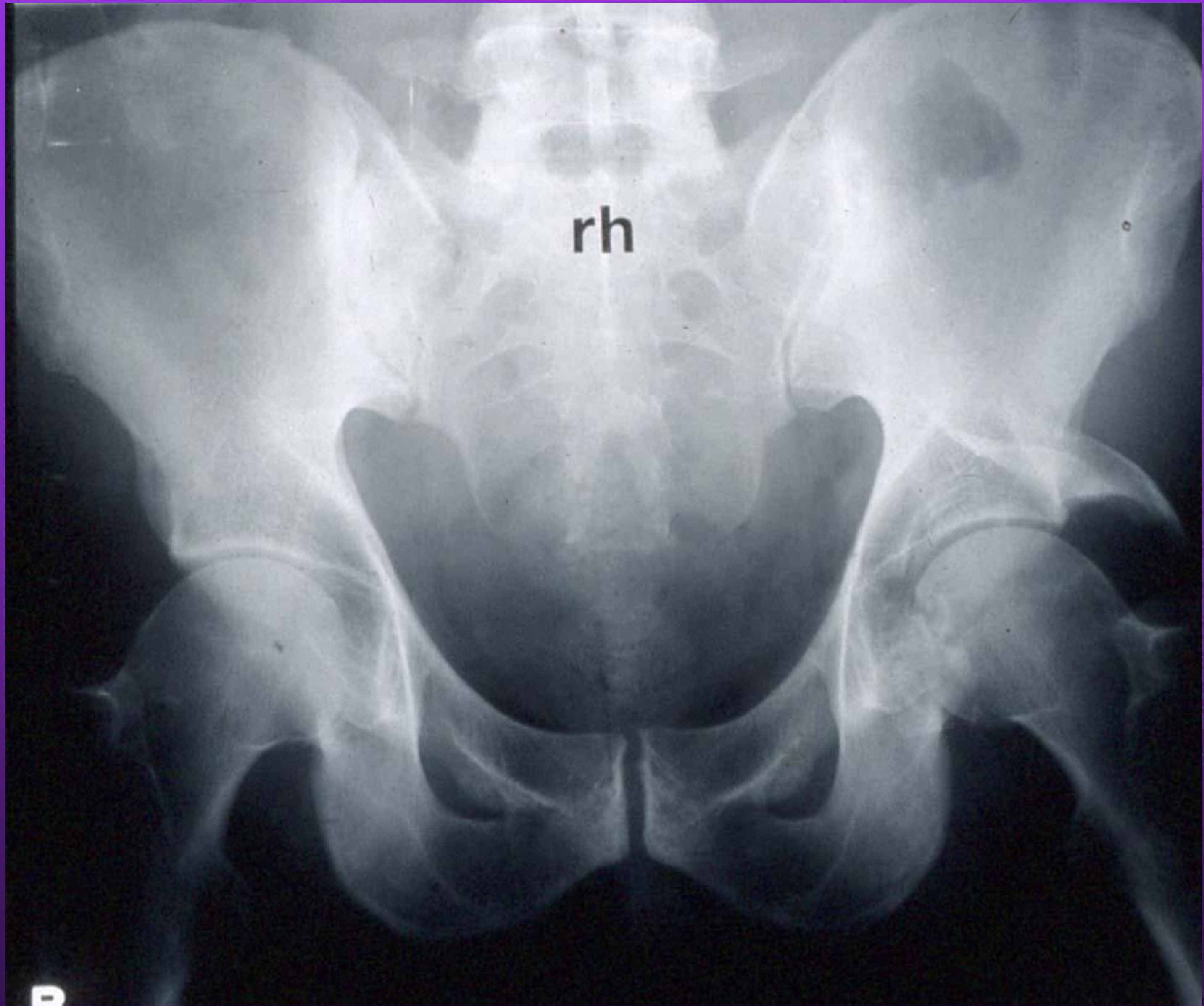
Gluteus medius tubercle
Posterior superior iliac spine
Anterior pillar of iliac wing
(1 on Fig. 3.11 C)
Gluteus maximus tubercle
Projection of external iliac fossa
(2 on Fig. 3.11 C)
Anterior superior iliac spine
External surface of sciatic buttress
(3 on Fig. 3.11 C)
Roof of acetabulum
Retro-acetabular surface
Projection of anterior articular surface
superimposed on anterior lip
of acetabulum
Projection of anterior part of
the ischio-pubic notch
Projection of surface which supports the
tip of the posterior horn of the
articular surface
Site of posterior border of innominate bone
which is not visible in this view
Projection of internal iliac fossa
(1 on Fig. 3.11 D)
The anatomical pelvic brim
is in dotted line when it differs in
position from radiological outline
Projection of ala of sacrum
D
Short segment of anatomical pelvic brim
C
Projection of iliac wing immediately
above pelvic brim
B
Anterior inferior iliac spine
External margin of psoas gutter
Pelvic brim
Coccyx
A
Pubic spine
Projection of wall supporting
pubic spine
Roof of obturator canal
Posterior border of obturator canal
Anterior border of obturator canal

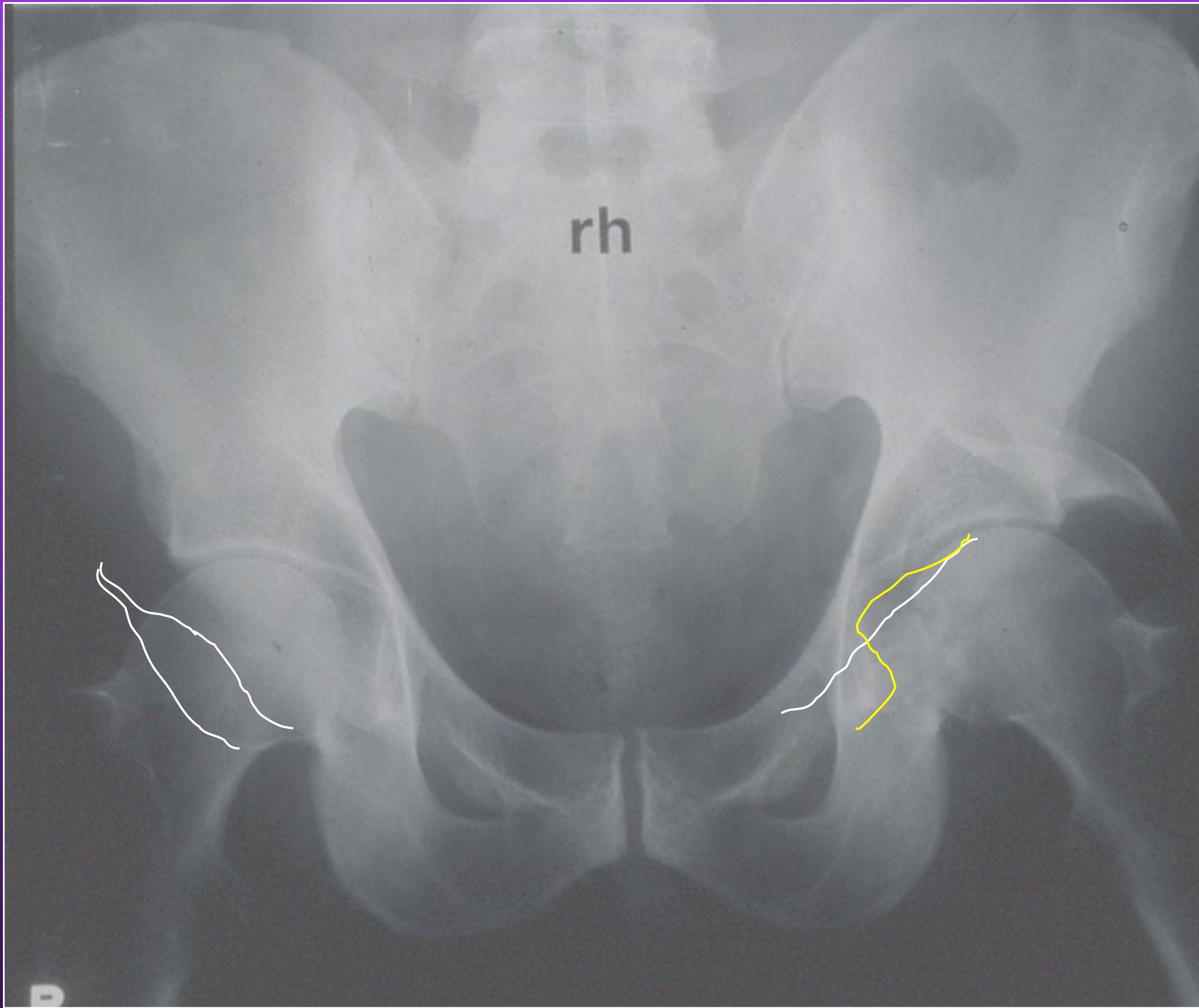

Frontal axis
of pelvis
A_1
A_2
45°
A'
A'_2 A'_1
A
Antero-posterior
Iliac-oblique


Frontal axis
of pelvis
A
B
A'
B'
90°
Iliac-oblique
Obturator-oblique
B


B
A
45°
B'
A'
A'.B'


R
RK


rh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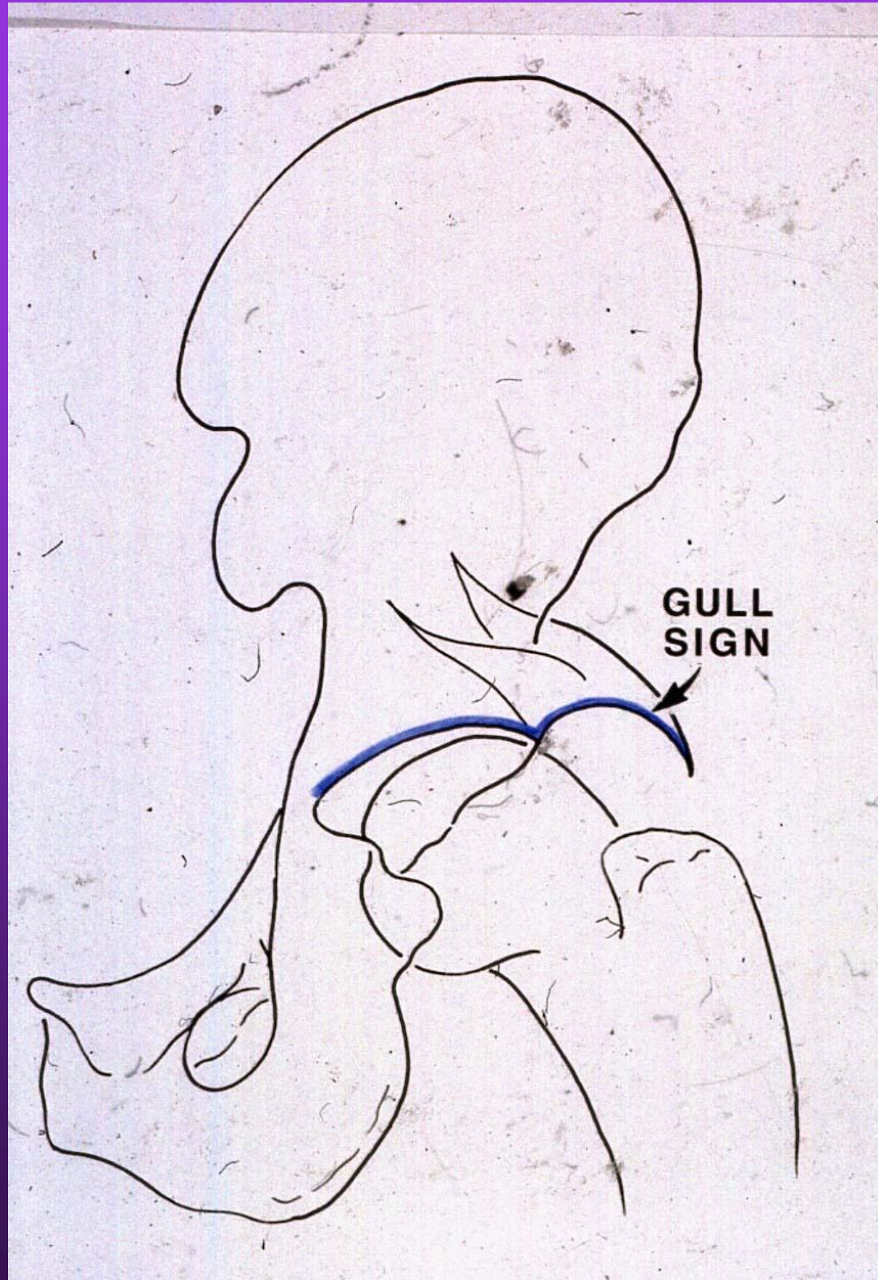
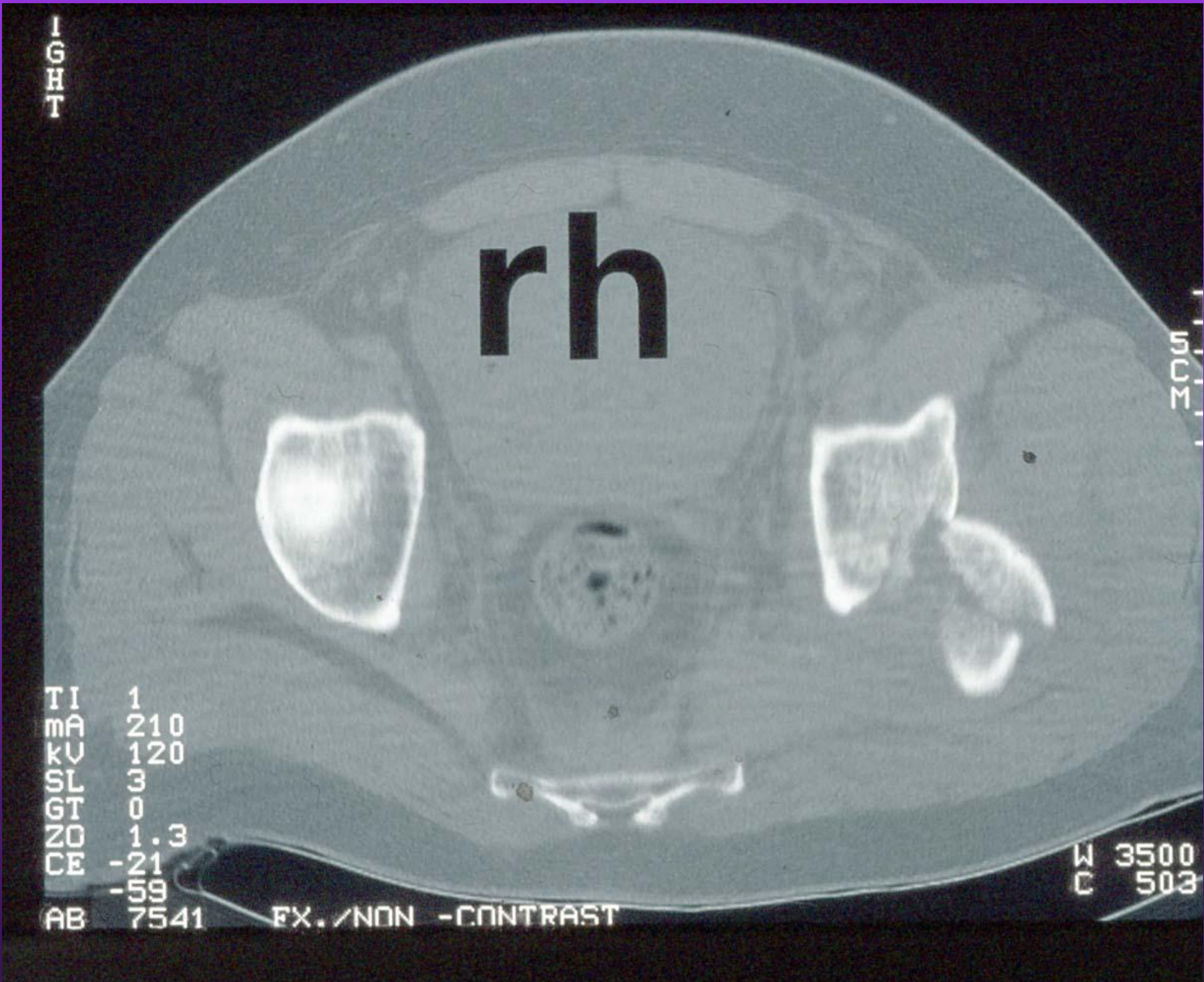
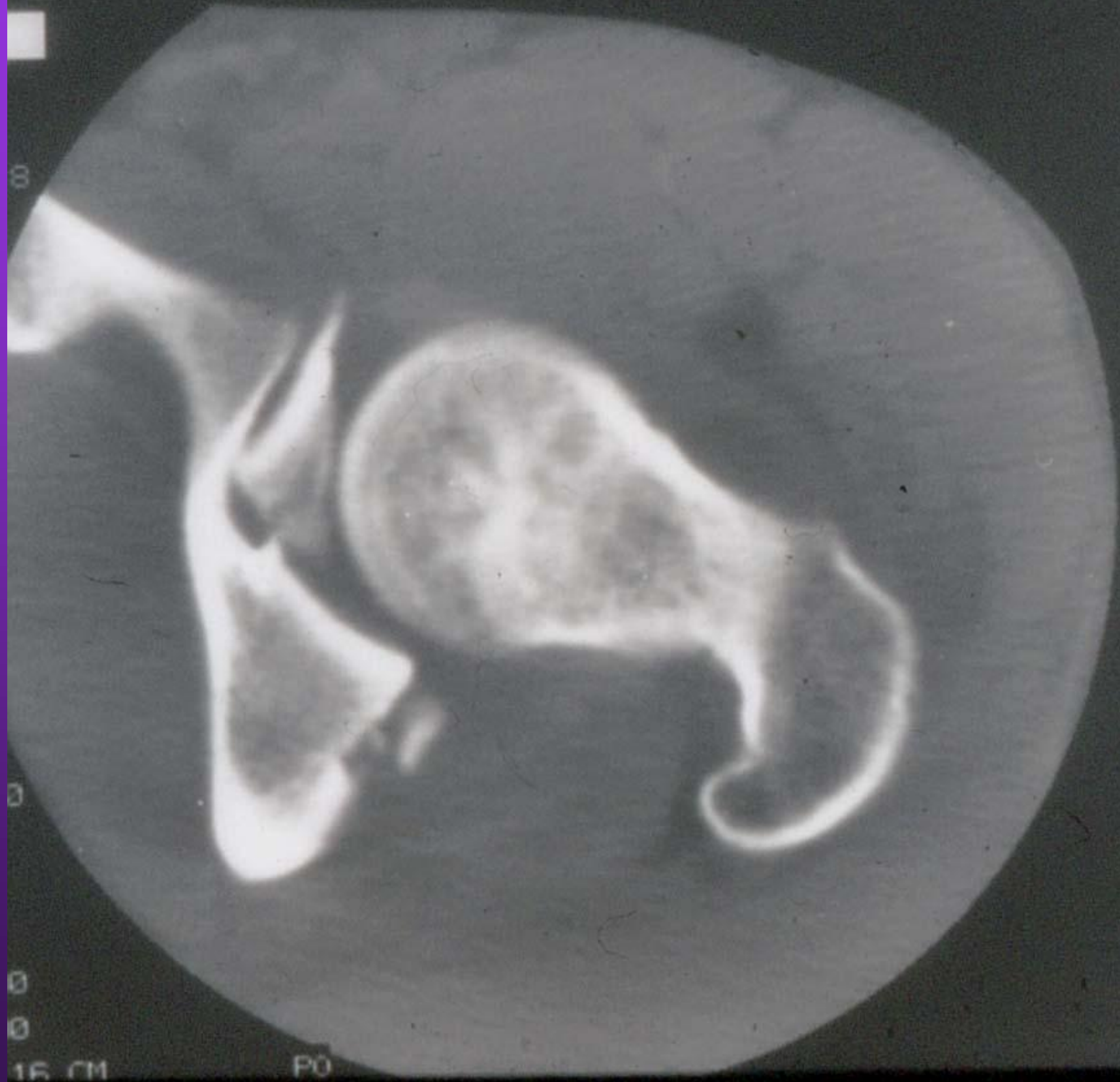

GULL
SIGN

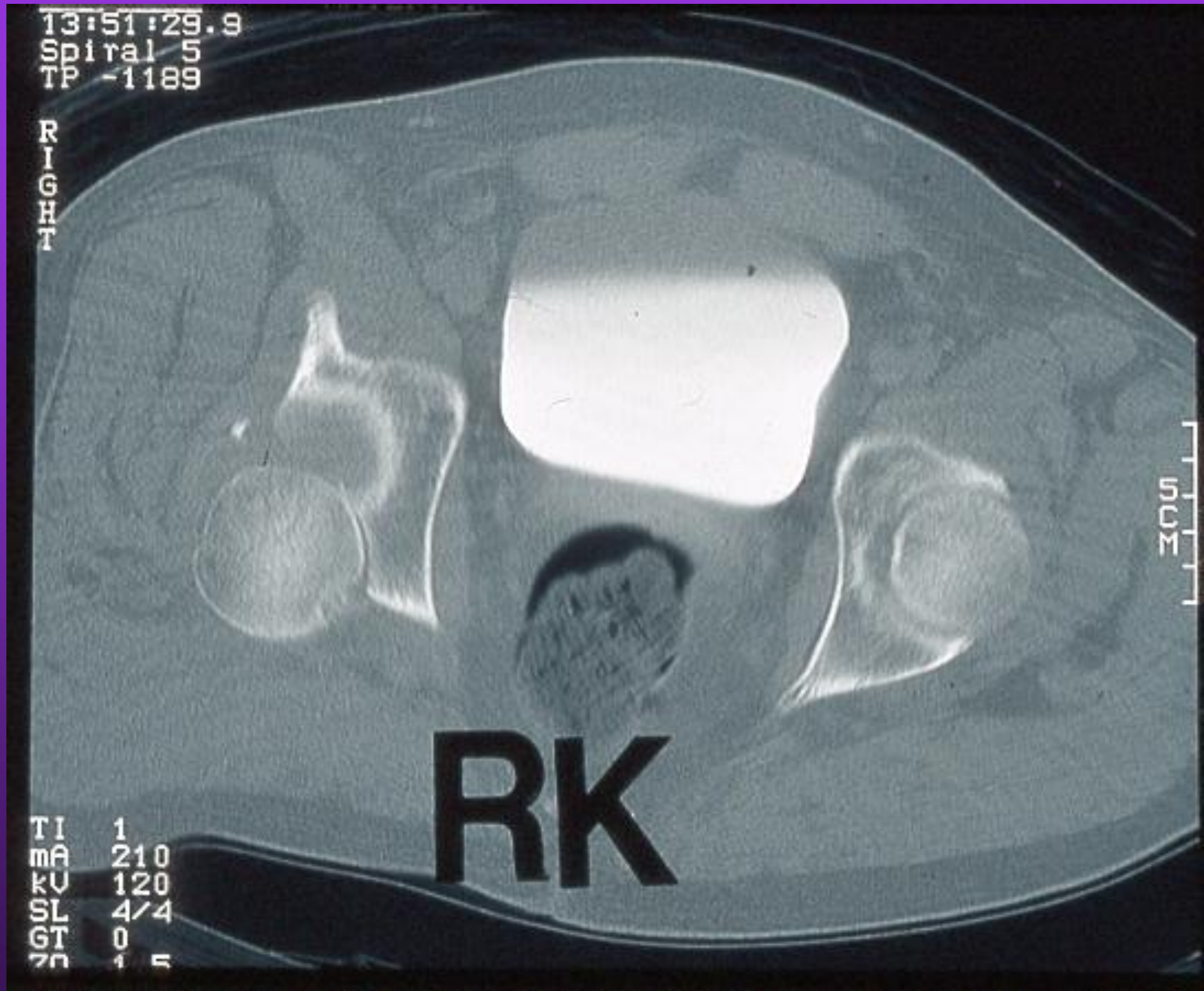
CT Scans

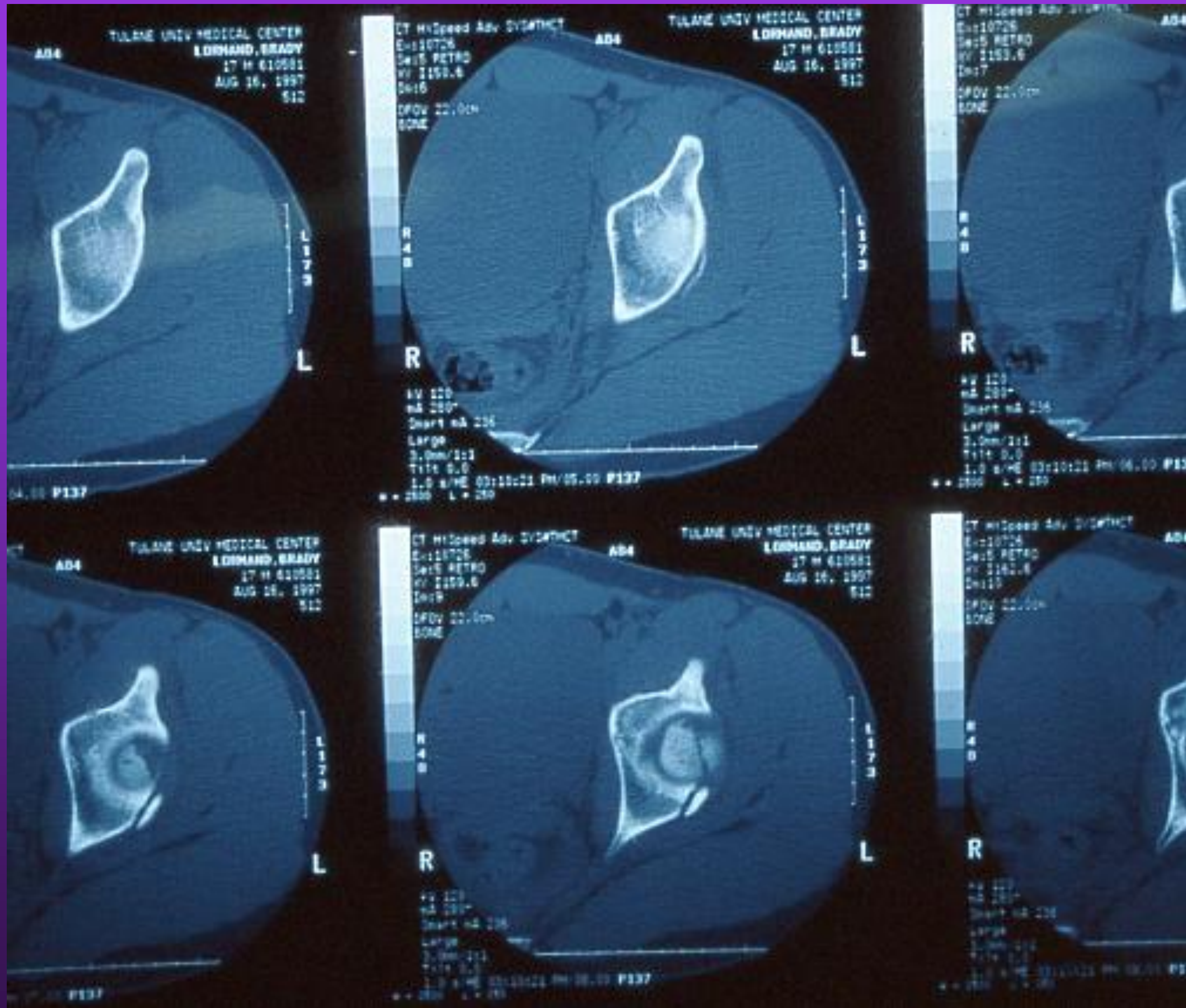
- Detection of marginal impaction
- Detection of intraarticular fragments
- Detection of femoral head fractures
- Assessment of hip joint reduction – congruency
- Orientation of fracture line


rh
IGHT
5 CM
TI 1
mA 210
kV 120
SL 3
GT 0
ZO 1.3
CE -21
-59
AB 7541
FX./NON -CONTRAST
W 3500
C 503



5 00
0
8 LAC/USC MED CTR
PICKER INTL 1200SX
EDUARDO
16 CM
PO


13:51:29.9
Spiral 5
TP -1189
RIGHT
5CM
TI 1
mA 210
kV 120
SL 4/4
GT 0
RK


TULANE UNIV MEDICAL CENTER
LORMAND, BRADY
AUG 16, 1997
512
A04
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P137

CT Scans

- Identification of fracture lines not visualized by radiographs
- Assessment of fracture comminution
- Assessment of associated pelvic ring injuries

CT Scans

- Assessment of sacral fractures
- Assessment of sacroiliac joint disruptions
- Size of posterior wall
- Vertical portion of “T” type acetabular fracture
- Rotation of fracture fragments

Closed Treatment

- Traction
  - Rarely indicated because rarely successful
  - If done, displaced without traction → ORIF
  - If non-displaced, traction is not needed
- Non-displaced fracture TDWB x 8 weeks
  - Watch posterior column/posterior wall carefully

Indications for ORIF

- Displaced acetabular fractures (roof arc <45°, <10mm dome)
  - > 1 mm
  - subluxation
- Lack of secondary congruence in both columns
- 20 - 40% posterior wall displacement

Security / 85531
Emergency / 55555
HOLD
MUTE
SPKR

GSC
Serving Science and Industry since 1932
8

Operative Strategy

I. Preop plan (classify, draw, choose approach)

II. Approach (know the anatomy of approach and fracture, limitations)

Operative Strategy (cont.)

III. Reduction (table, clamp design, and placement)

IV. Provisional fixation with lag screws and “adequate” stabilization”

Brown 1988 Articular Step-off Tibial Plateau

- Substantial increase in peak pressure >1.5mm
- Variations in tolerance (.25mm – 3mm)
- Sensitivity to step-off correlates with cartilage thickness

Marsh, JBJS 2002

Articular Fractures: Does an Anatomic Reduction Really Change the Result?

(AOA Symposium 2001)

Factors Influencing Remodeling of Articular Cartilage

- Age (cartilage cells less responsive to injury)
- Joint shape and location within the joint
- Cartilage thickness

Factors cont.

- Biologic and mechanical properties of the cartilage and joint
- Amount of initial joint damage
- Congruency and reduction

Can a Perfect Reduction be Obtained?

Acetabulum Preload

Olson 1996

Poor Results

- > 1 mm fracture displacement
- Hip joint incongruence
- Injury to femoral head/elderly
- impaction

2 Components of Reduction

- Fracture reduction
- Femoral head congruence in acetabulum (?marginal impaction)

Intraoperative

- Good quality c-arm
- Look for obliquity that shows worst reduction
- Be willing to take everything down

Assessment

- Every radiographic landmark that was broken must be studied for step-off and gap (i.e. iliopectineal line, … etc.) on ALL three views
- Check congruency of femoral head in acetabulum on ALL three views

Remember

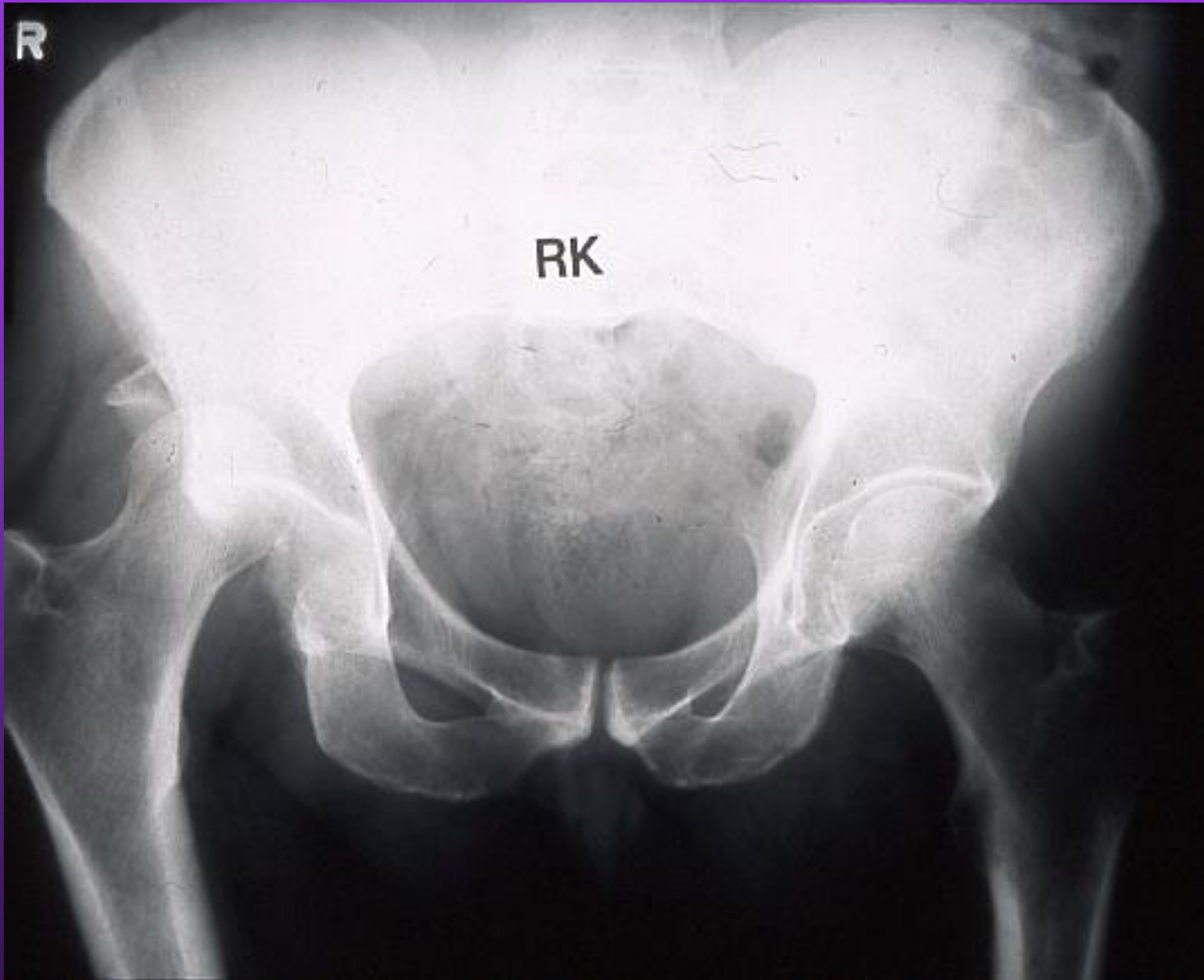
- It will not look better tomorrow
- Xrays never lie

Post-op Assessment

- 5 views of the pelvis (whole pelvis, quality)
- If concerned (obesity, stepoff on cortex, T-types or BC with staged approach) CT scan
- > 800 cases – 4 cases returned to OR for poor reduction, 1 case refused (3 excellent and 2 poor results > 2 yr. f.u.)

Moed CORR 2000

- 92/94 (99%) anatomical reduction plain films
- 44/59 (75%) CT scan >2mm fracture gap
- >1cm risk factor for poor results(17/59-29%)
- ?location of injury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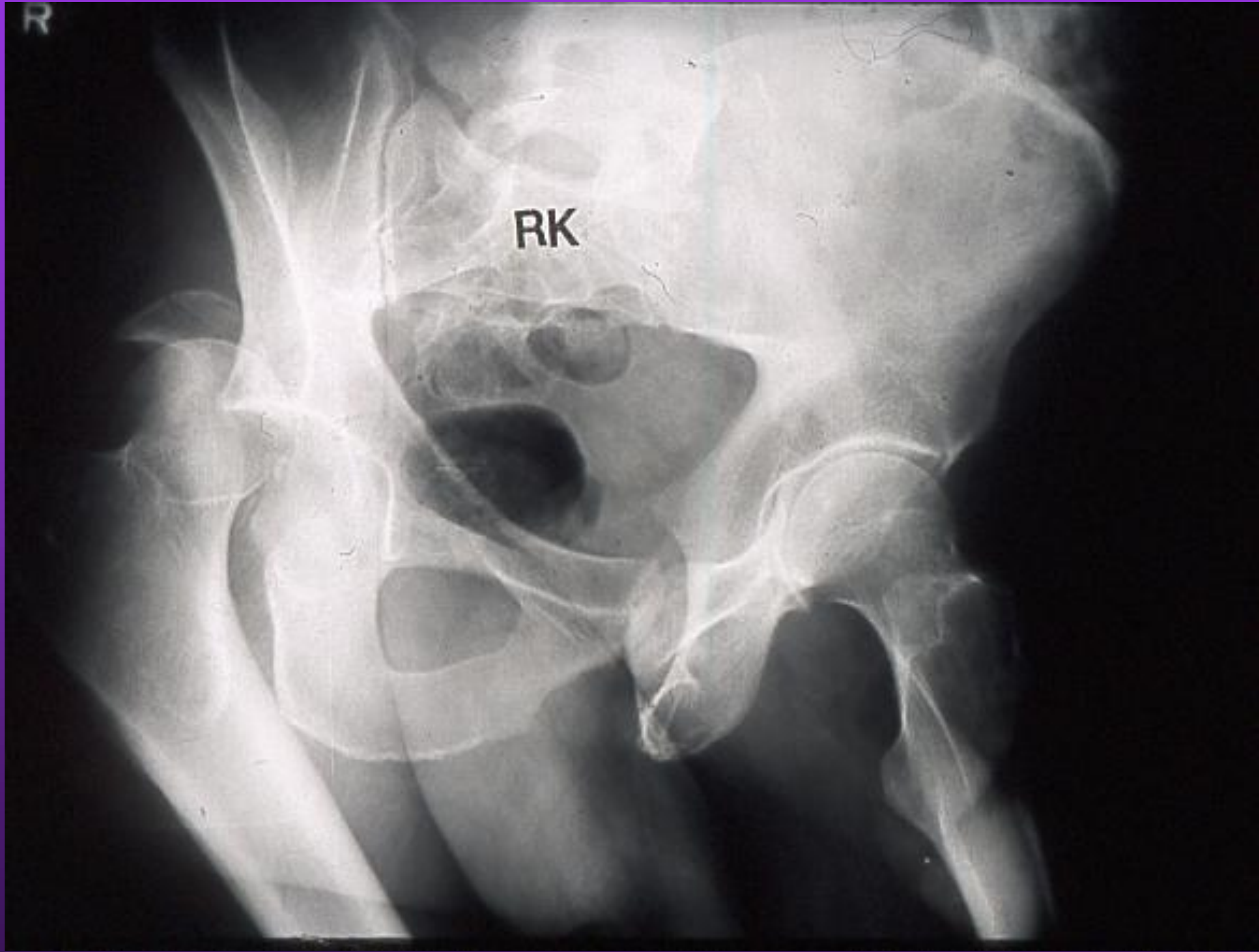
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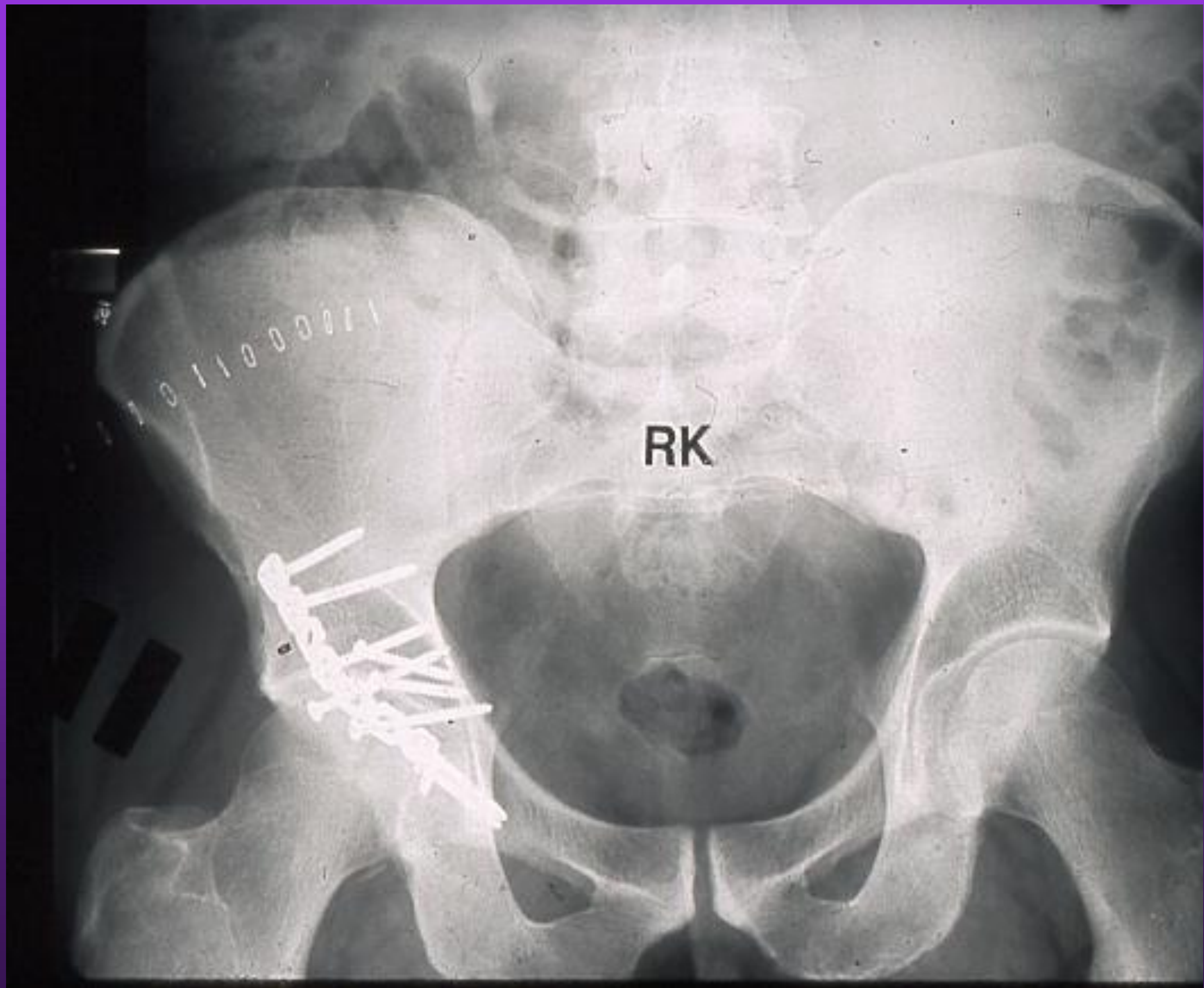
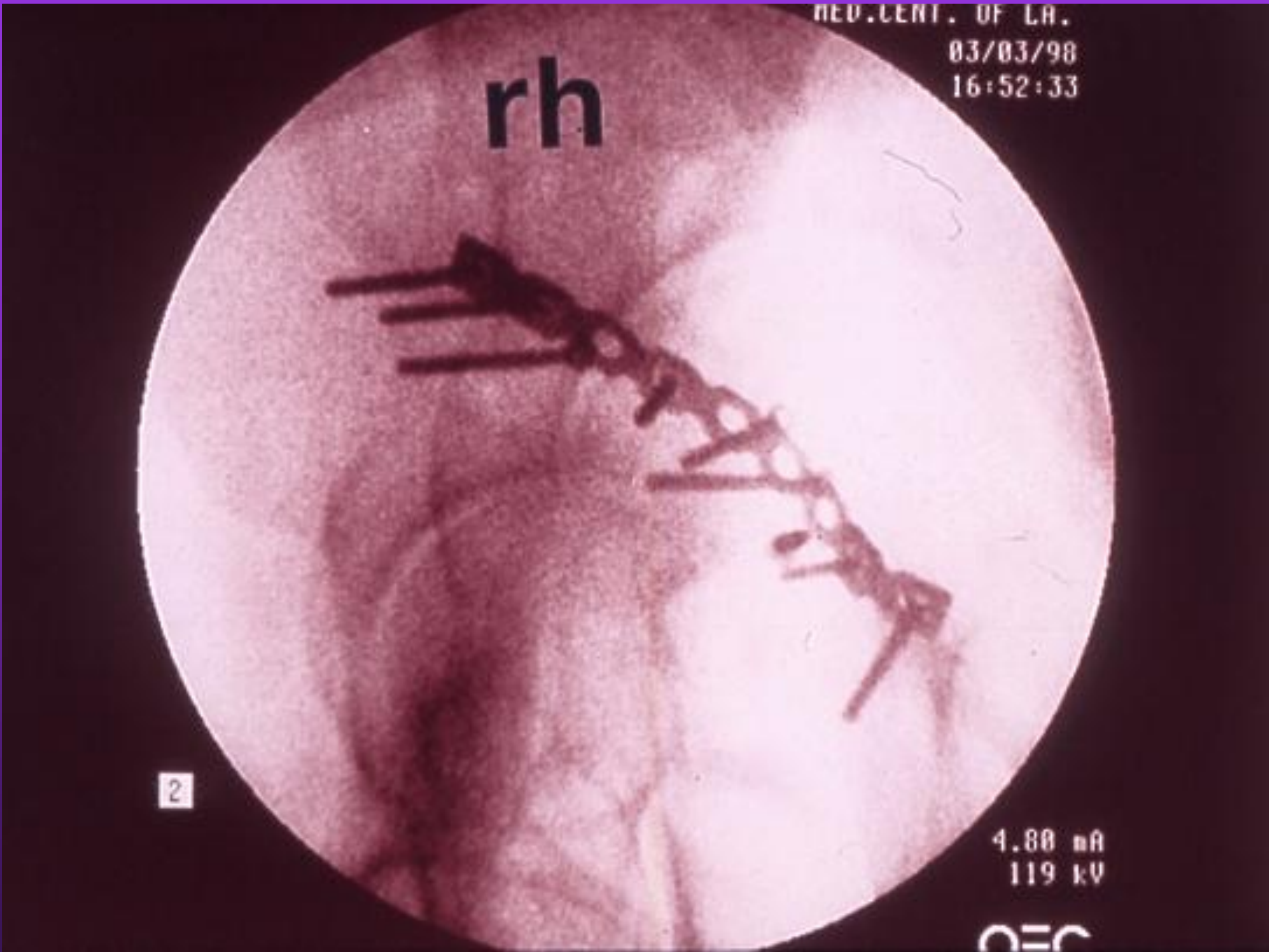

RK


rh
03/03/98
16:52:33
2
4.80 mA
119 kV

Posterior Wall Fractures

- Frequently missed
- Only 18/35 patients good or excellent results if operated on > 3 weeks (Johnson, Clin Orthop 1994)

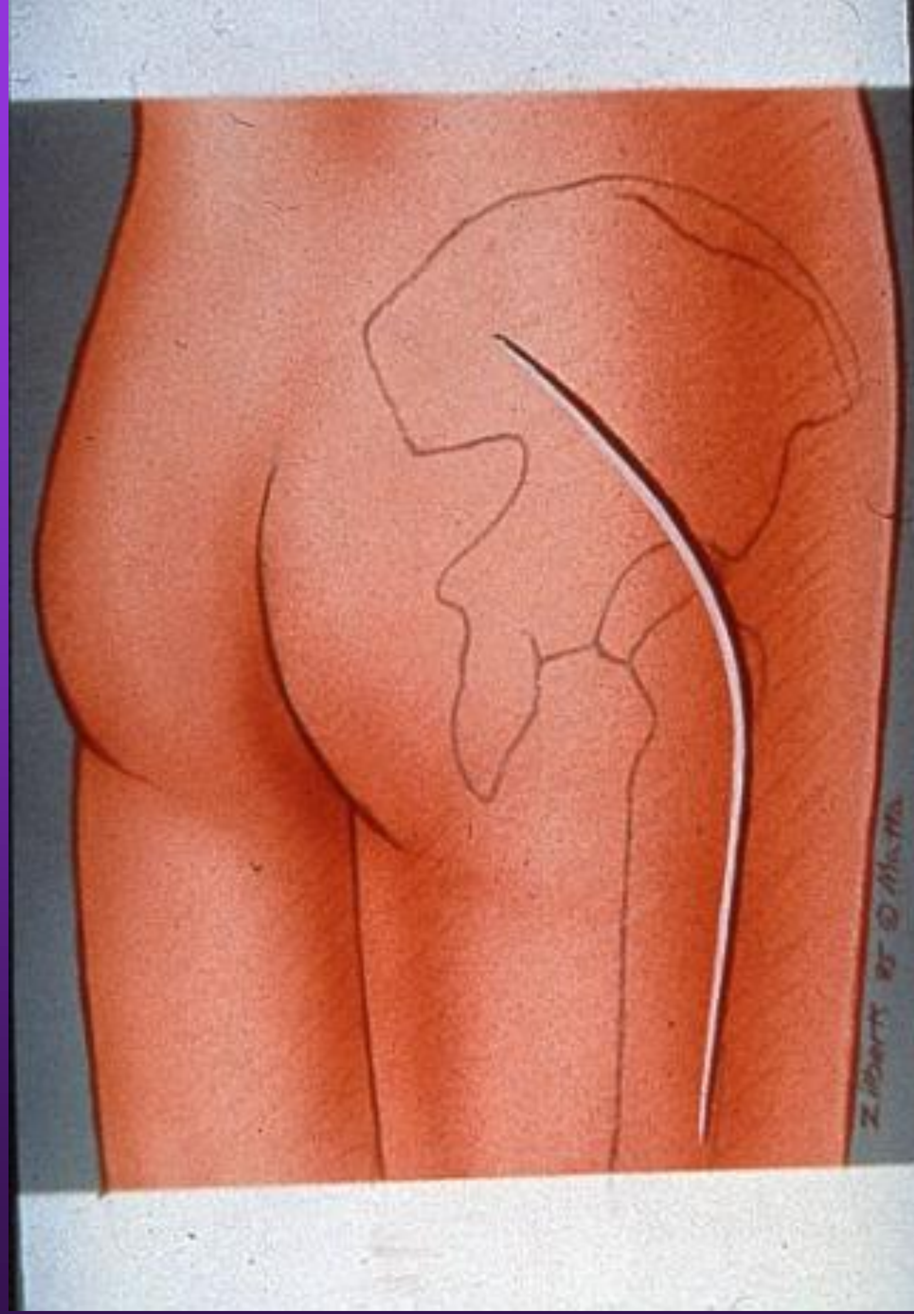
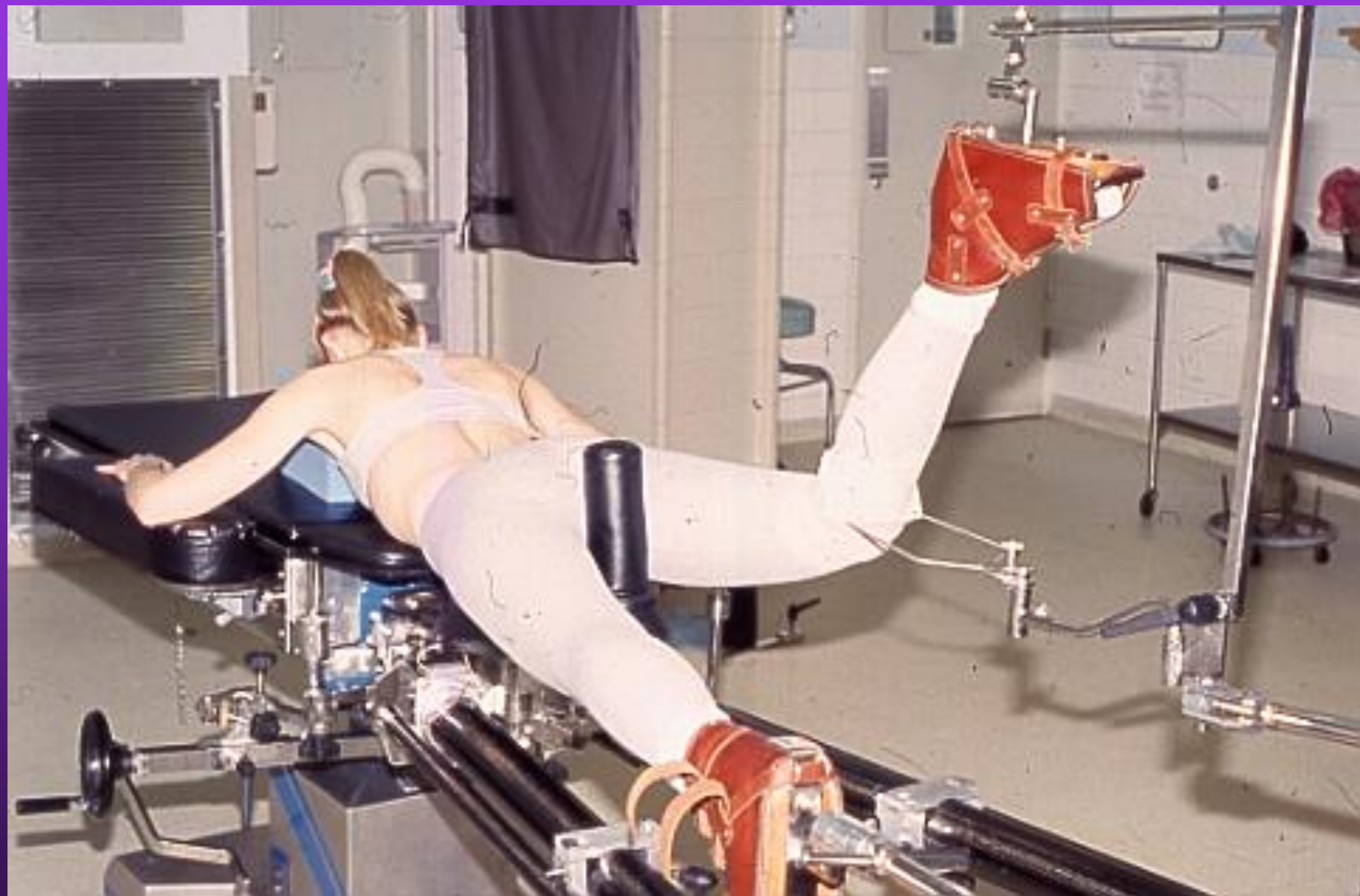


Fig. 333. Vessels and nerves on the right wall of the male pelvis seen from inside. The urinary bladder, seminal vesicles, and rectum are pulled downward.

Fig. 333



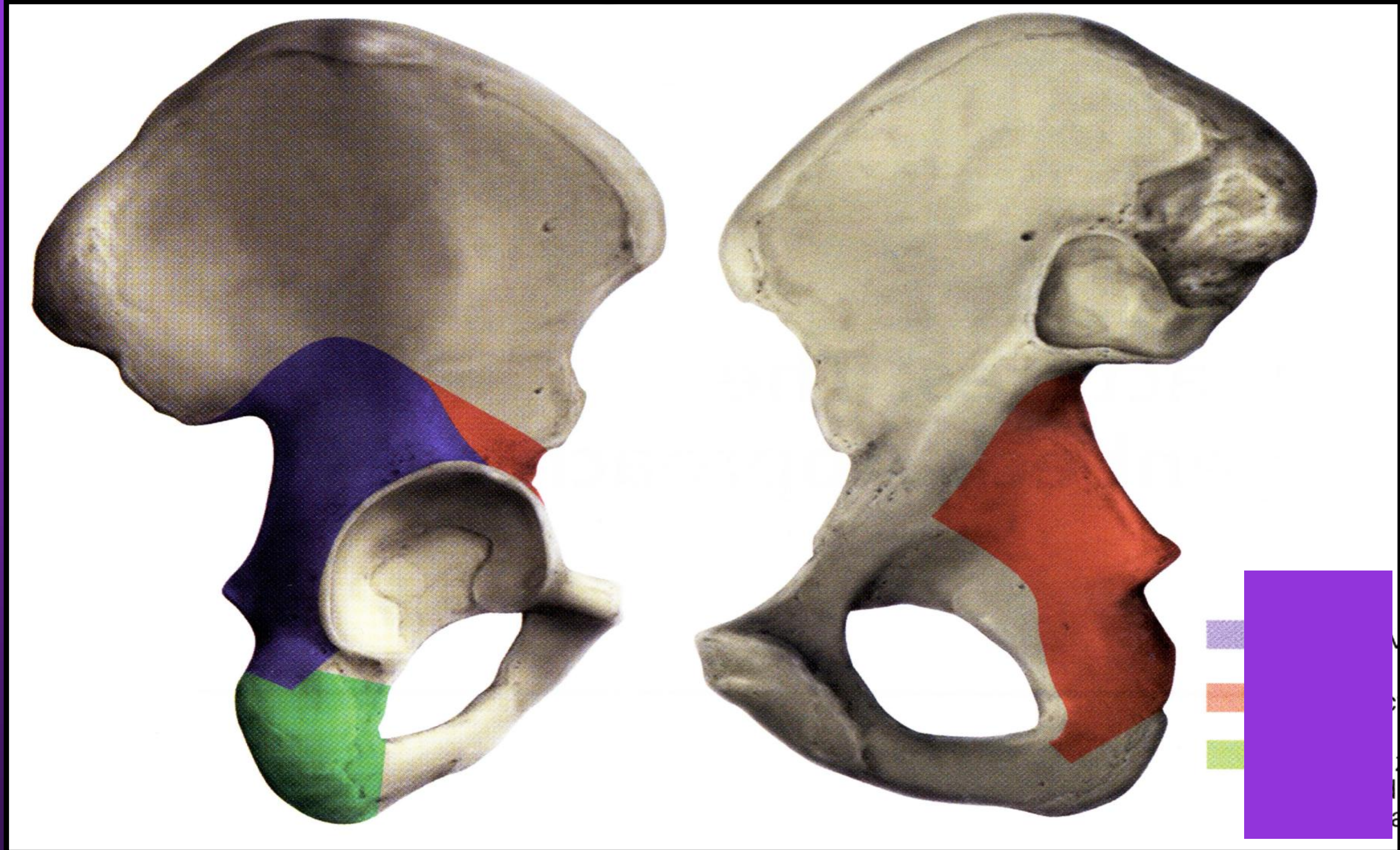
Prone Position

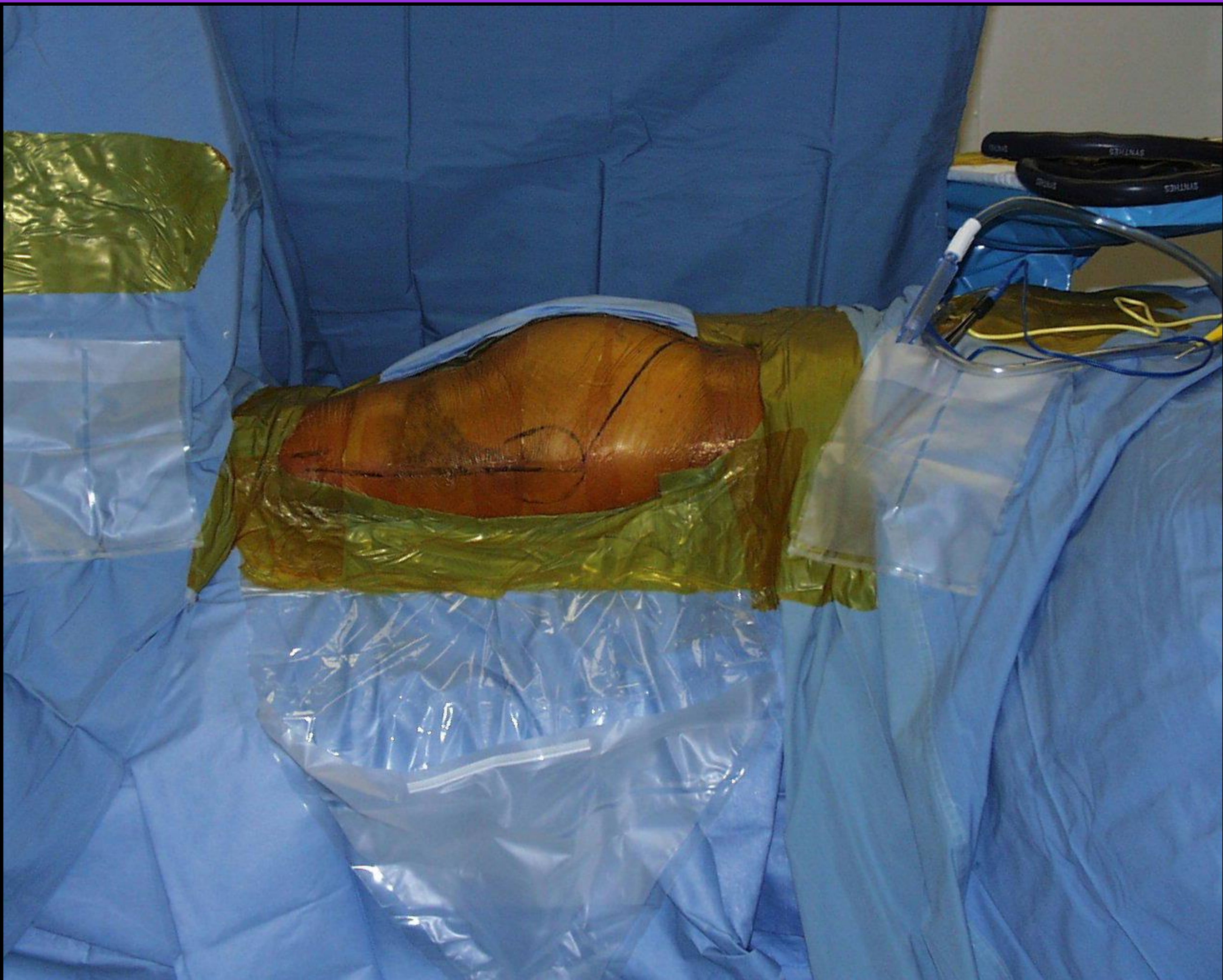
- Aids in Reduction of Ischiopubic Segment
- Facilitates Palpation of Quadrilateral Surface
- Allows Clamp Placement through Greater Sciatic Notch
- Easier Prep and Drape

Limitations: Kocher-Langenbeck

- Superior Acetabular Region
- Anterior Column
- Fractures High in Greater Sciatic Notch

Kocher Langenbeck: Access





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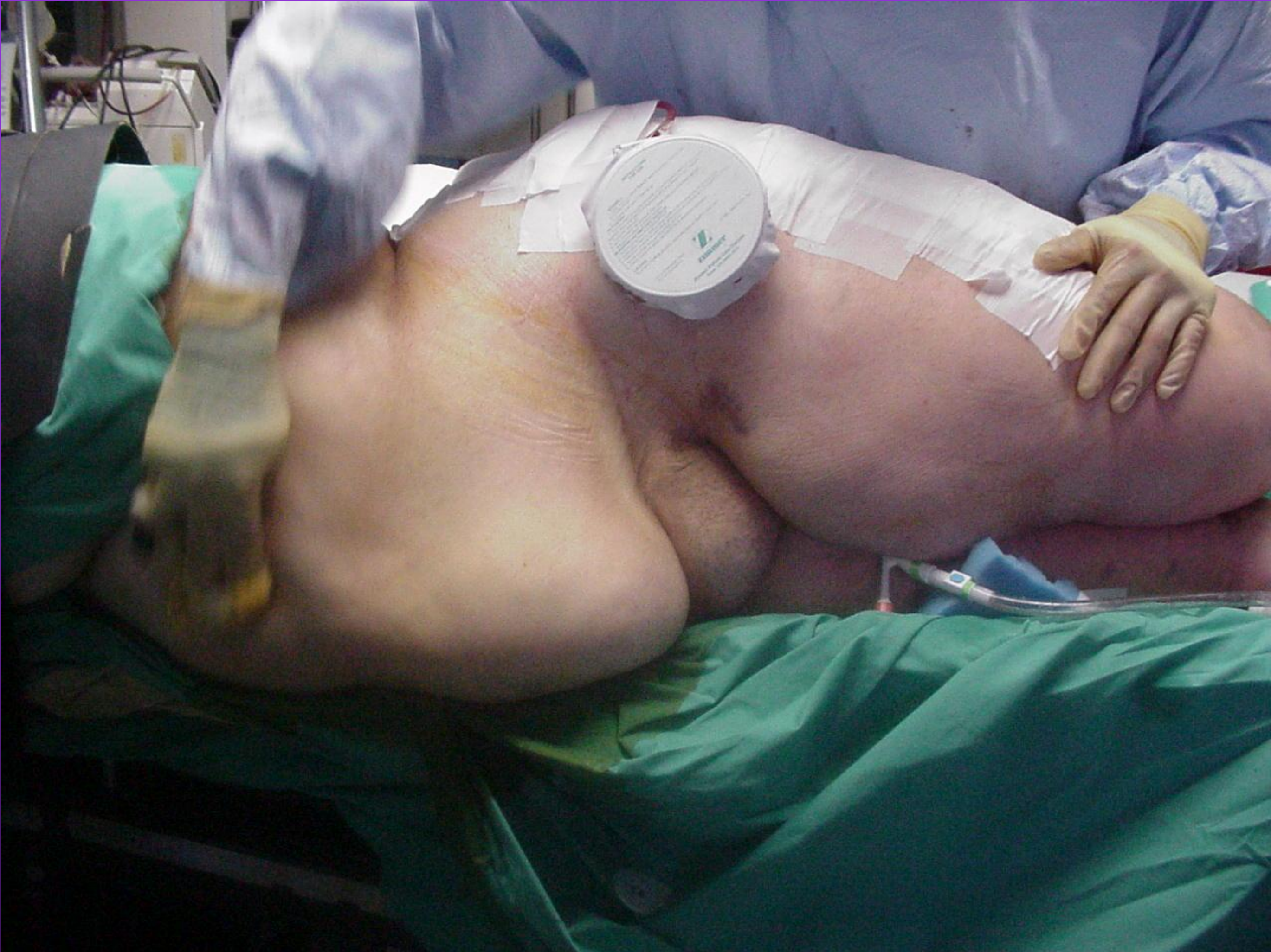
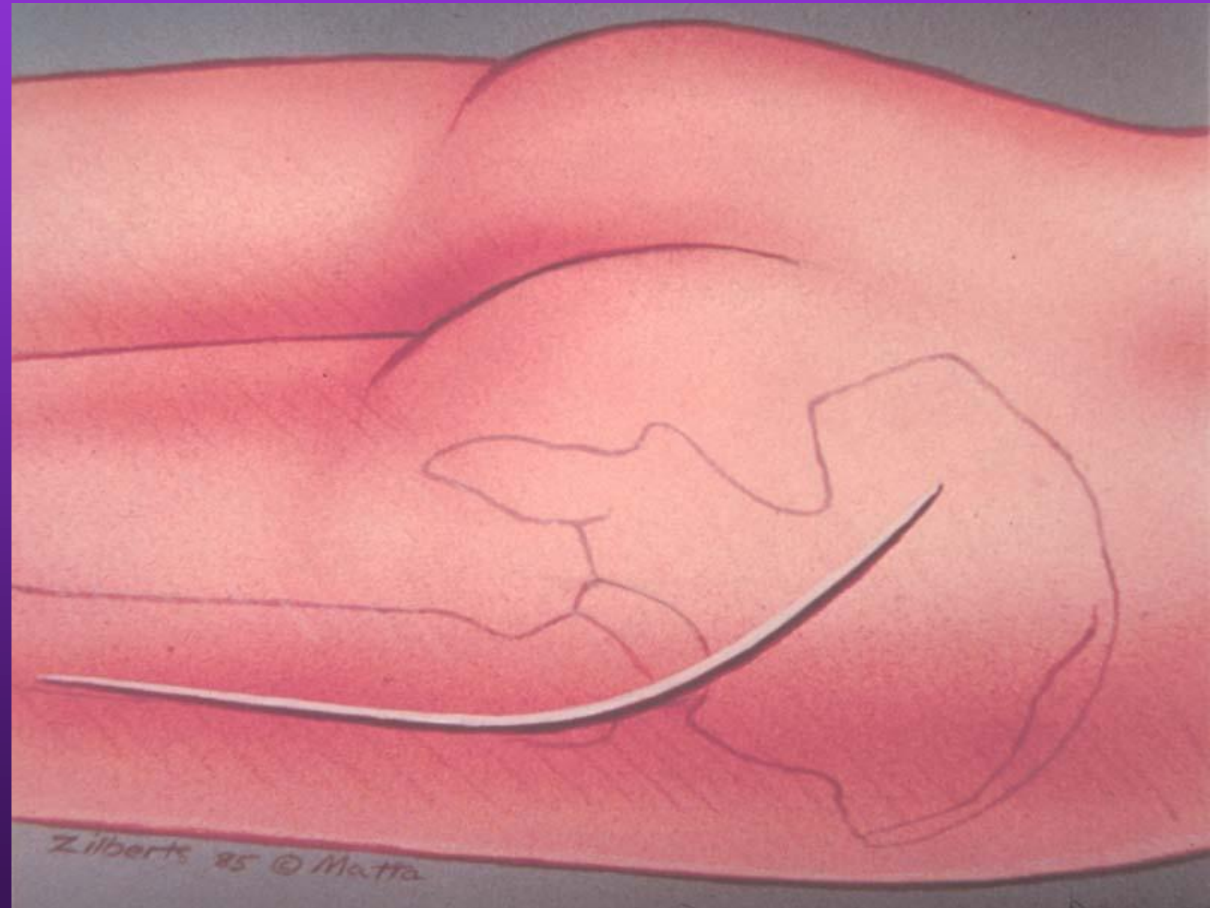


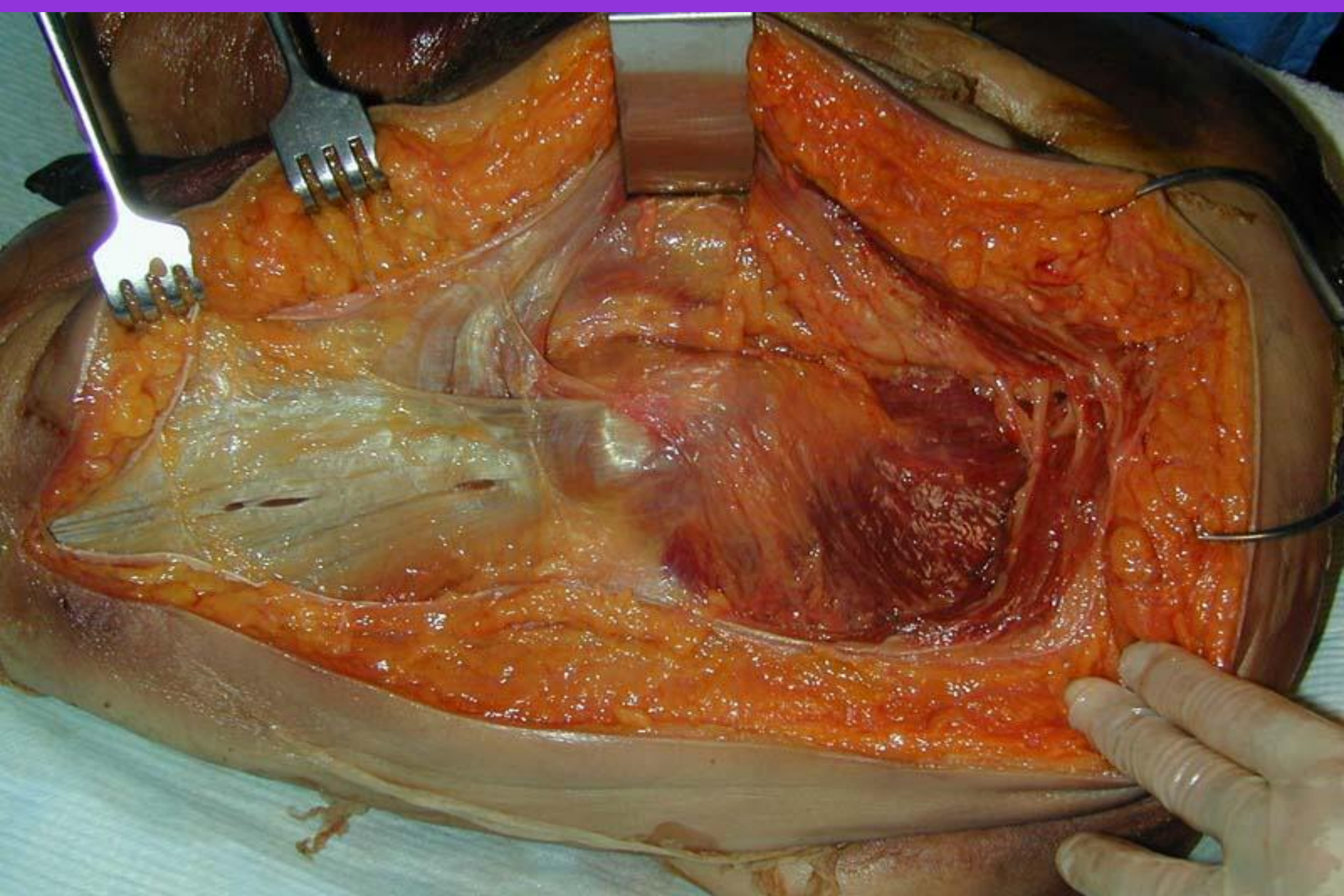
Kocher-Langenbeck: Incision

- 6 to 8 cm from PSIS
- Tip of Greater Trochanter
- Parallel Shaft of Femur 15-20 cm



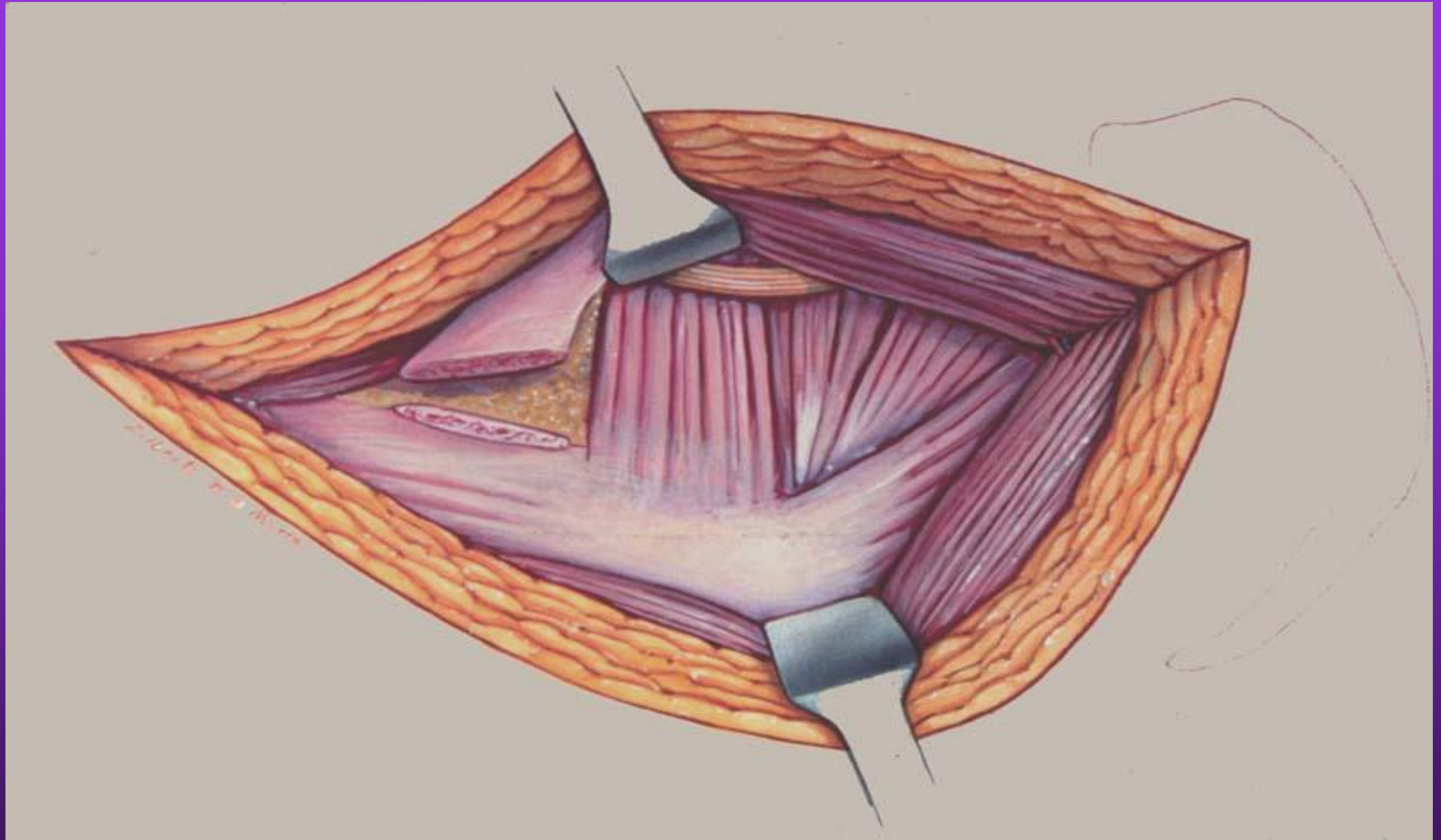
Dissection: Kocher-Langenbeck

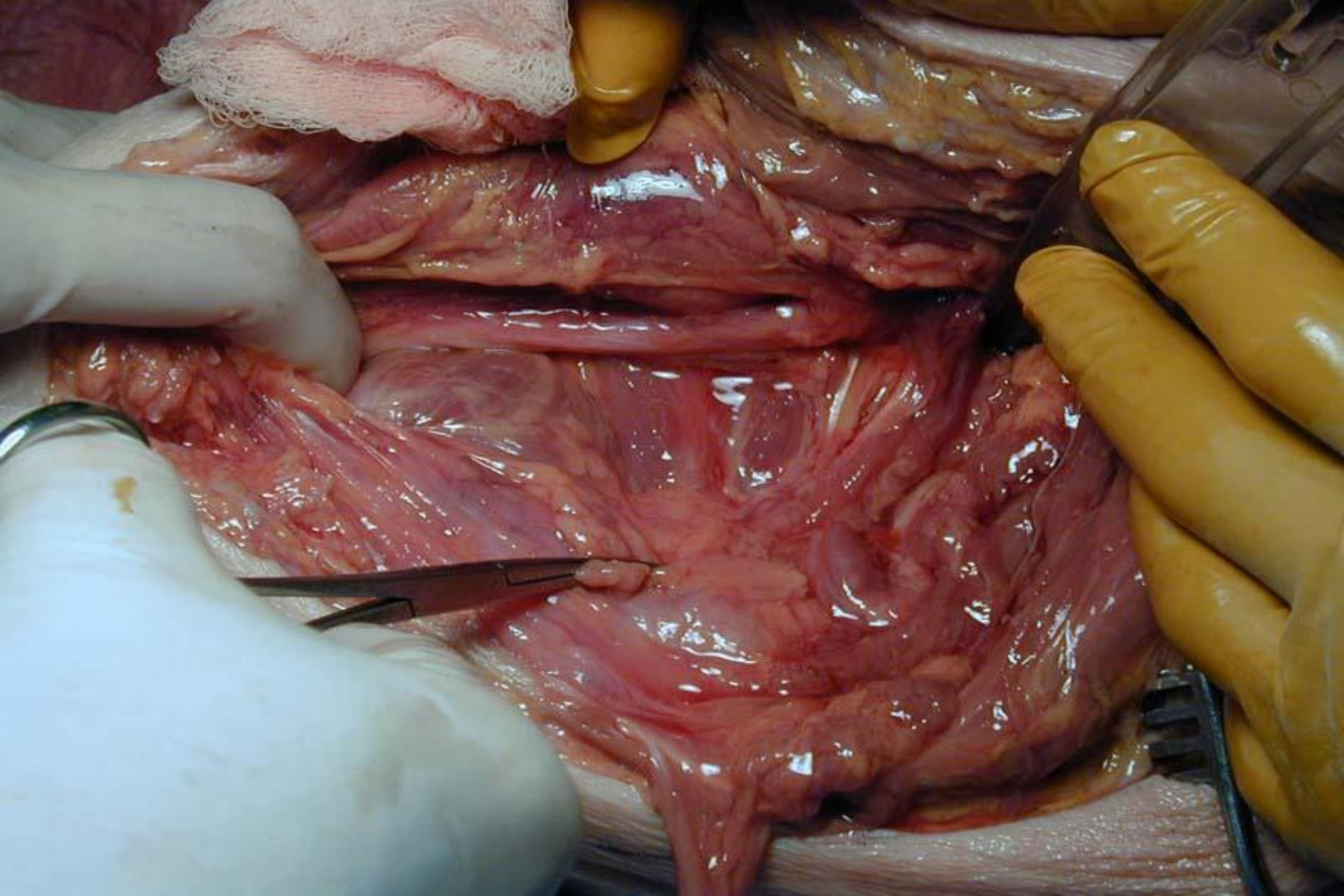
- Divide Iliotibial Band
- Separate Fibers of Gluteus Maximus
  - Superior 1/3: Superior Gluteal Artery
  - Inferior 2/3: Inferior Gluteal Artery
- Split to Inferior Gluteal Nerve Branch



Dissection: Kocher-Langenbeck

- Release Gluteus Maximus Insertion
- Identify Sciatic Nerve on Border of Quadratus Femoris Muscle

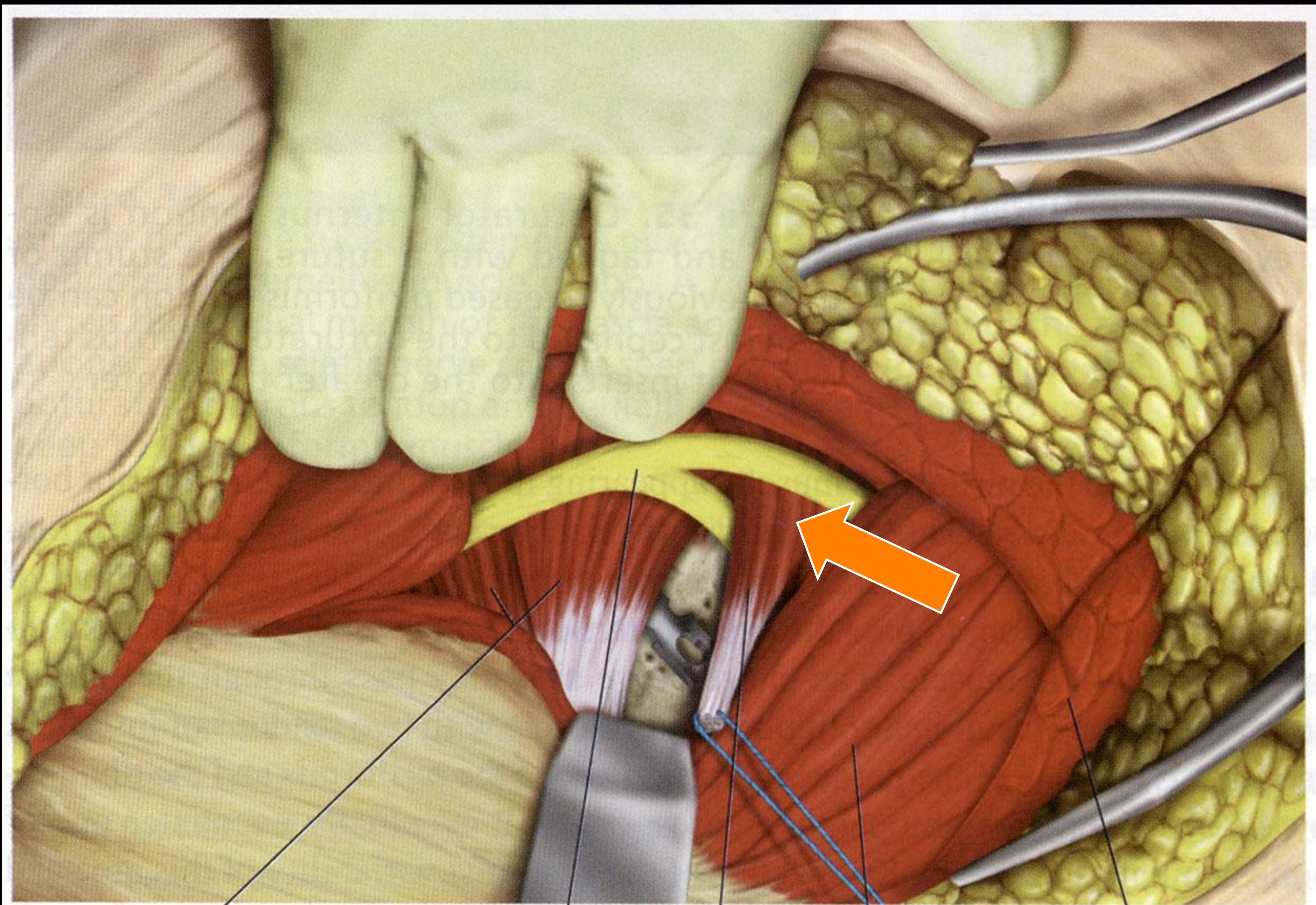


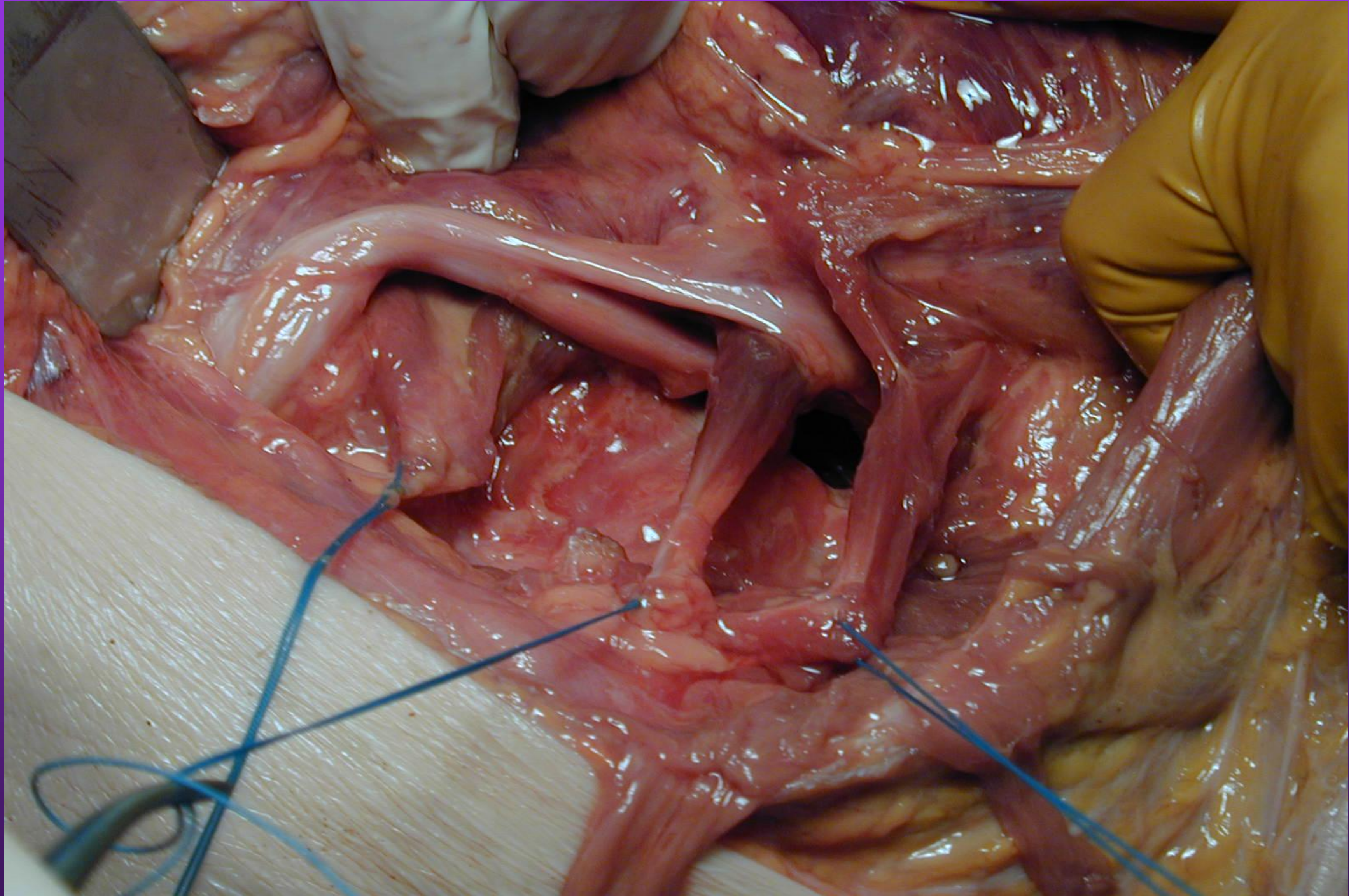


Sciatic Nerve Anatomy

- 84%: Anterior to Piriformis
- 12%: Peroneal Division through Piriformis
- 3%: Peroneal Division Posterior to Piriformis / Tibial Division anterior to Piriformis
- 1%: Entire Nerve through Piriformis

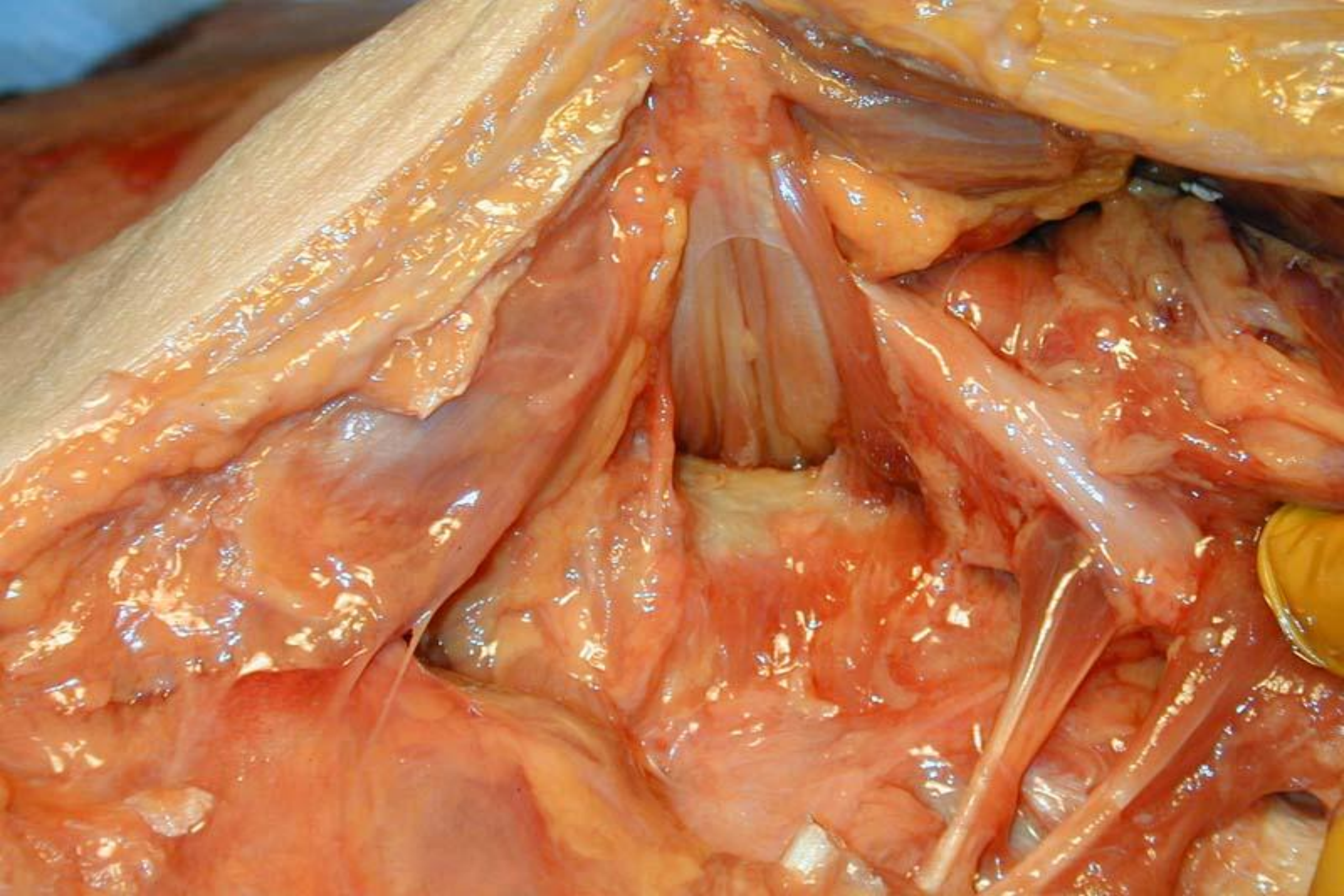
Hollinshead, WH 1982


Obturator internus
and gemelli
Split sciatic nerve
Piriformis
Gluteus medius
Gluteus maximus



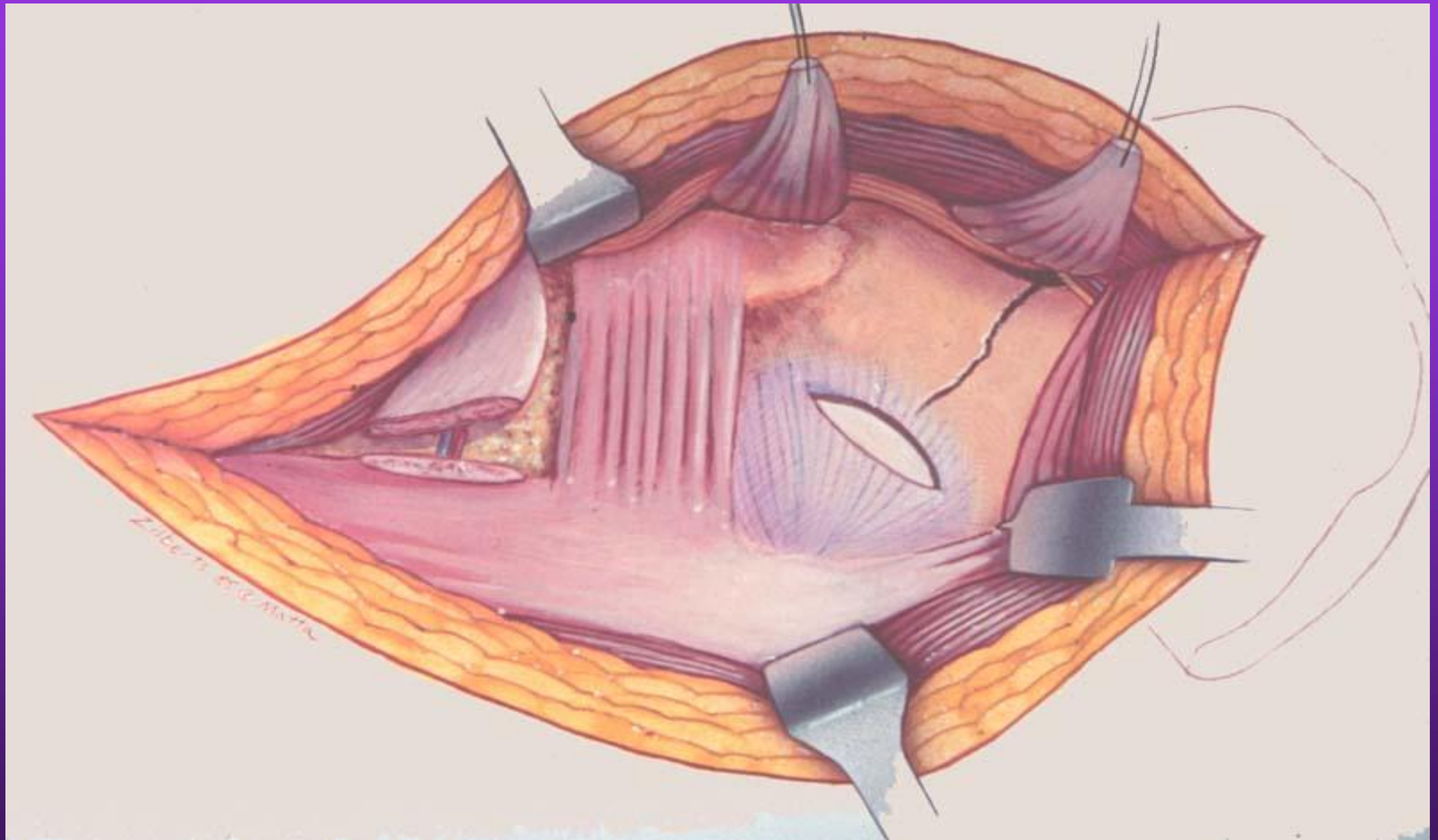
Dissection: Kocher-Langenbeck

- Release Piriformis Tendon >1cm from trochanter (knife)
- Release Conjoint Tendon (Obturator internus)
- Open Obturator Internus Bursa for Sciatic Nerve Retractor



Dissection: Kocher-Langenbeck

- Subperiosteal Elevation of:
  - Greater Sciatic Notch
  - Quadrilateral Surface
  - Gluteus Minimus
- Debridement of Fracture Edges
- Avoid Devascularization of Fx Fragments

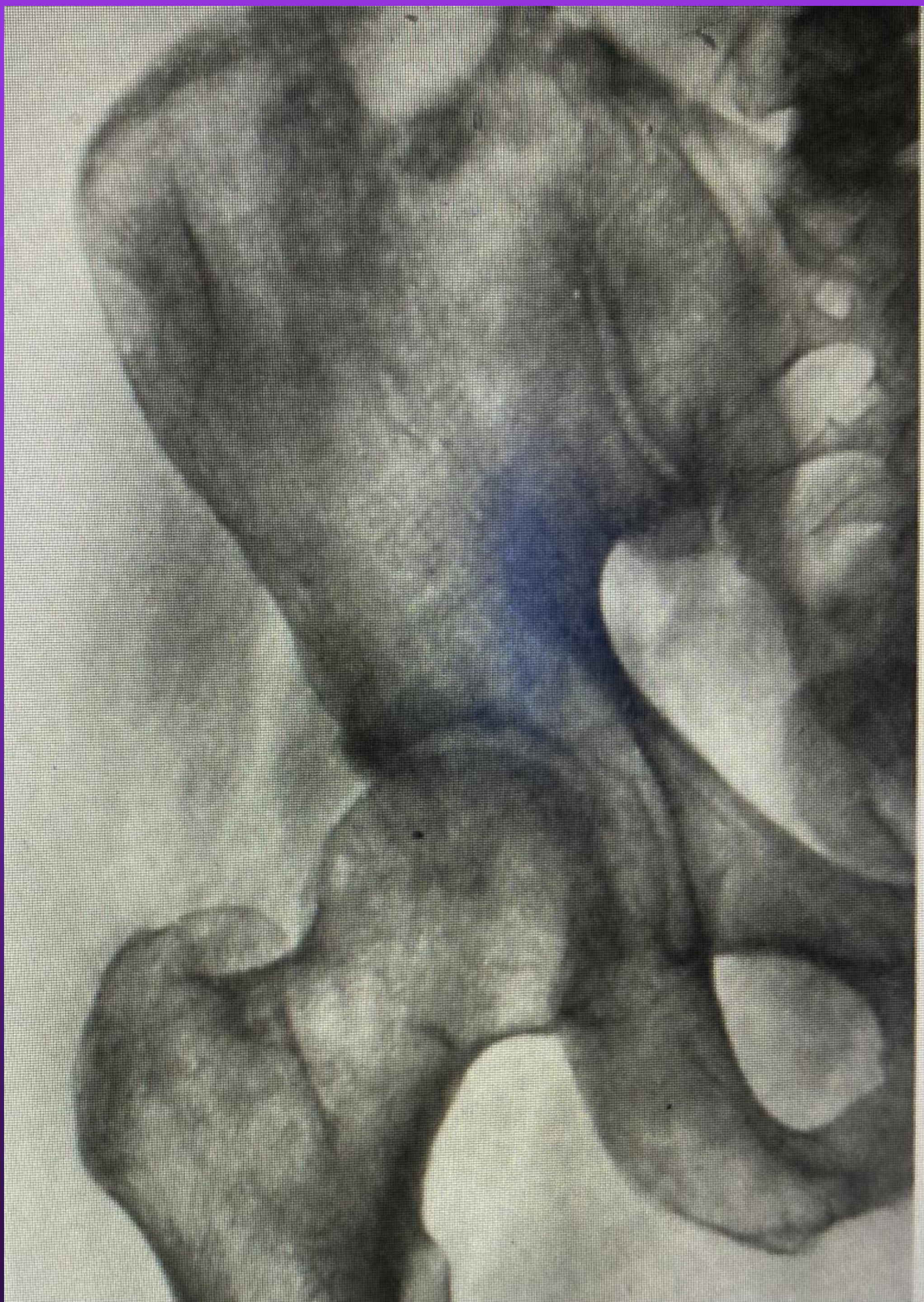


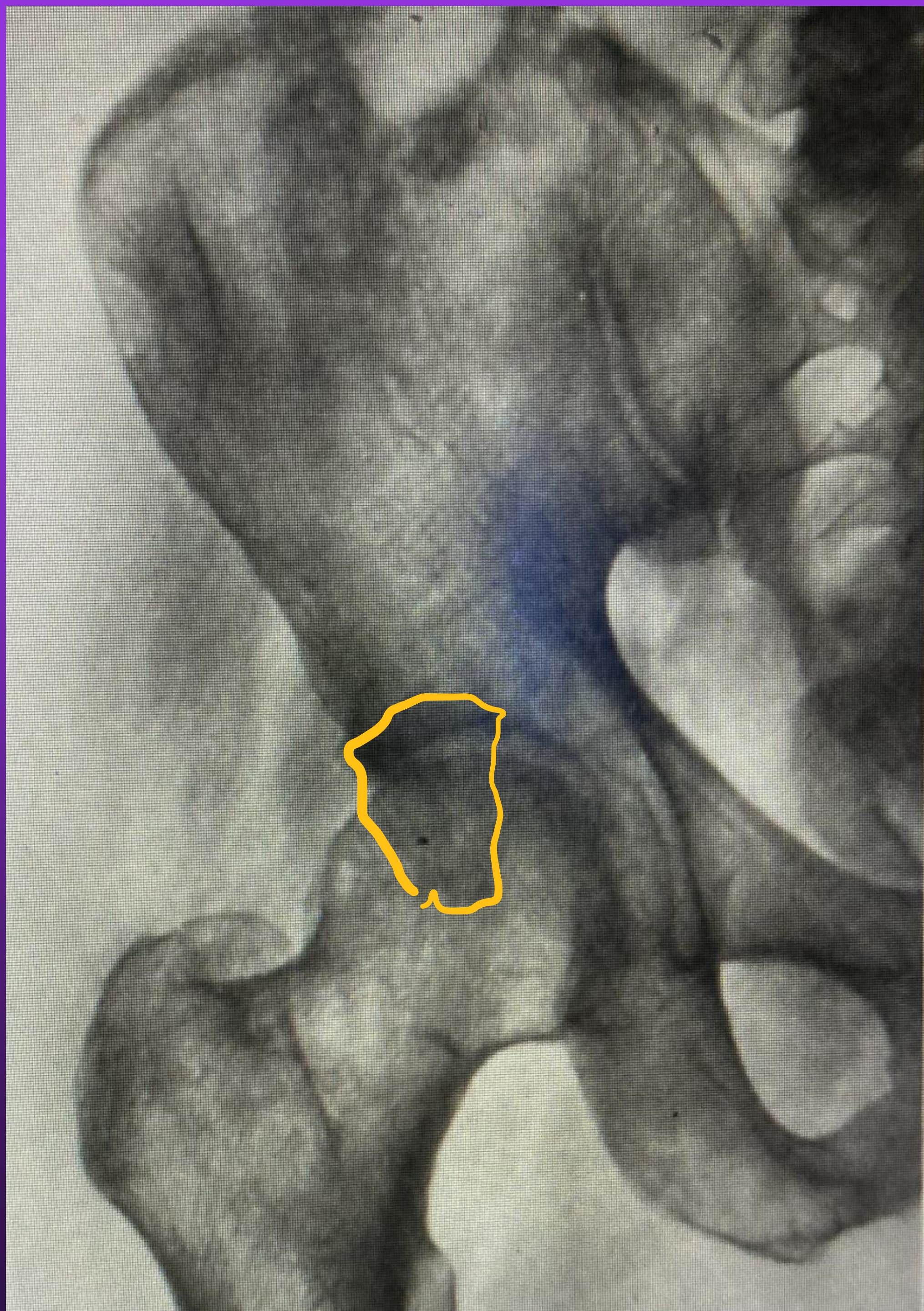
KL (cont.)

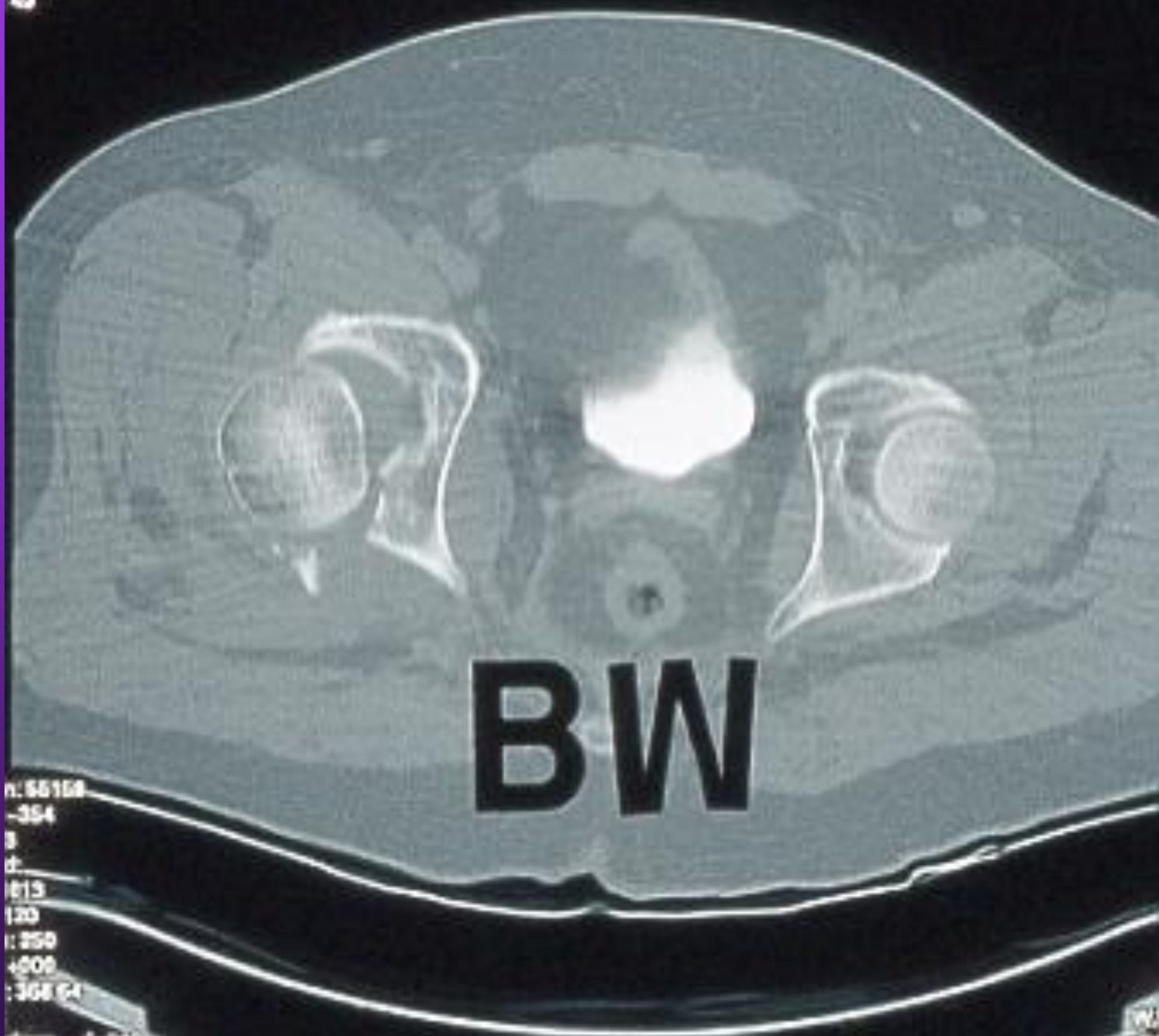
- If quadratus taken down → from ischium
- Periosteal elevation of posterior column from notch → laterally
- Superior dome fragment → greater trochanter osteotomy

Vascular (cont.)

- Superior gluteal NV bundle
  - Greater sciatic notch
  - Can be damaged by aggressive superior retraction during Kocher-Langenbeck exposure.

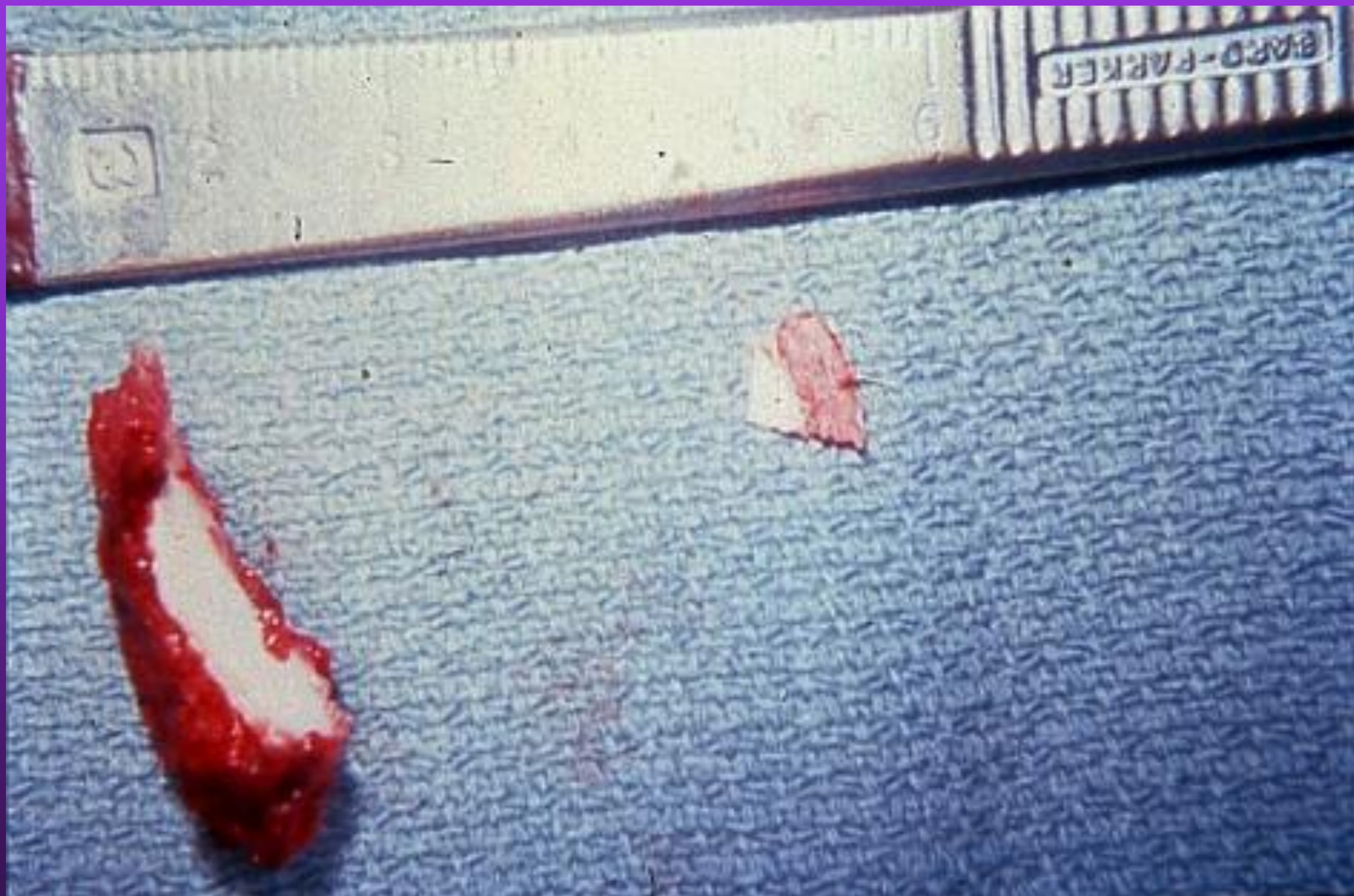


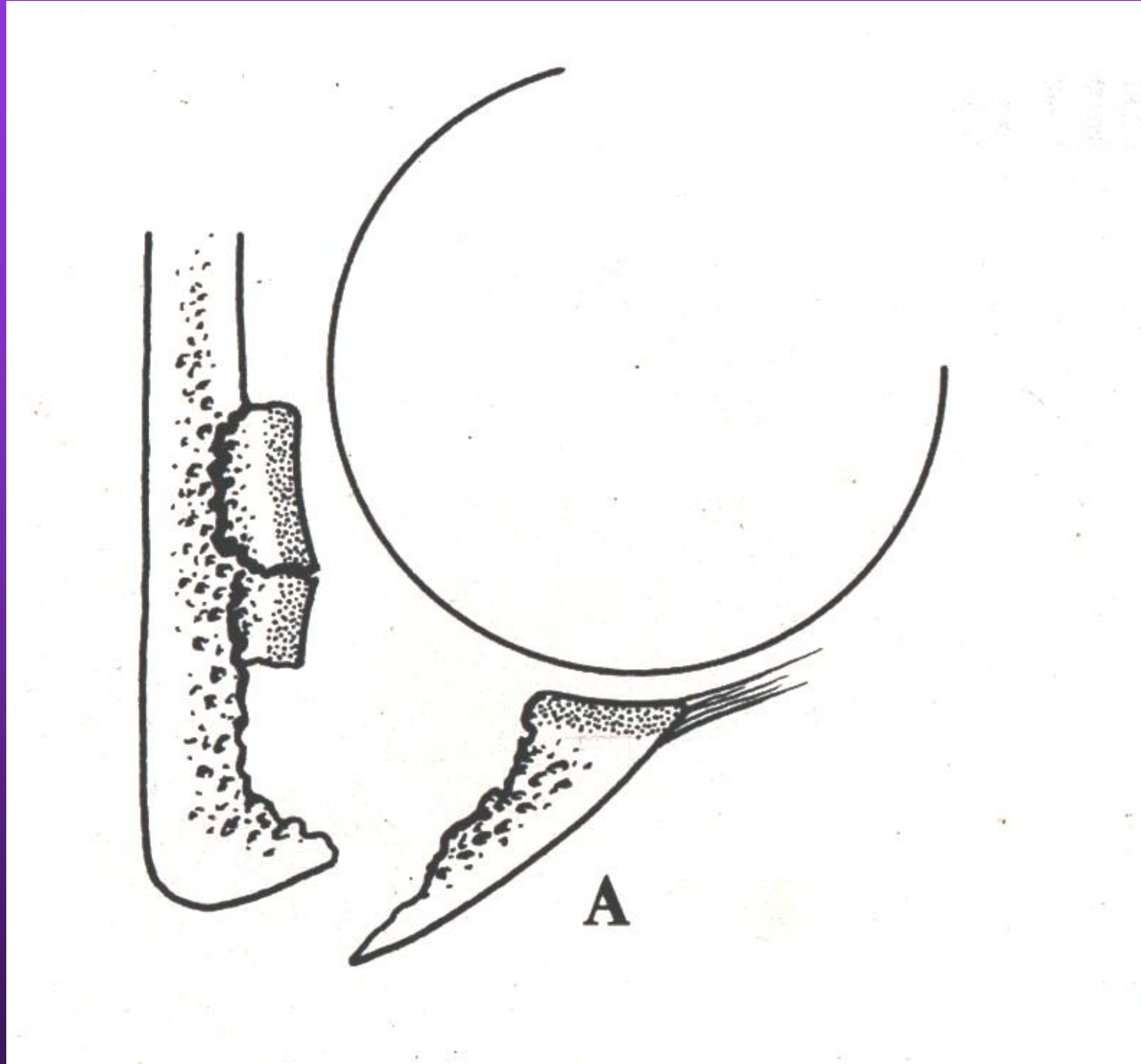



BW

Marginal Impactions

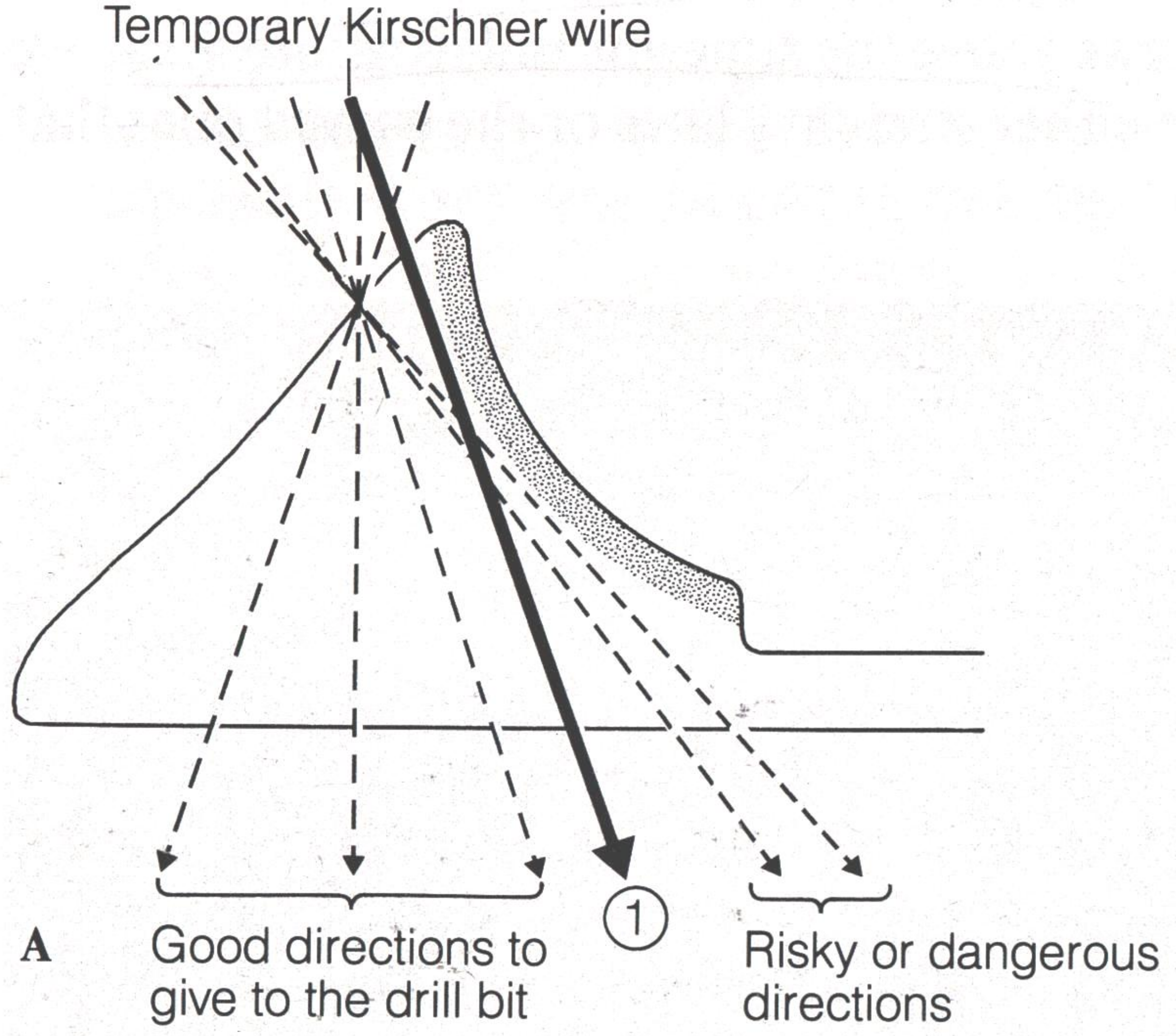
- Articular surface elevated with as much as possible cancellous bone
- Autogenous graft from greater trochanter
- Proximal based trap door 1 x 1 cm at vastus lateralis ridge


BARD-PARKER


A

Posterior Wall Fixation

- Ball spike
- 3.5 mm lag screws
- 3.5 mm recon buttress plate curved around dome

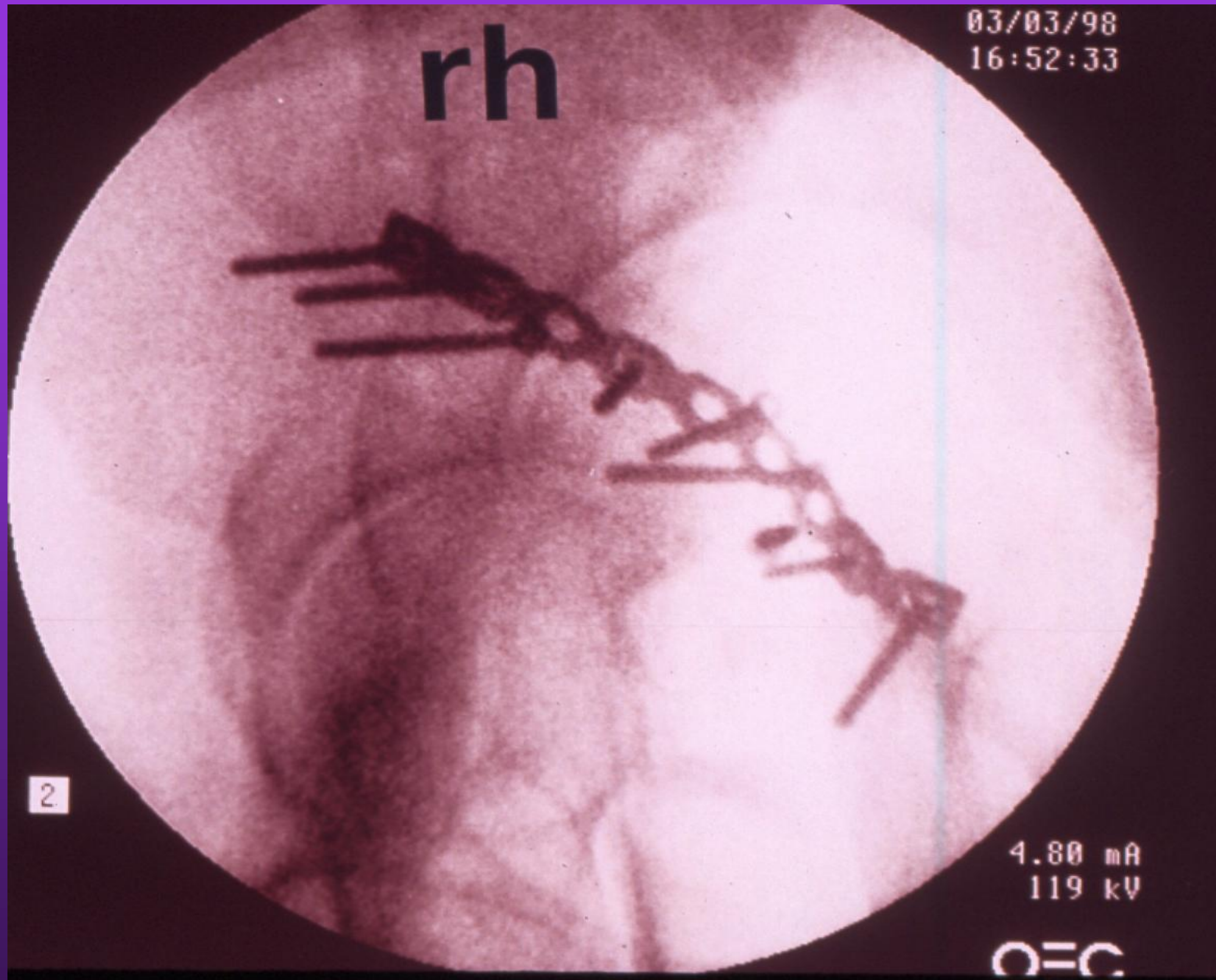

Temporary Kirschner wire
1
A
Good directions to give to the drill bit
Risky or dangerous directions

KL (cont.)

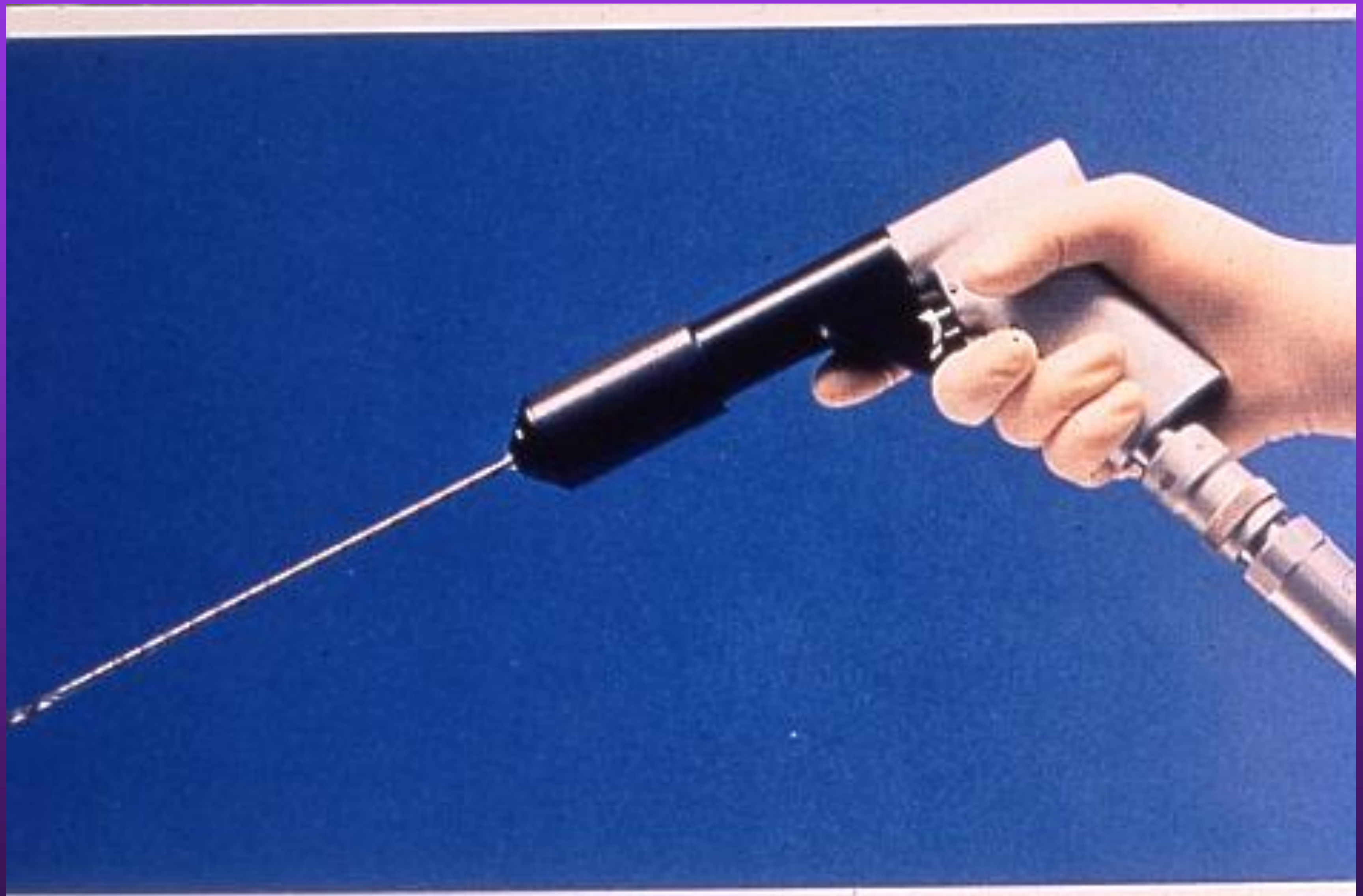
- Check joint for femoral head damage and loose bodies
- Abduction weakness correlated with hip outcome scores
- Debride dead gluteus minimus at end

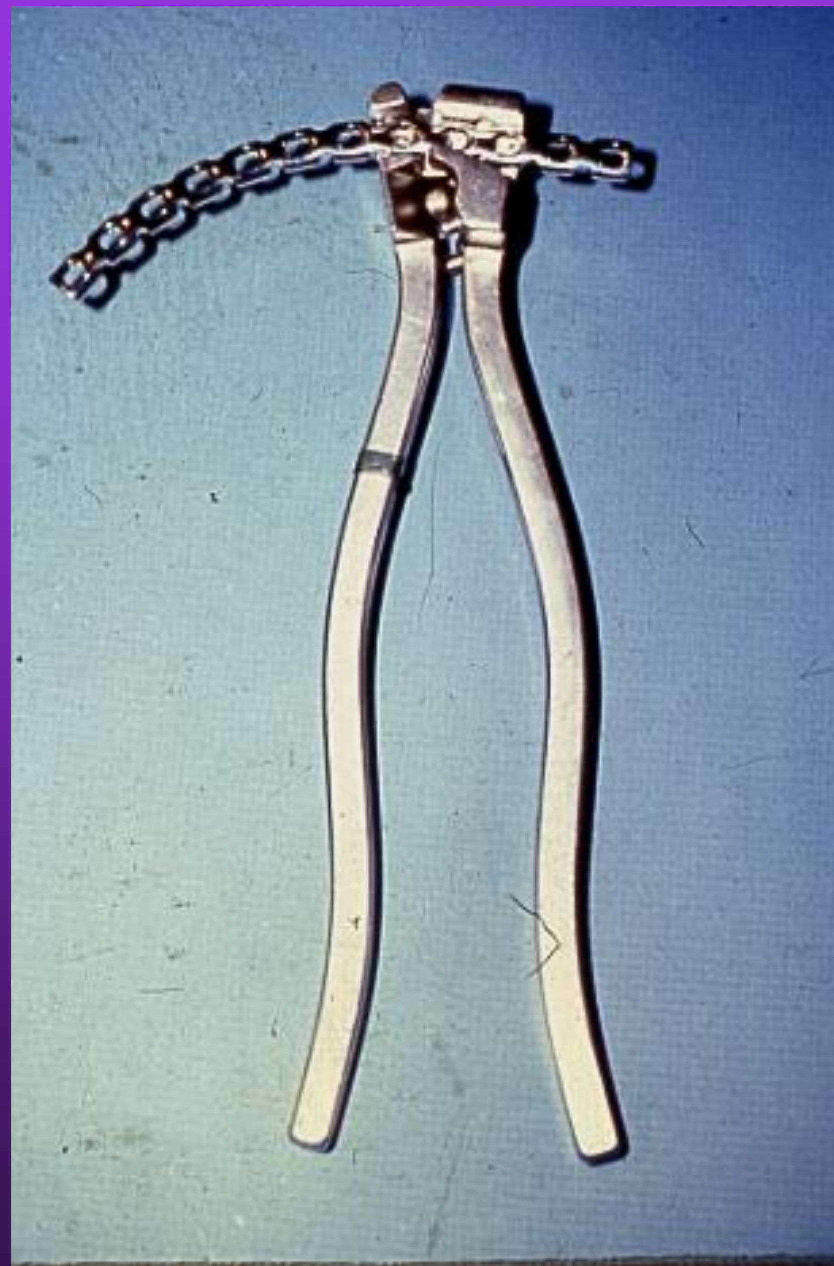
Posterior Wall

- Surgical principles
  - Maintain capsular attachment to posterior wall piece
  - Clean out joint
  - 2-3 mm stripping at fracture line
  - Look for marginal impactions



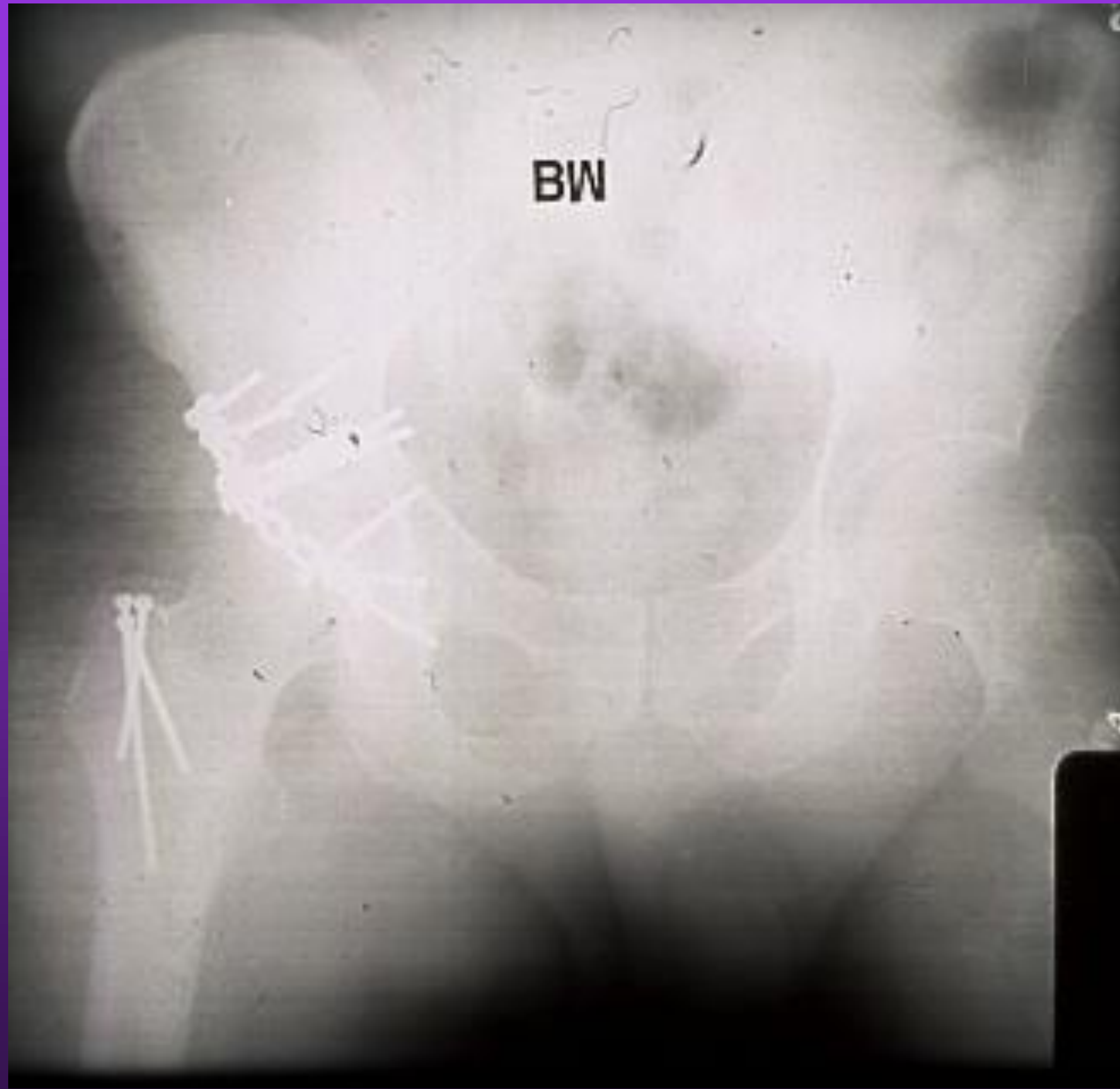
rh
03/03/98
16:52:33
2
4.80 mA
119 kV
OEC





Contouring Plate for Posterior Wall

- 1 screw into ischium
- 1 screw into cotyloid notch
- Curve around posterior wall towards dome of acetabulum
- Spring plates (1/3 tubular) rarely for rim comminution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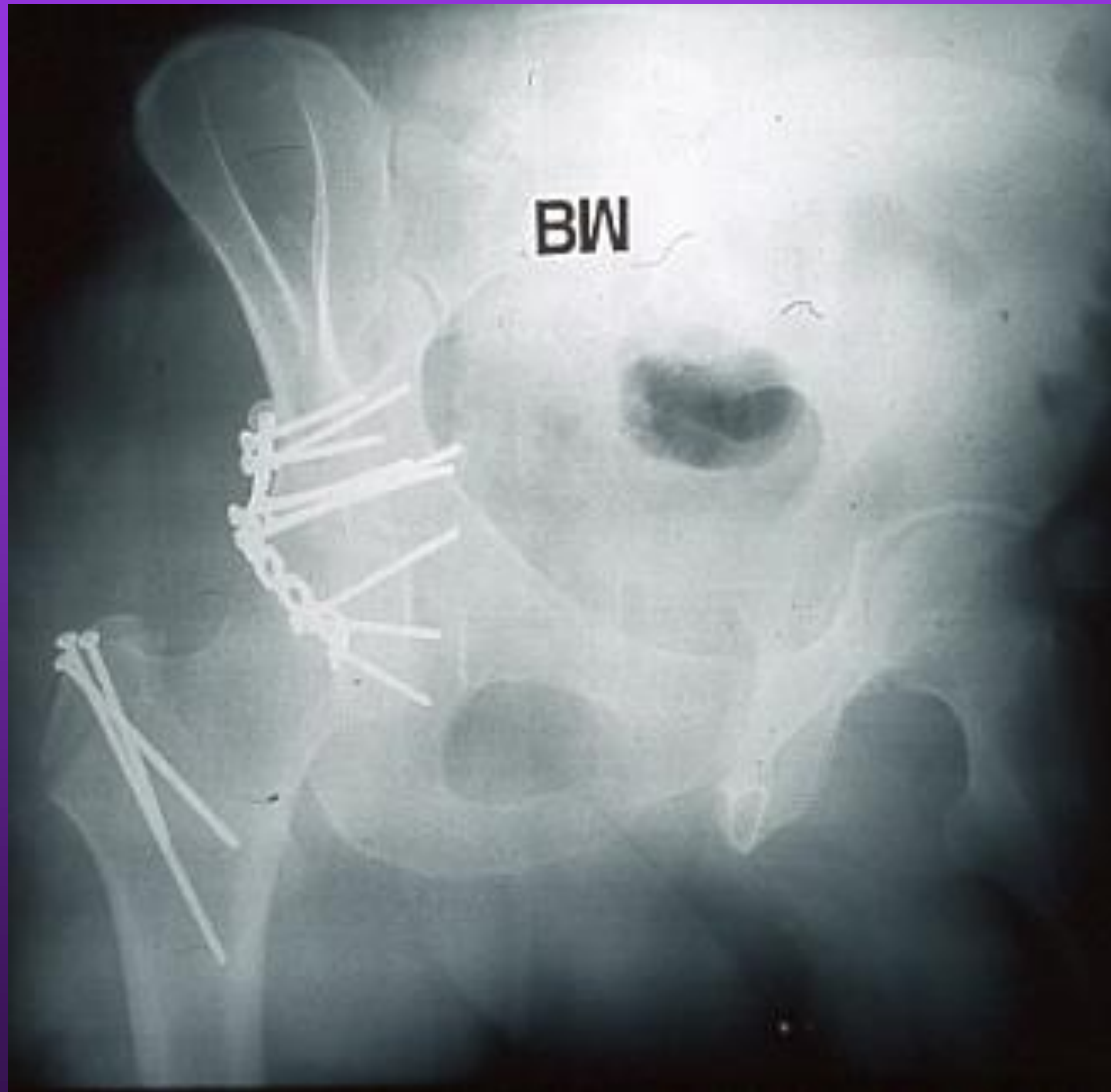
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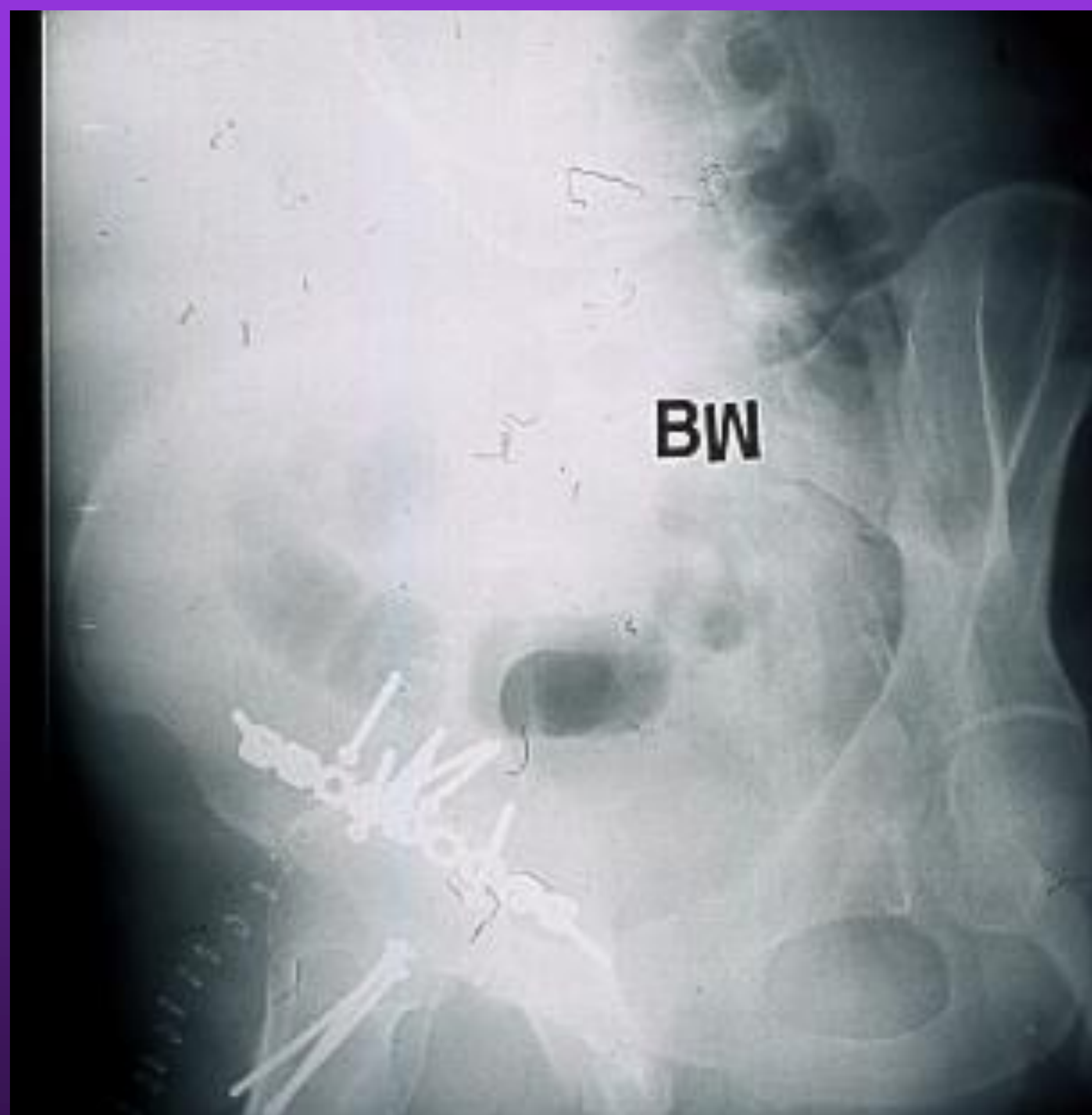
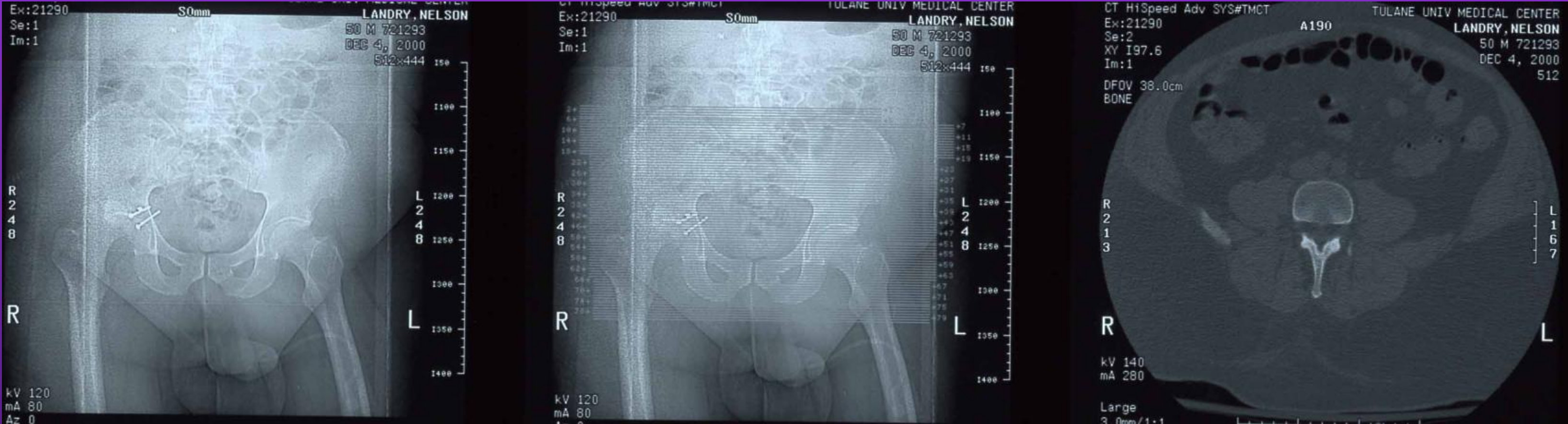

BW

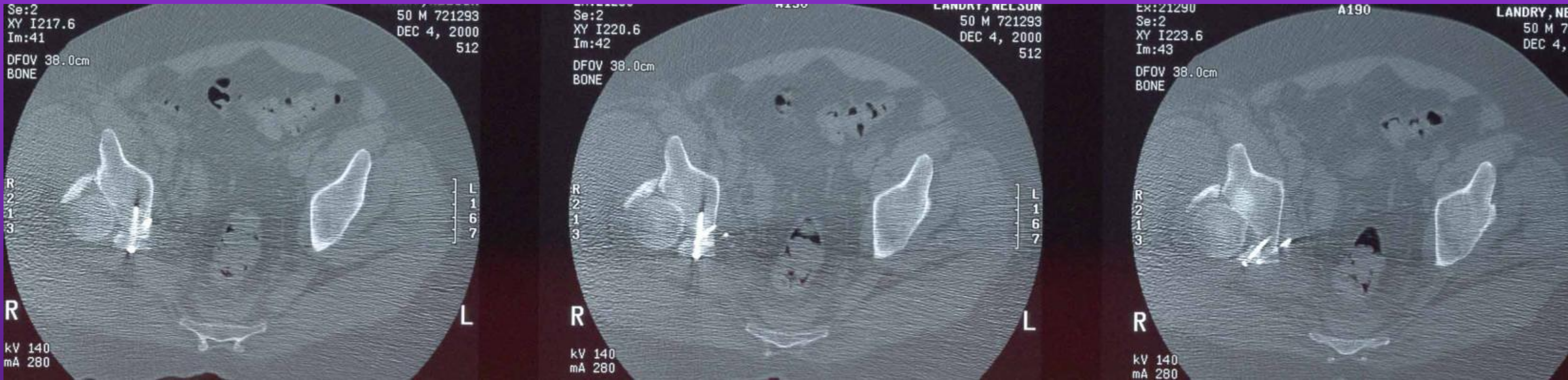
Posterior Wall Fxs: Surgical Keys

- Avoid Devascularization of Fragment/s
- Remove Intra-articular Fragments
- Address Marginal Impaction
- Provide adequate buttress
- Avoid Over-Contouring of Plate

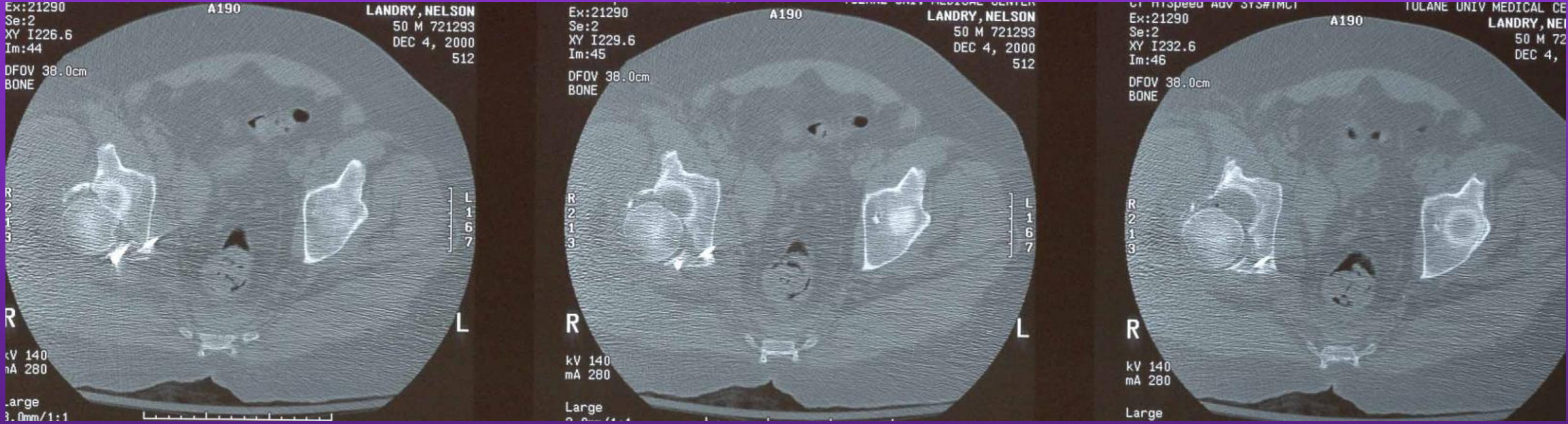
NL-12/4/00

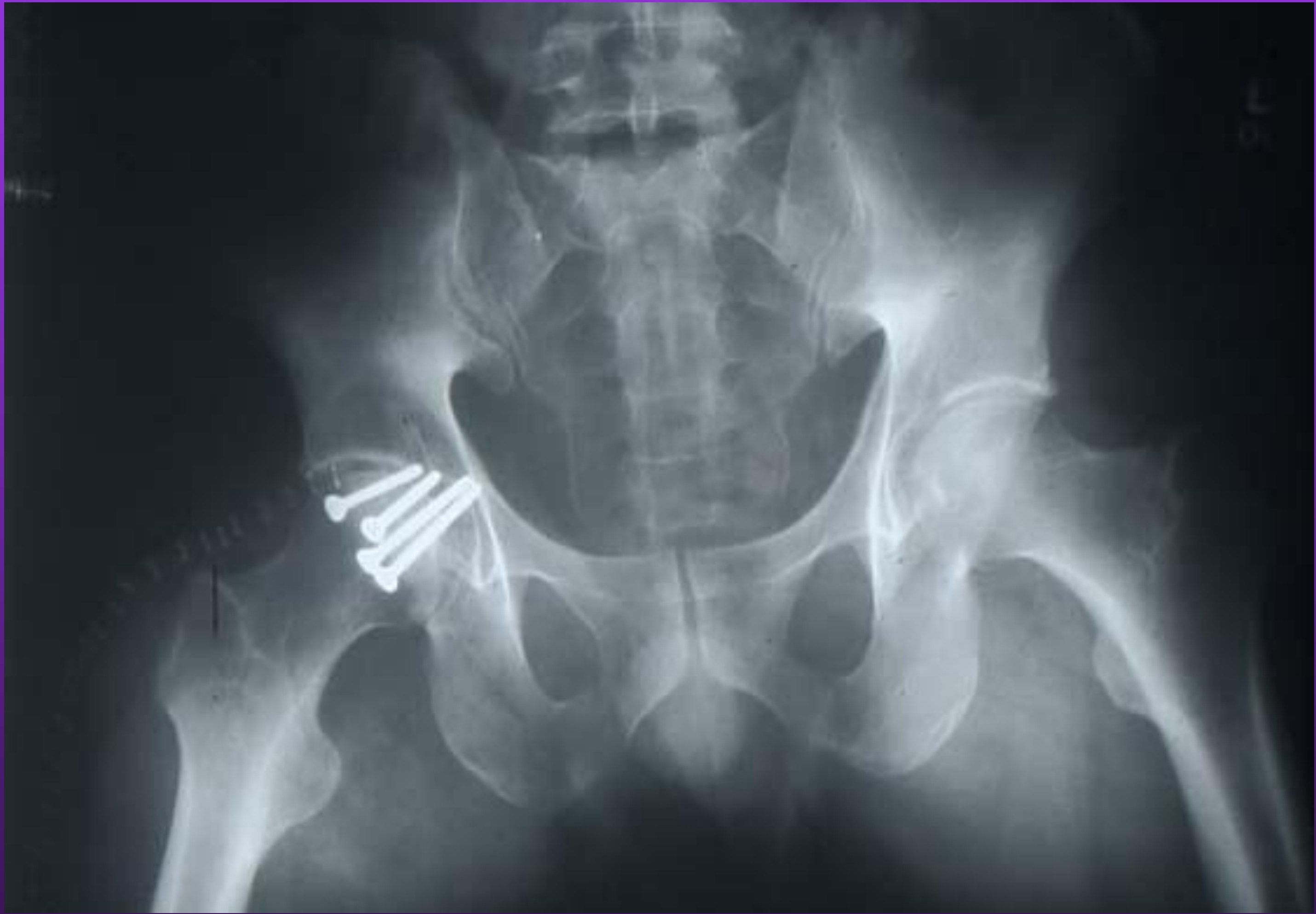


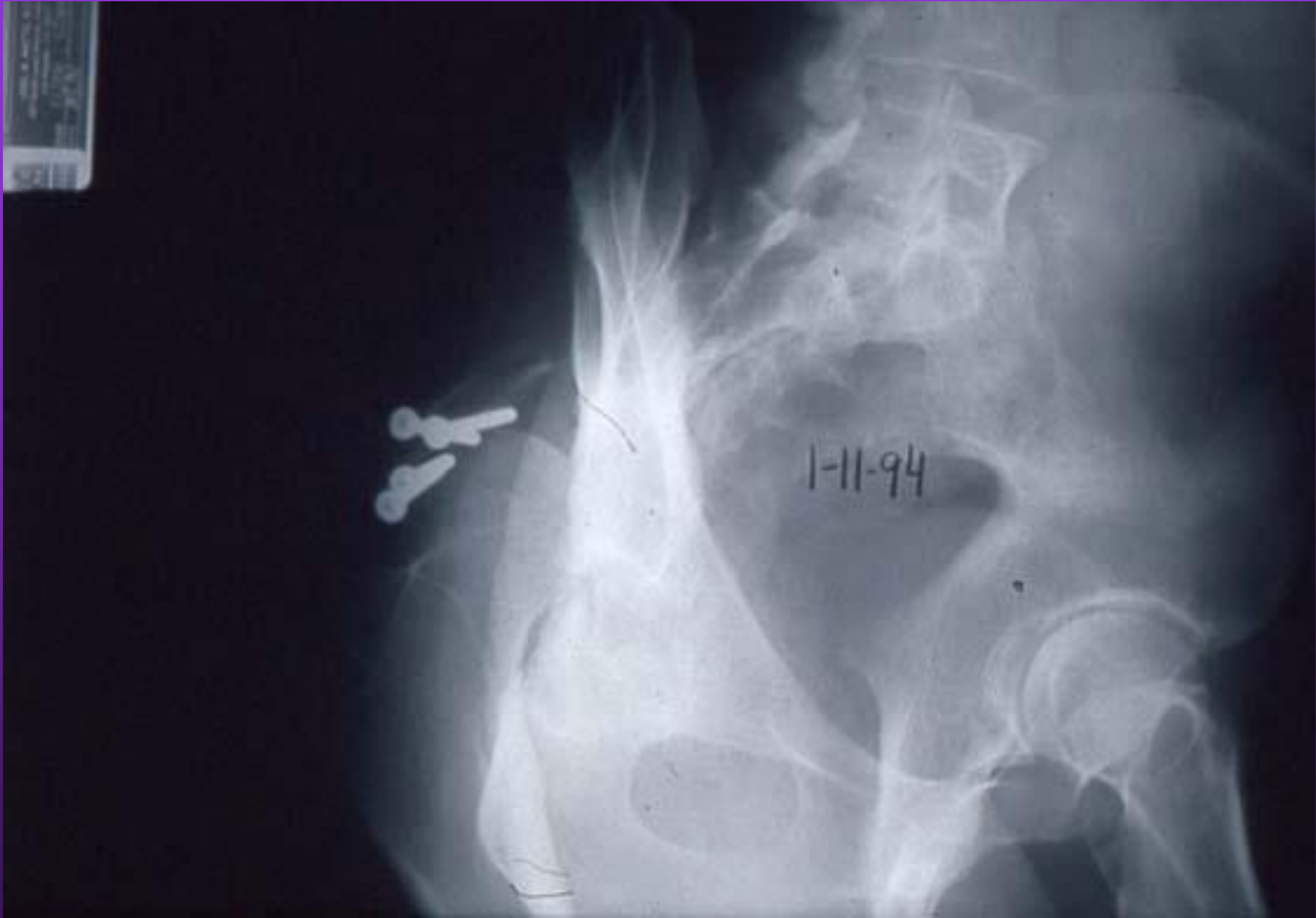
NL-12/4/00



NL-12/4/00



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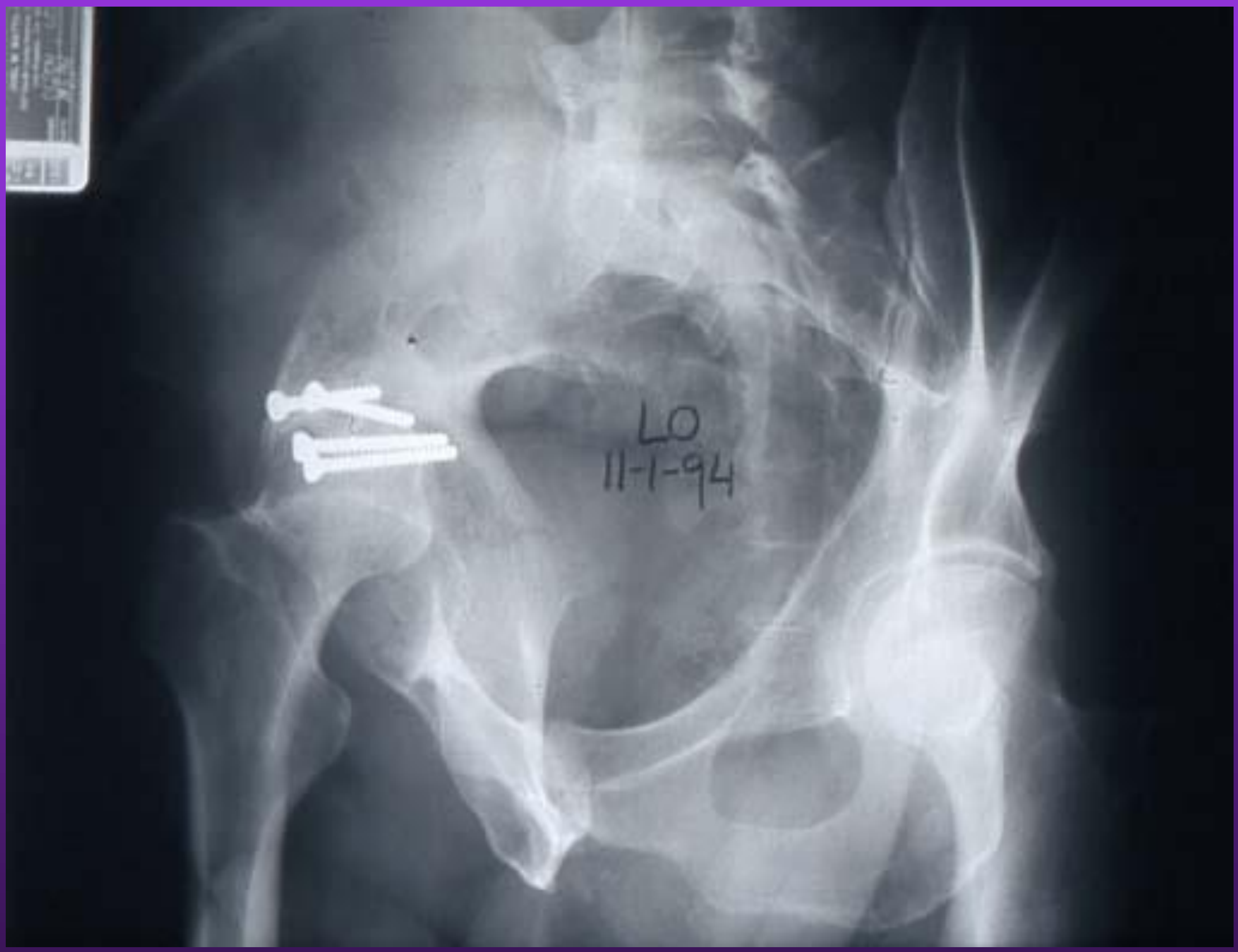
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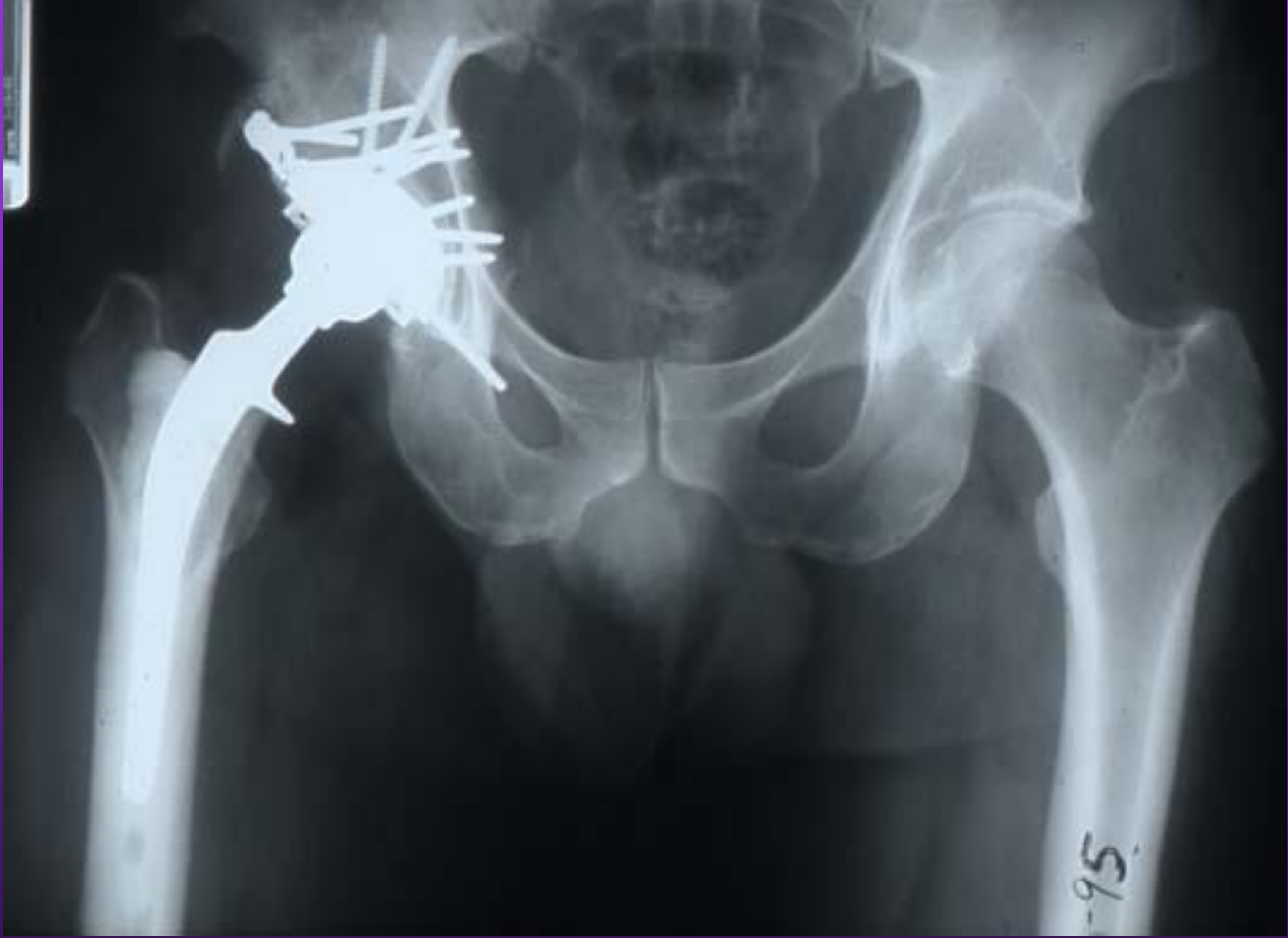


ORIF Versus Total Hip Arthroplasty in Elderly

Letournel

Osteopenia is one of the most important contraindication of ORIF of an acetabular fracture

Primary or Delayed Total Hip Arthroplasty

- Results poor (4-5x loosening of cup)
- Rarely needed after ORIF (7%-23%)
- Results better with ORIF even in elderly

Difficulties with ORIF

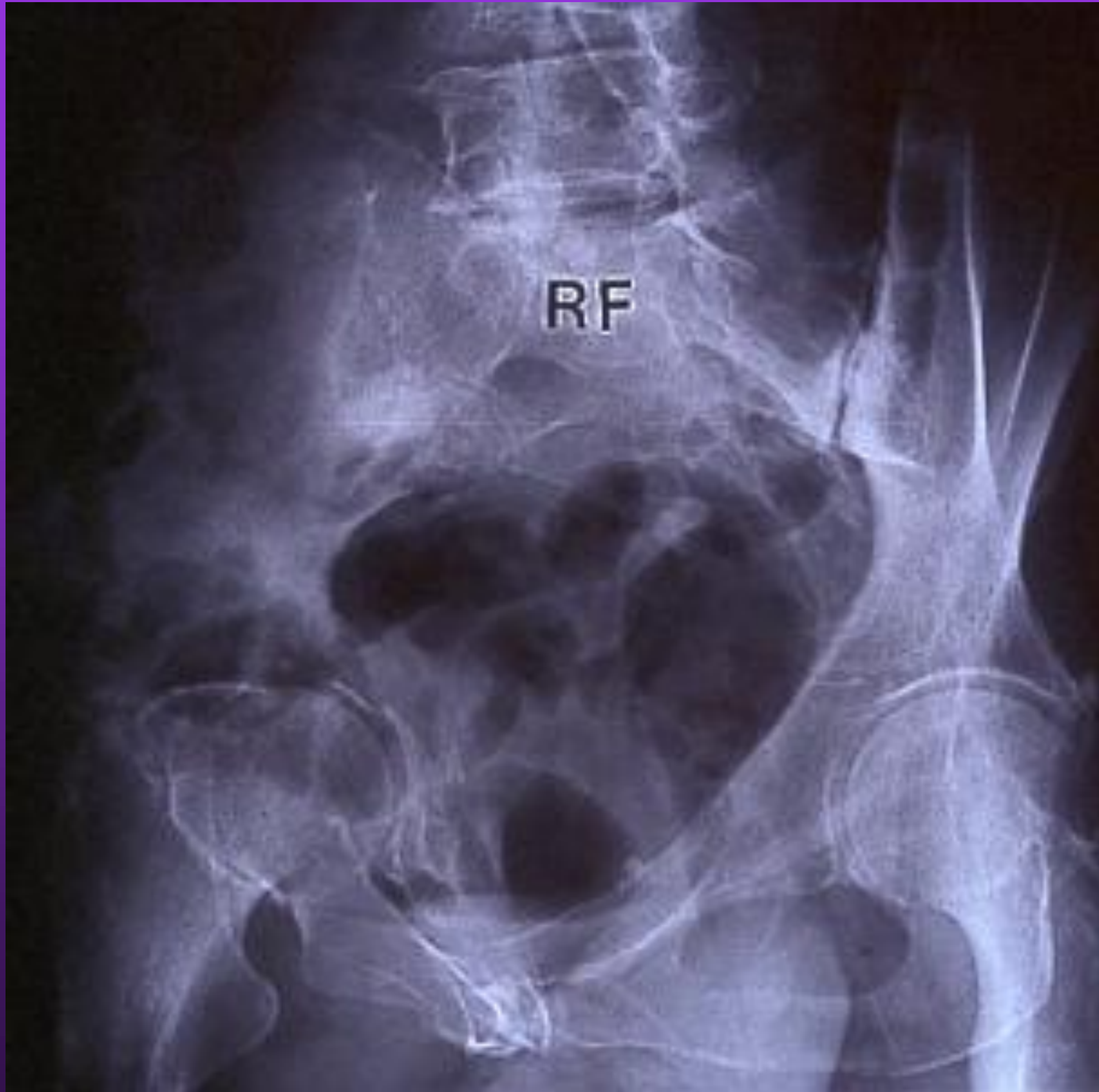
- Exposure more difficult with potentially increased complications
- Osteopenic bone holding fixation
- Anesthesia related risks

Difficulties with 1° Total hip Arthroplasty

- Requires same open reduction internal fixation
- Prolonged and technically difficult procedure
- Potential good results with ORIF only (i.e. which ones are going to fail?)

1° THA

- Femoral head damage
- Comminution of the quadrilateral plate
- Impaction of dome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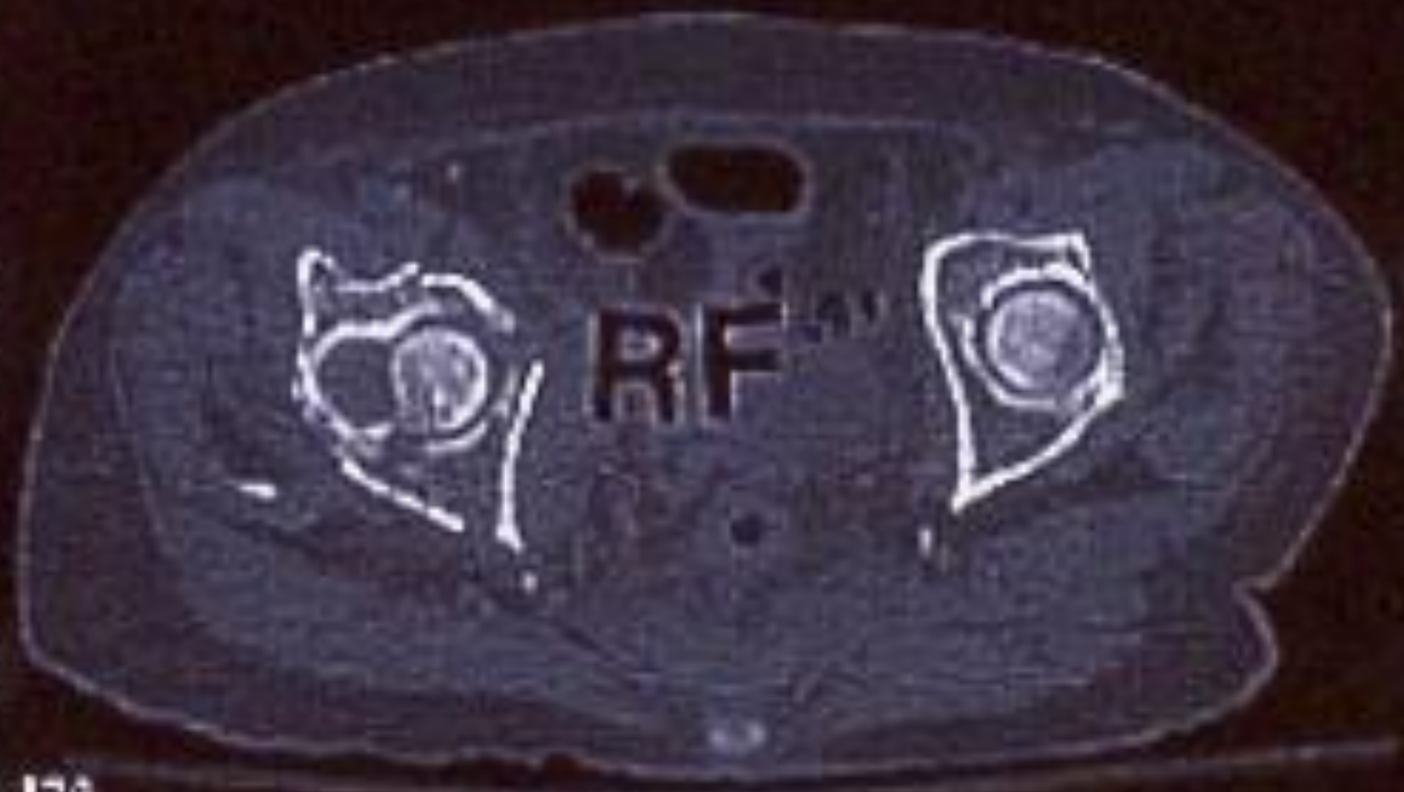
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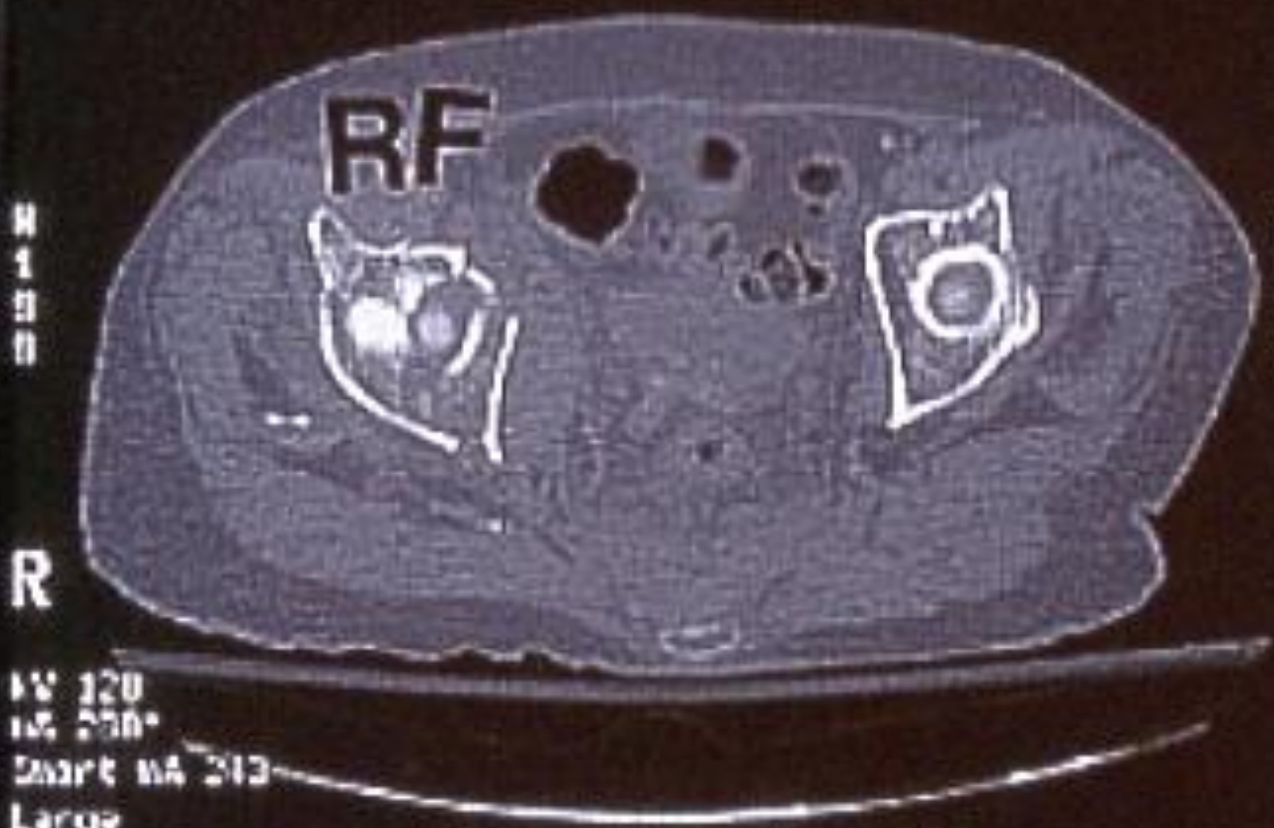
A210
BONE
RF
R
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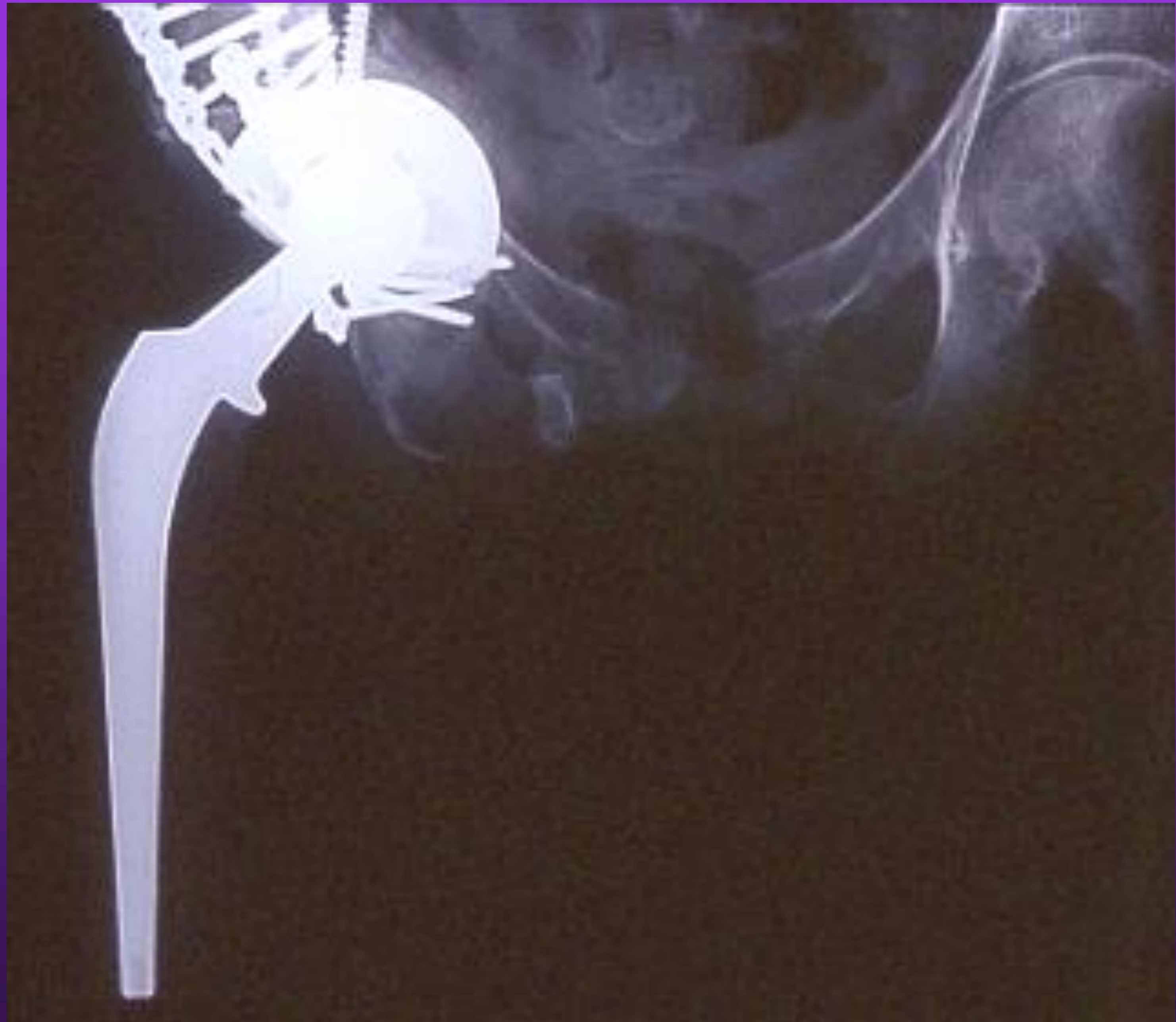


Moed CORR 2000

- 92/94 (99%) anatomical reduction plain films
- 44/59 (75%) CT scan >2mm fracture gap
- >1cm risk factor for poor results(17/59-29%)
- ?location of injury

Posterior Wall Fractures

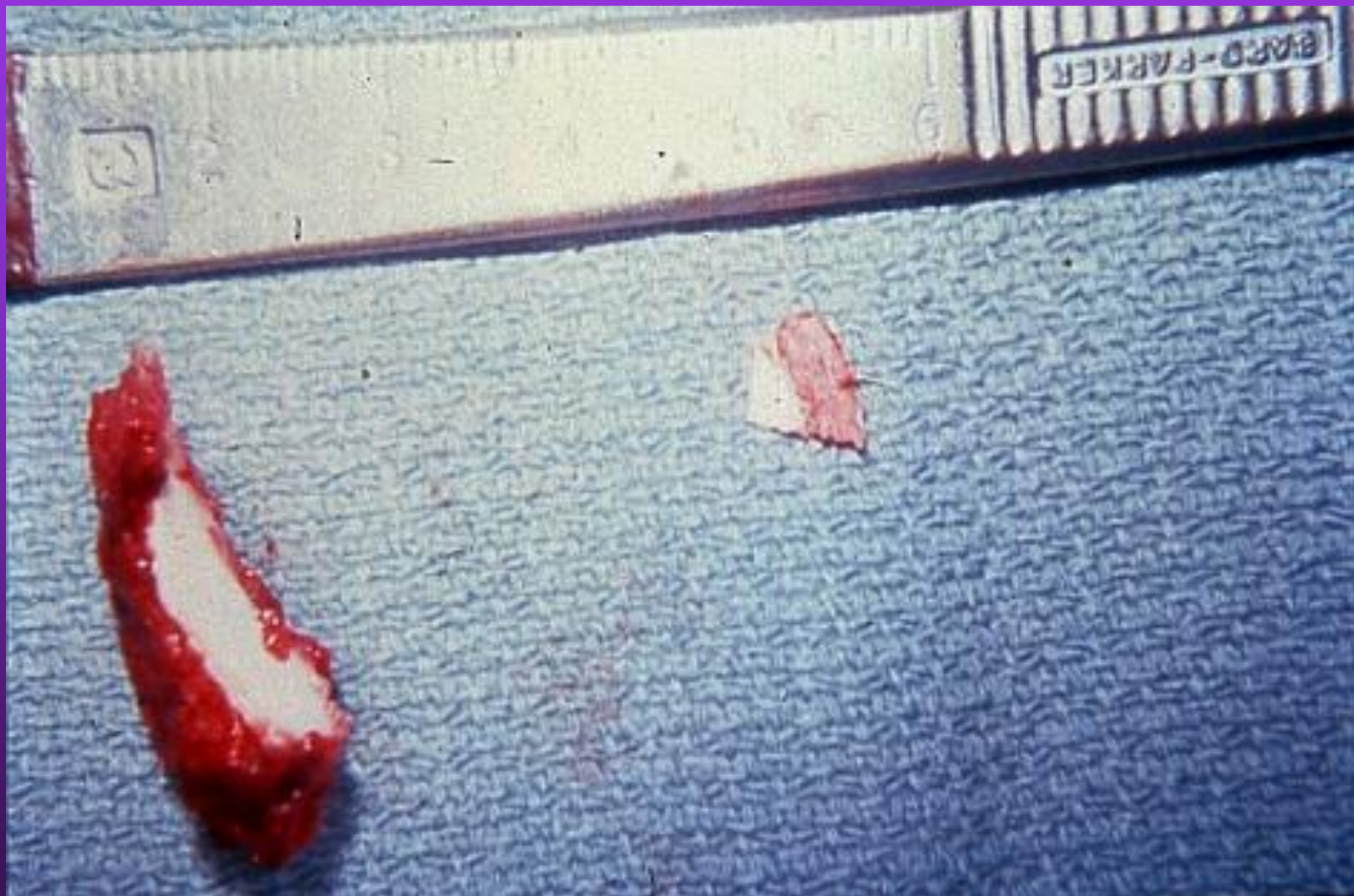
- Frequently missed
- Only 18/35 patients good or excellent results if operated on > 3 weeks (Johnson, Clin Orthop 1994)

Posterior Wall

- Surgical principles
  - Maintain capsular attachment to posterior wall piece
  - Clean out joint
  - 2-3 mm stripping at fracture line

Marginal Impactions

- Articular surface elevated with as much as possible cancellous bone
- Autogenous graft from greater trochanter or Norian (CaPh)
- Proximal based trap door 1 x 1 cm at vastus lateralis ridge


BARD-PARKER

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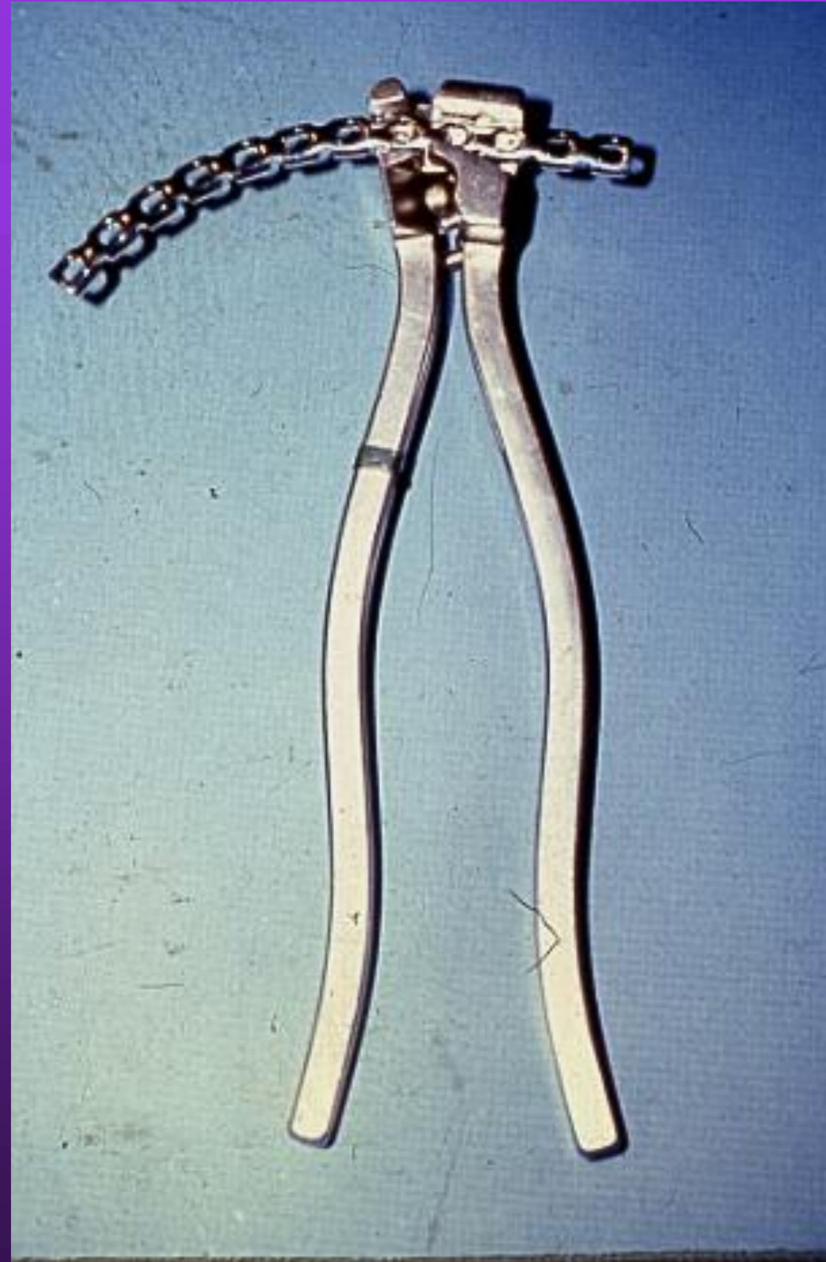

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- Address Marginal Impaction
- Provide adequate buttress
- Avoid Over-Contouring of Plate

Helfet, 1992 JBJS

"Stabilization of Acetabular Fractures in Elderly Patients"

Helfet (cont.)

- 17/18 follow-up > 2 years
- 1/17 failed – 1/17 poor
- 4/18 gap 3 mm with concentric reduction
- 1 loss of reduction

Helfet Unpublished Data

- 45 patients > 50 yo
- 3/45 THA 1°
- 11/45 THA after ORIF

Helfet (cont.)

- 51% complications (foot drop, intraarticular hardware loss of reduction, hernia, wound problems)
- Recommend THA only when femoral head damage (23% THA after ORIF)

Helfet (cont.)

- Recommended against extensive approaches due to HO and infection
- Preop indication - walker

Preop Assessment

- Independent walker
- Medical clearance
- Displacement > 3 mm in the 45° roof or subluxation of femoral head

Preop (cont.)

- Osteopenia
- Mentally able to cooperate with postoperative course

ORIF vs. 1° Total Hip Arthroplasty

- <1% of cases - THA combined with ORIF
- Better results in elderly with ORIF

Summary

- Understand and draw fracture on a pelvis
- Careful approach
- Anatomical reduction
- Stable fixation

The Pelvis is a Place to Work
Not a Place to Play