Challenges in the Management of Bone Metastasis

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Why Bone Metastasis ?

1-**Commonest type** of Skeletal Tumors.

2-One of the **Major Medical and Social problems** in the future.!!!!!

The incidence is likely to increase, as Ca. patients now survive longer.

3-Long-term survival means

Orthopaedic Surgeon must plan for durable fixation of #.

4- Advances in **Chemo R, Radiation R** & **reconstructive techniques** have **improved the treatment options.**

→ **restore function more quickly and more durably.**

5-Common **errors in Dx or surgical management** that has adversely affected function or survival.

6-These errors often share a common feature:

Rush in judgment and treatment rather than an informed, methodical evaluation.

Magnitude of the Problem

= **Skel. mets varies: 12-70%**

= **Bone**: **3rd** most common organ involved by mets, behind **lung and liver**.

= In Breast Ca.

(it is the **2nd** most common site)

In USA

= Ca. is the 2nd leading cause of death

= 350,000 people die with bone mets /Y

Roodman .N Engl J Med. 2004

Annual Dx of 1.2 million new Ca. cases.

@ 30% invasive Ca. (70% → Bone Mets)

@ 1 in 9 of all women had Ca. breast.

@ 7-10% develop pathological fractures

Common Sequelae of Bone Mets.

1-Pain due to PG, Substance P,…

2-Pathological Fracture,

3-Cord & Cauda Equina Syndrome

4-Spinal instability

5- Hypercalcaemia

6-B. M Suppression

Evaluation and Management

= History &Exam

= Imaging Techniques

= Lab. Investigations

=Proper Plan for Management

The indications for Surgery of long-bone and Pelvic Girdle metastases.

= Impending and pathological #

= Intractable pain

Presence of mechanical pain

Patients with a life expectancy of >6 weeks

The goal of Surgery

Reinforce or replace the affected bone with a rigid and durable construct.

Why durable construct?

Fixation must persist for the life, because the bone involved in metastatic lesions may not heal.

Principles of Surgical Management

1-Preop. **Embolization** of suspected vascular lesions e.g Renal ,Thyroid

2-Correction of **Hypercalcemia**

3-Correct preexisting anemia, thrombocytopenia and coagulopathy.

4-Avoid previously irradiated fields and ensure adequate soft tissue coverage

5-Curettage to remove all gross tumor.

Surgical Margins

Intralesional excision are appropriate in metastatic skeletal lesions requiring fixation

Extralesional excision i.e. resection (for a solitary metastatic lesion).

How to avoid undertreatment of pathologic & impending #?

Always ask,

“Where can I put the bone cement?”

1-Upper Extremity Mets

= 20% of bony mets occur in UL.

= 50% are in the humerus.

=Disabling as in the lower extremity.

Predicting the Risk of Pathological Fracture

Mirels' Scoring System

Clin Orthop. 1989

Variable		Score	
	1	2	3
Site	Upper Limb	Lower Limb	Peri-trochanter
Pain	Mild	Moderate	Severe
Lesion	Blastic	Mixed	Lytic
Size	<1/3	1/3-2/3	>2/3

TABLE II Mirels's Scoring-Based Treatment Recommendations[6]

Total Mirels Score (points)	Risk of Fracture	Recommended Treatment
≥9	Impending **33% risk**	Prophylactic fixation
8	Borderline **15% risk**	Consideration of fixation
≤7	Not impending	Nonoperative treatment

Problems

= Some patients with an impending fracture may **not experience pain**.

= Not applicable to the acetabulum and the Vertebrae **(Complex Anatomy)**

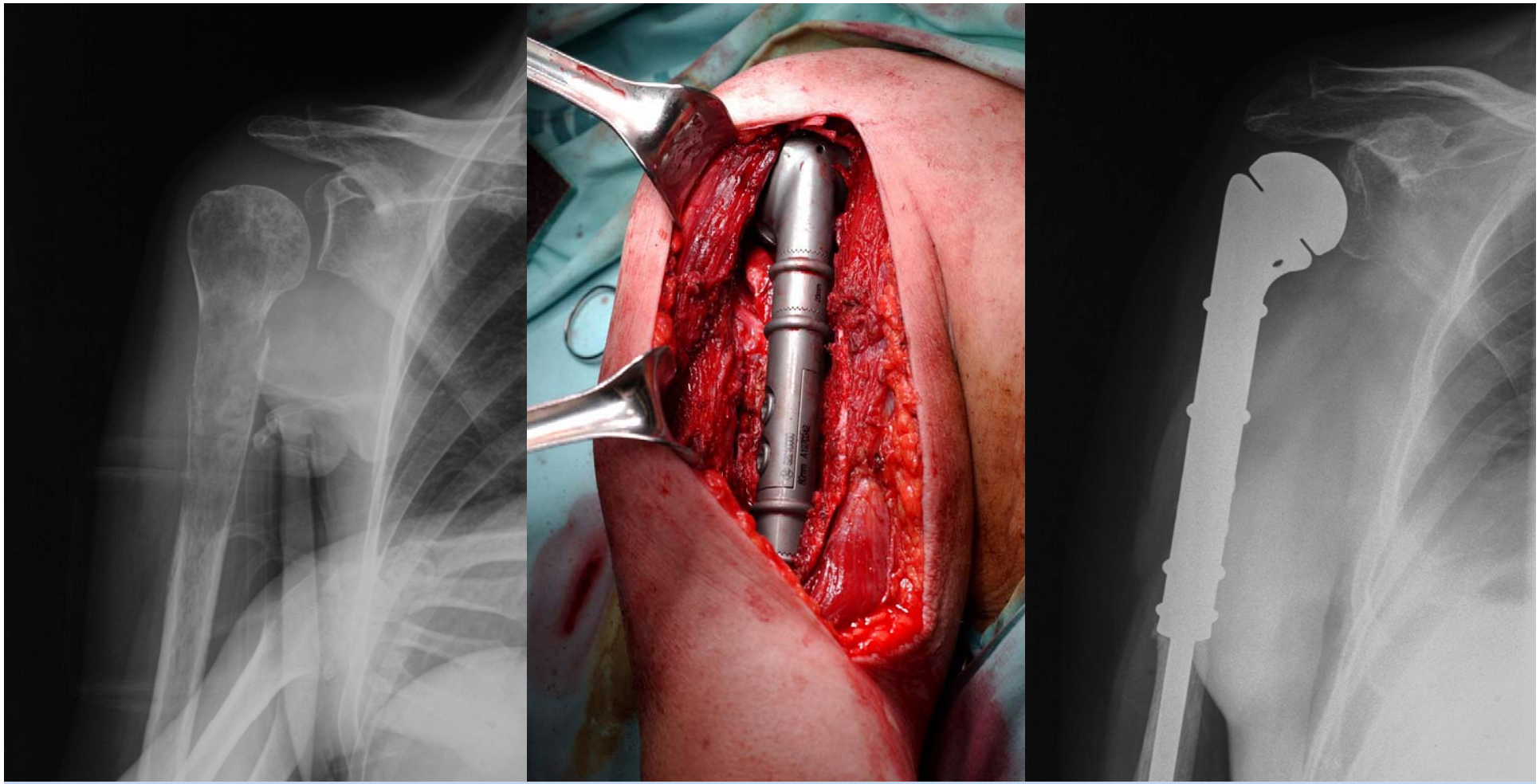
Humeral Head Mets

= Hemiarthroplasty with long stem or

= Plates with PMMA

Proximal Humerus Mets

Resection of the proximal humerus &
Endoprosthesis reconstruction



Mets. Renal Cell Ca.

Endoprosthesis Reconstruction

Mets Renal cell and Thyroid Ca. are the only Solitary Bone Mets. for which resection increase patient survival

Lin etal. JBJS-A . 2007

Sampson etal. Cancer. 2007

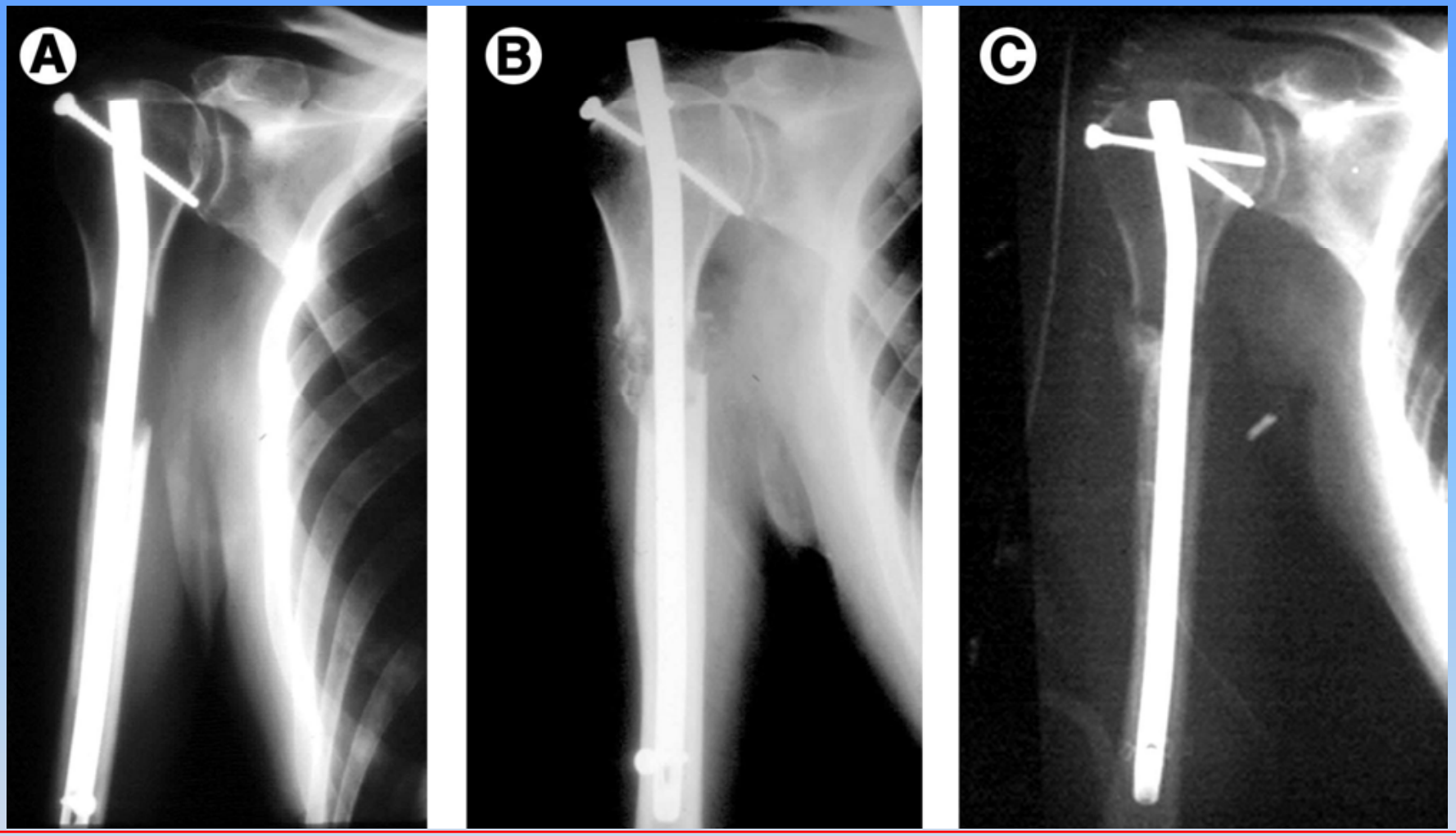
Upper Humeral Shaft Mets

1= Locked or Cemented IMN

(Flexible IMN, are no longer recommended).

2= Side Plate + Screws & PMMA

Nails to Plates equal resultS



(A) inadequate reconstruction
(B) failure of fixation
(C) appropriate reconstruction with cementation.

3= Resection & Shortening

if the lesion is < **3 or 4 cm** in length.

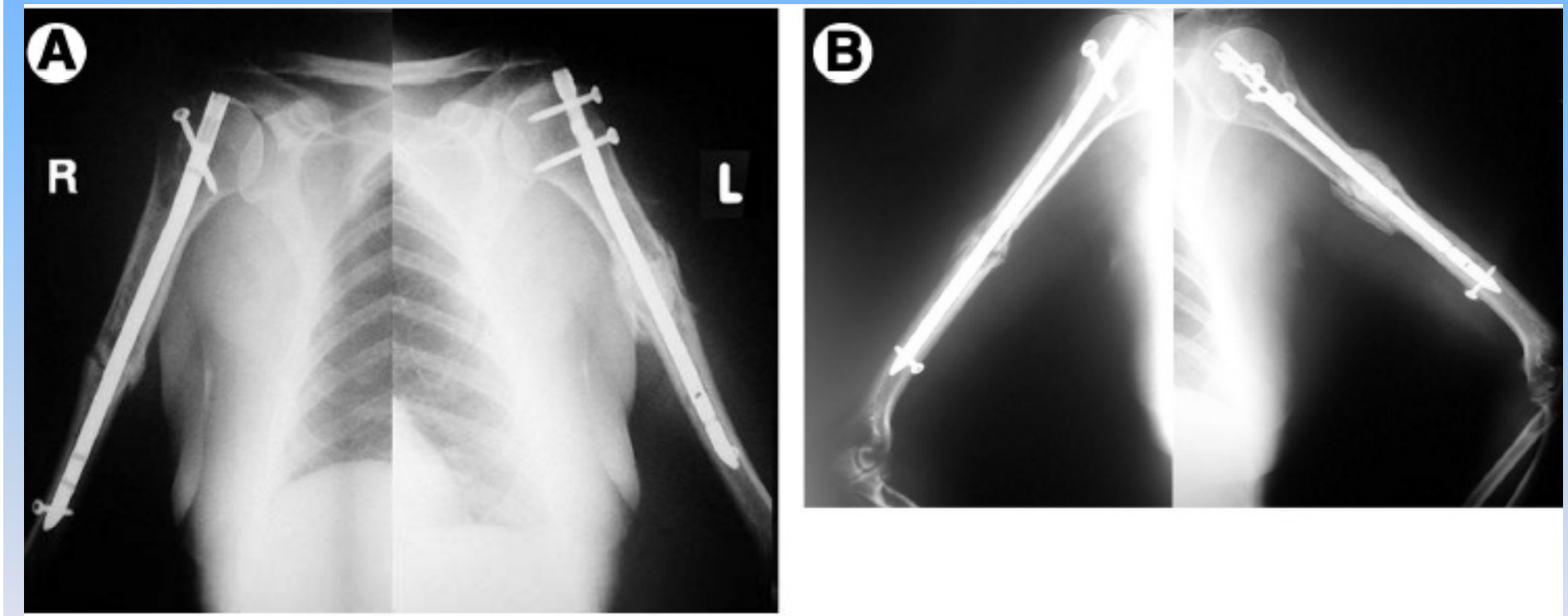
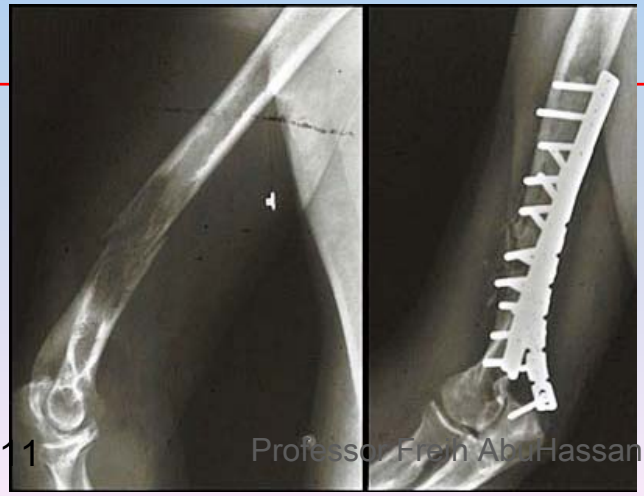


Figure 5 Bilateral humeral shaft fractures treated with a locked rod on the patient's right and a locked rod with cementation on the left. Radiographs taken immediately postoperative (A) and 5 months postoperative (B).

Lower Humeral Shaft Lesion

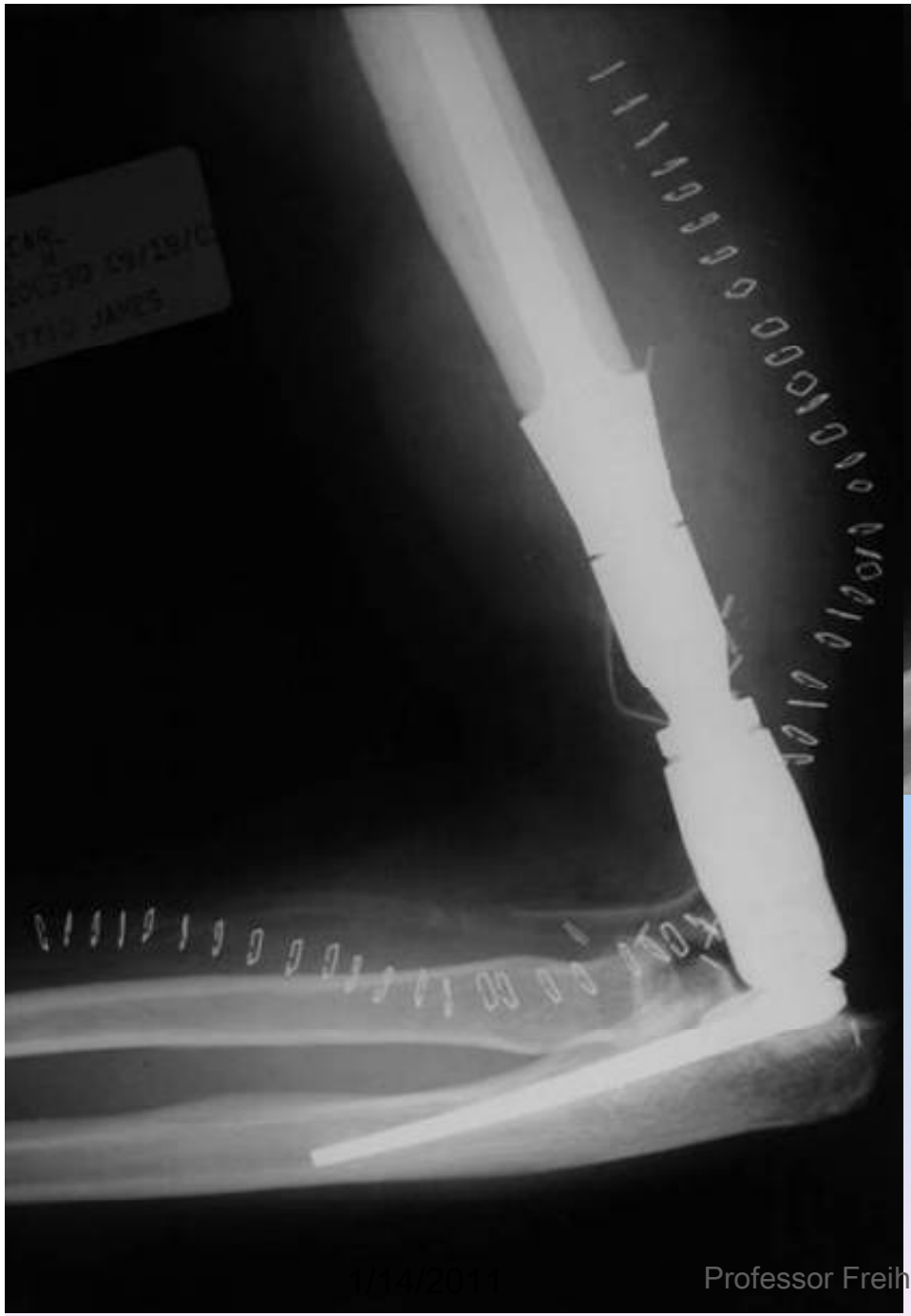
Dual reconstruction plates with PMMA

N.B: Olecranon osteotomy → nonunion when patients are radiated.



Extensive lesions near the joint

Total elbow arthroplasty



Forearm Mets

Plate fixation with PMMA

2-Spinal Metastases

= 98% of Spine tumors are mets

= Vertebral body affected first.

Indications of Surgery

1. **Intractable pain**
2. **Growing tumor** resistant to other measures.
3. **No response to Radiation Therapy**
4. **Spinal instability**
5. **Neural compression.**

Tomita 2001, McAfee 1989, Siegal 1989

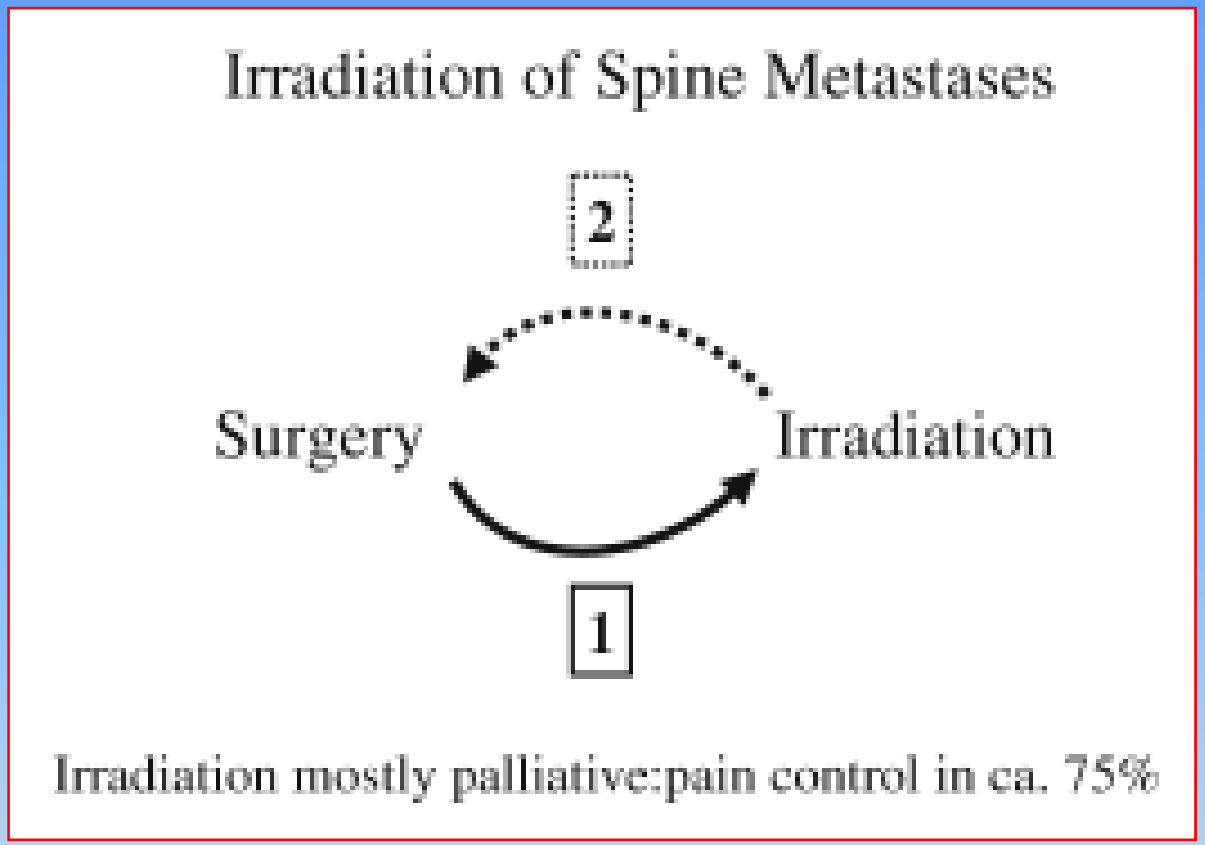
Signs of Spinal instability

=Transitional deformity

=Vertebral body collapse of >50%

=Tumor involvement of 2-3 columns

= Involvement of the same column at > 2 adjacent levels.



= Surgery before irradiation

= Irradiation which preceding surgery has a significantly higher complication rate.

Disadvantages of Laminectomy for Treatment of Spinal Cord Compression.

= Does not address the ant. pathological process.

= Removal of the post. elements may worsen the existing instability and deformity

Ideal Operation for Spinal Mets

Removal of the tumor, and fixation for stabilization.

Holman. etal. J Neurosurg Spine. 2005

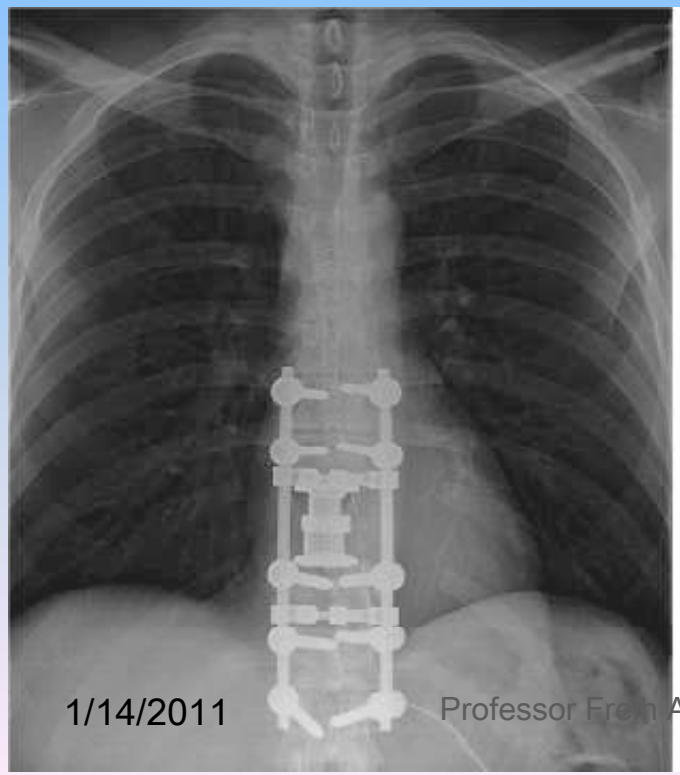
= **Anterior approach**(thoracotomy) for Th.V
= **Retroperitoneal approach** for L. vertebrae
= **Posterolateral approach**.
= **Transpedicular approach**

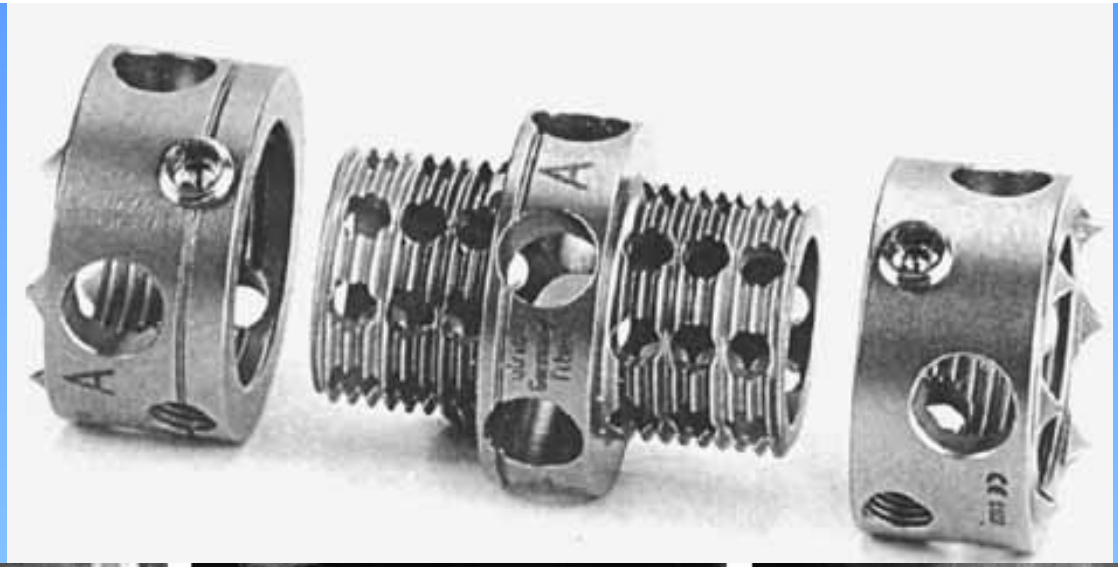
Graham. Etal. Orthopedics. 1997

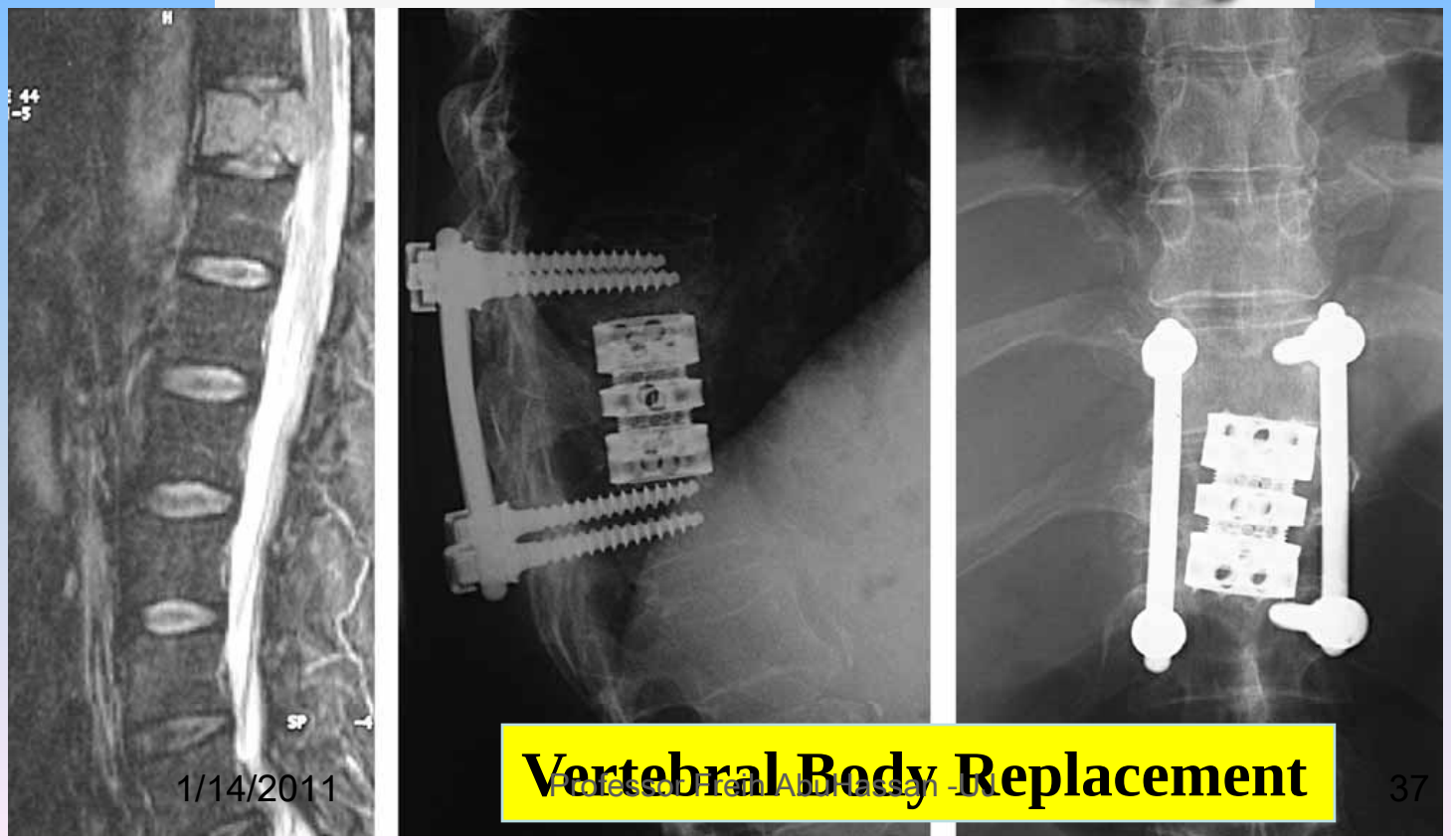
=Fixation with **Cages and Ant. Plates** is the preferred technique in most instances.

=**Circumferential fixation** is advisable when posterior elements are involved.

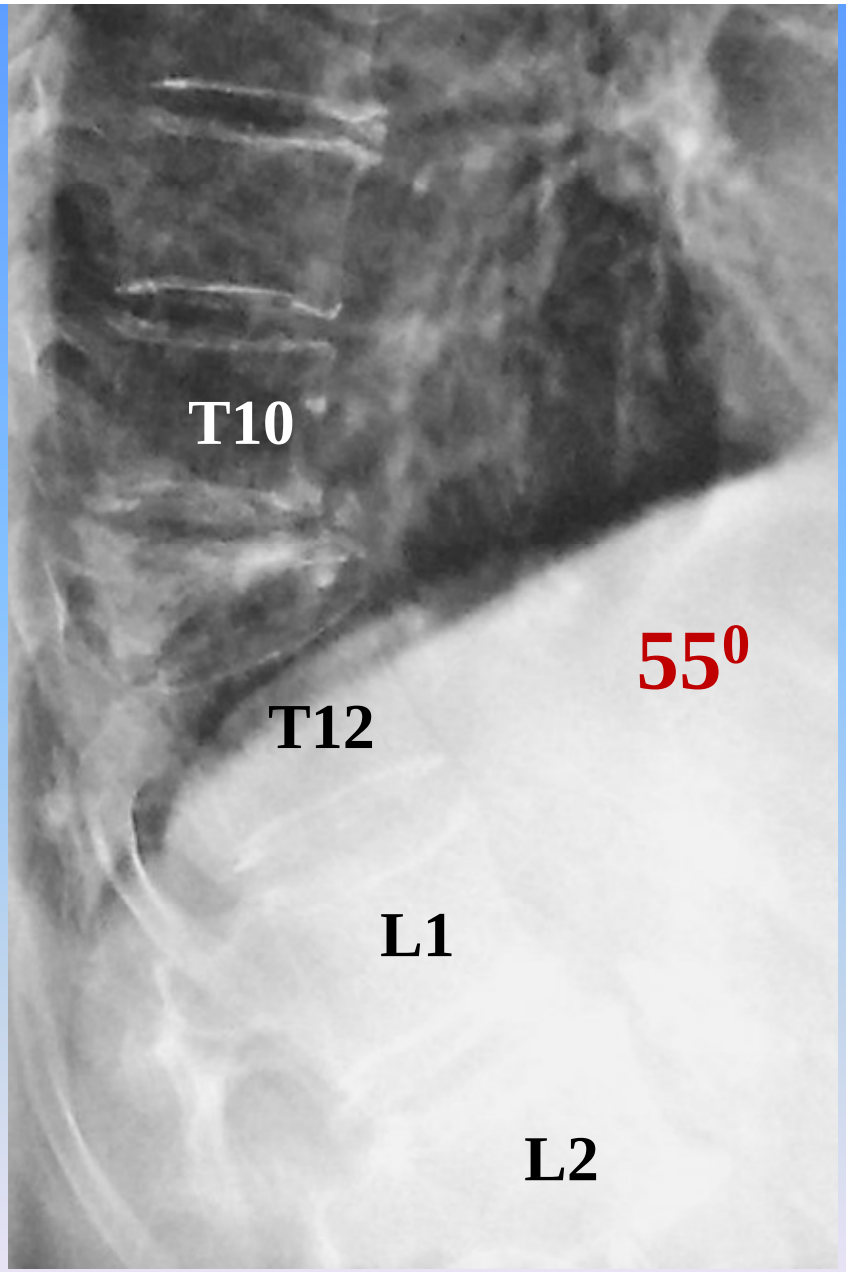

SWISS



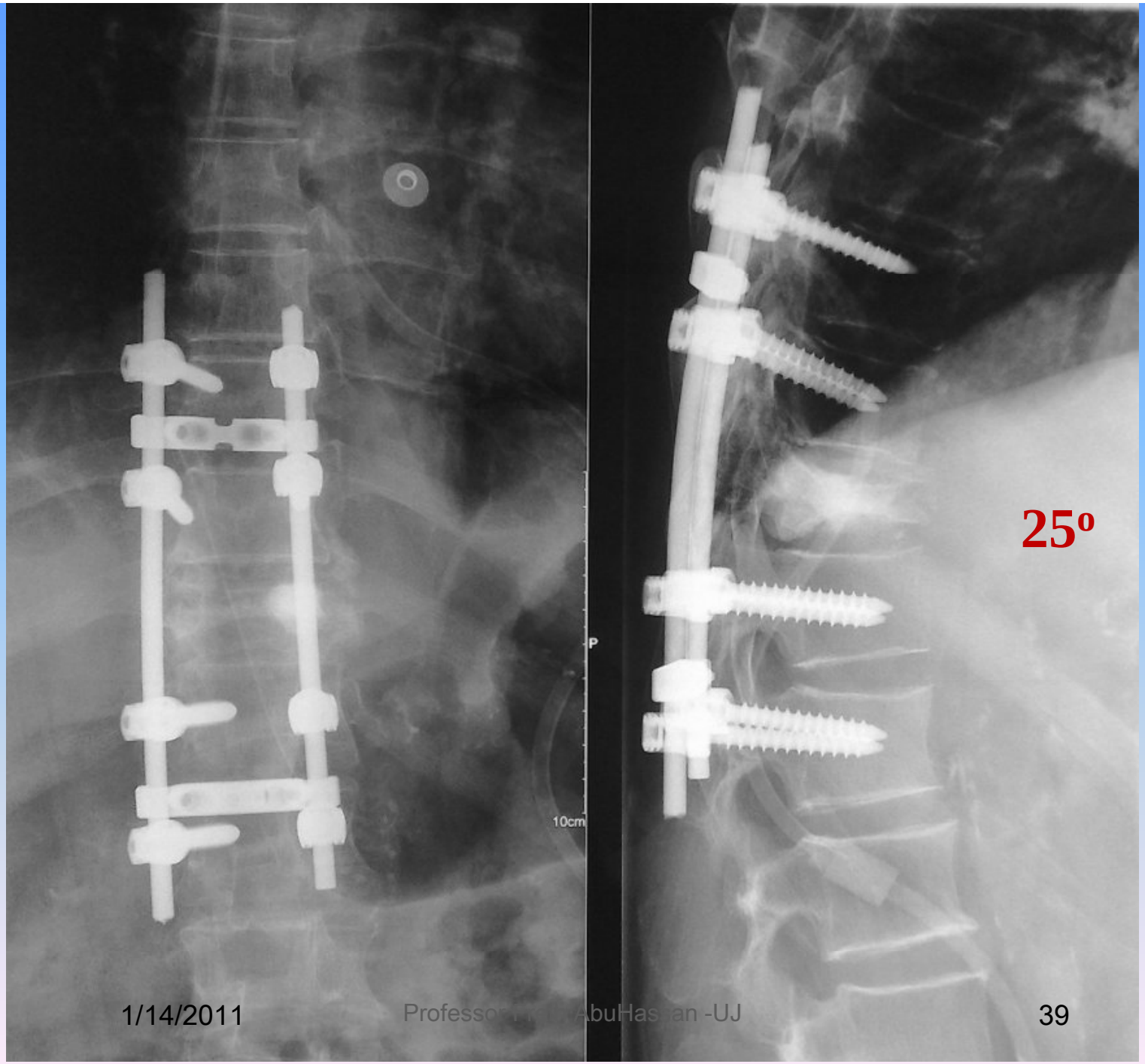




Vertebral Body Replacement



73-year-old man with T11 Lesion (Prostate Ca.)


25º
10cm

Vertebroplasty

Direct injection of PMMA into the vertebral body →induce immediate stability.

Kyphoplasty

Inflatable balloon to restore the vertebral body height and correct the kyphotic deformity followed by the injection of PMMA.

Indications

= Spinal mets in poor medical condition or a short life expectancy

= Intractable pain,

= Spinal instability without a neurological deficit.

Advantages

=Stabilization,

= 45% correction of the kyphosis

=Immediate pain control in about 85%

Chen etal Spine. 2007

Potential Complications

= Leakage of cement into the spinal canal 10%
= Epidural spinal cord compression

Singh etal. J Bone Joint Surg Br. 2006

3-Periacetabular lesions

Technological advances have simplified the surgical treatment of Pelvic Metastases

Protrusio Ring Devices, +/- Flanges, Obturator hook

Harrington Classification of Acetabular Bony Defect

Class I Contained Cavitary defect.
Lateral cortices, ***Superior*** walls & ***Medial*** walls are intact

Class II ***Medial*** wall and ***Dome*** involved-
Peripheral acetabulum / rim intact

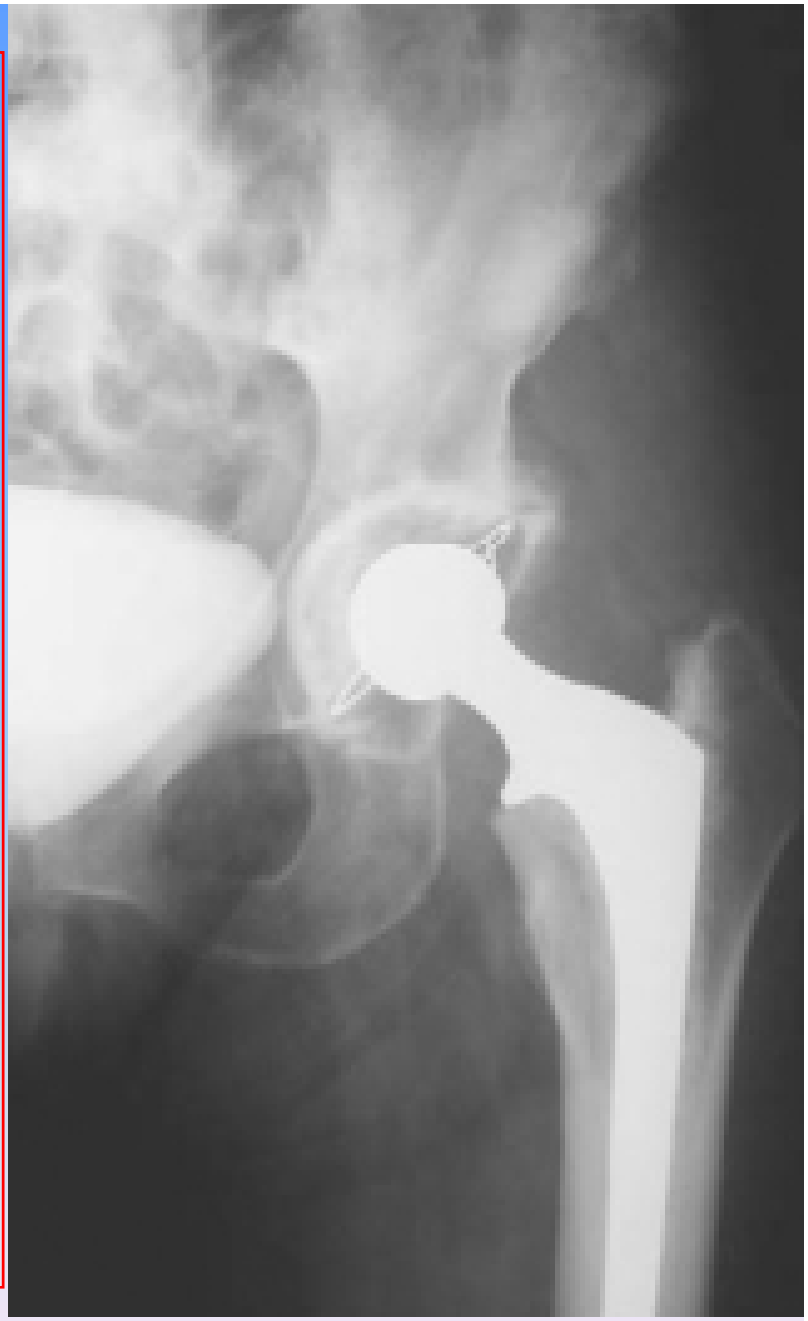
Class III Defects in both lateral wall and the Superior cortices

Class-I lesion →

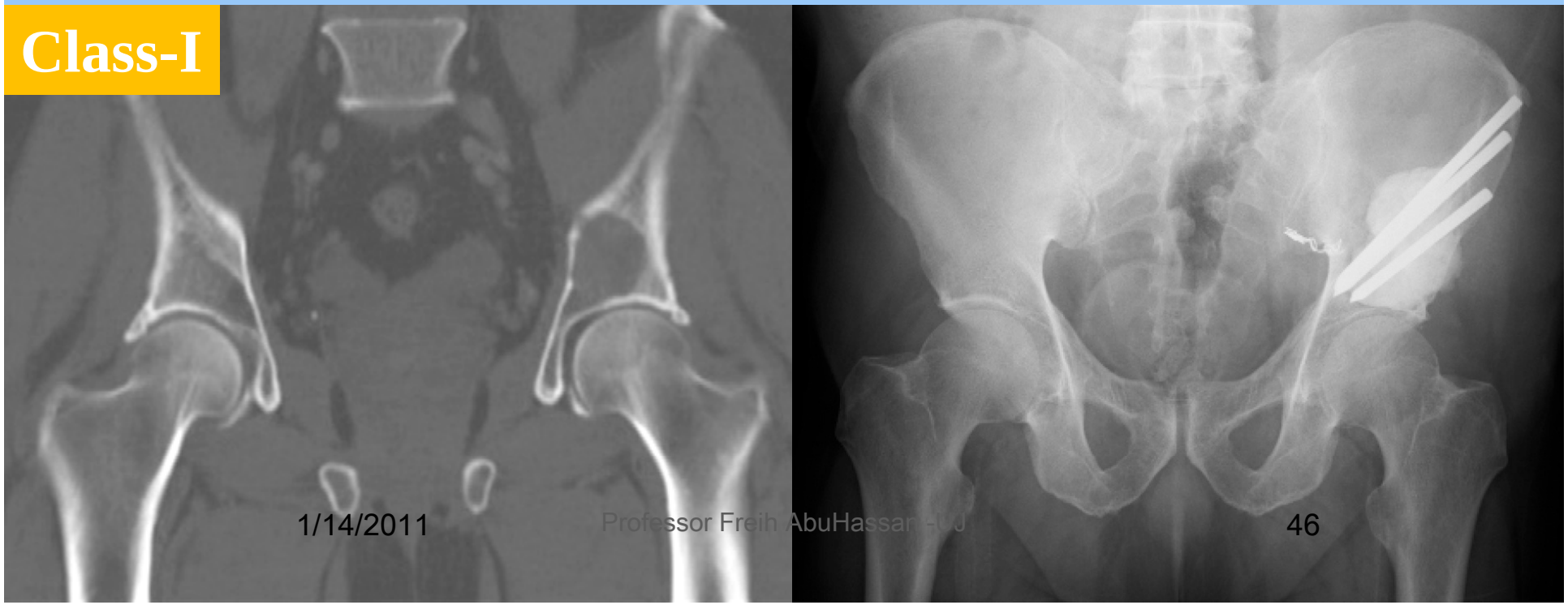
Conventional Cemented Acetabular Component.

More recently, **Trabecular Metal Acetabular** components esp in patients treated preop. with pelvic radiation

Rose. etal Clin Orthop. 2006



In Class-I lesion with sufficient bone over the roof, can be treated with intralesional Curettage and internal fixation with PMMA



Class-II (loss of Medial structural continuity) → **Protrusio Acetabuli Cup**.

Class-III

All three elements of the acetabular cavity are violated → Complex reconstruction of the missing cavity with

= Steinmann pins

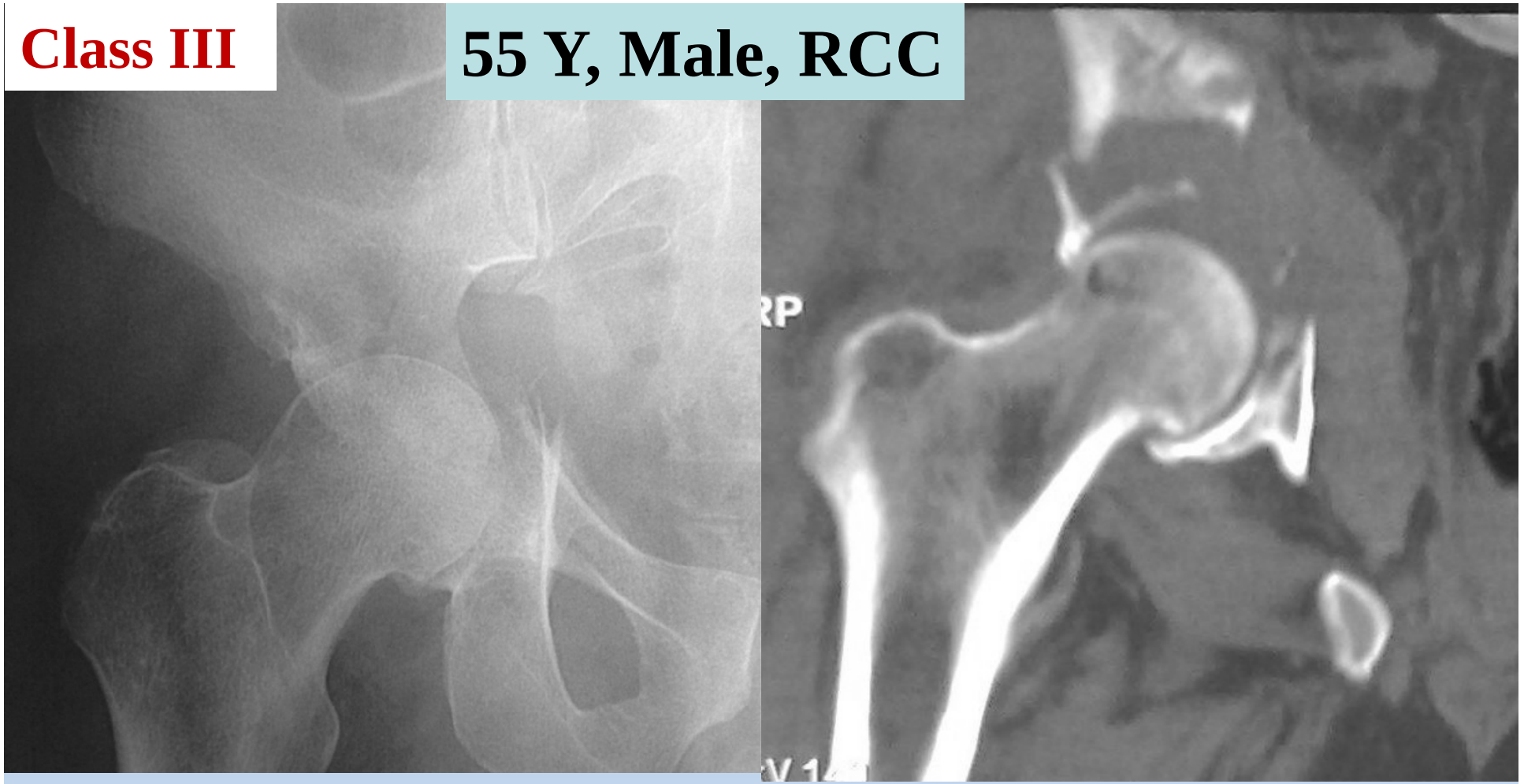
= Mesh

= Special Recon. Ringes

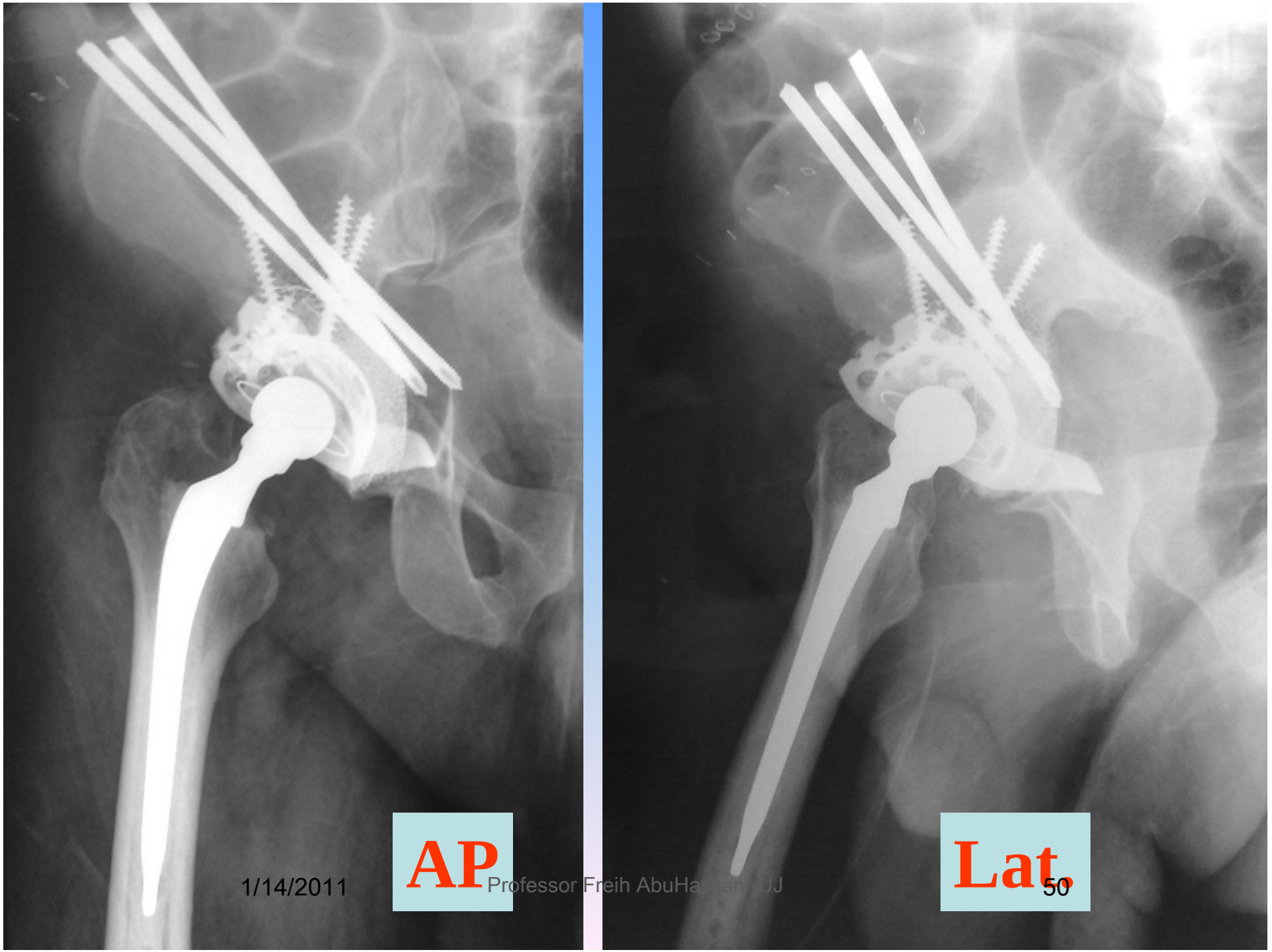
= PMMA

Class III

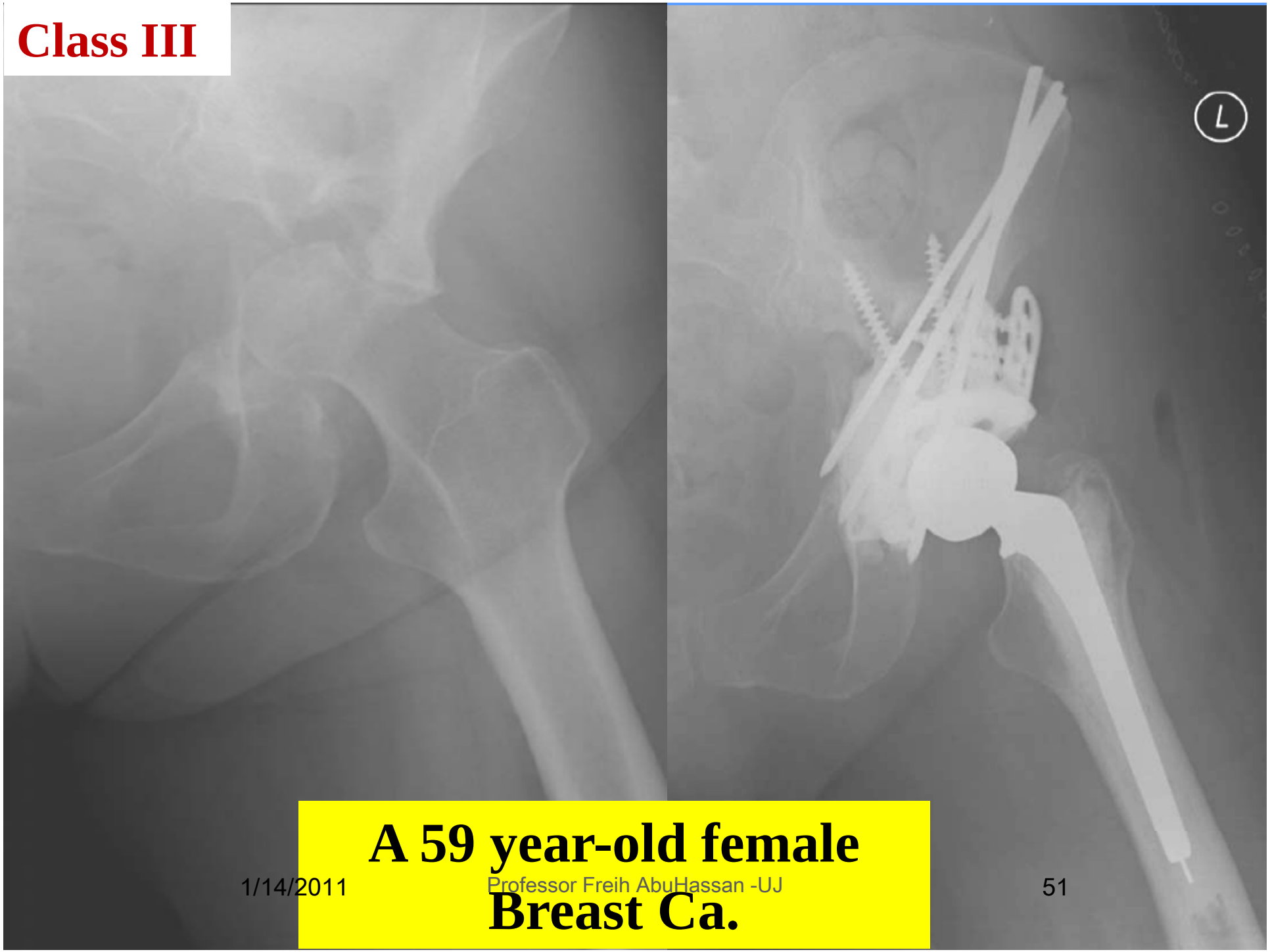
55 Y, Male, RCC



Medial wall, superior dome and much of the acetabular rim have been destroyed (Preserved femoral head)


AP
Lat.

Class III

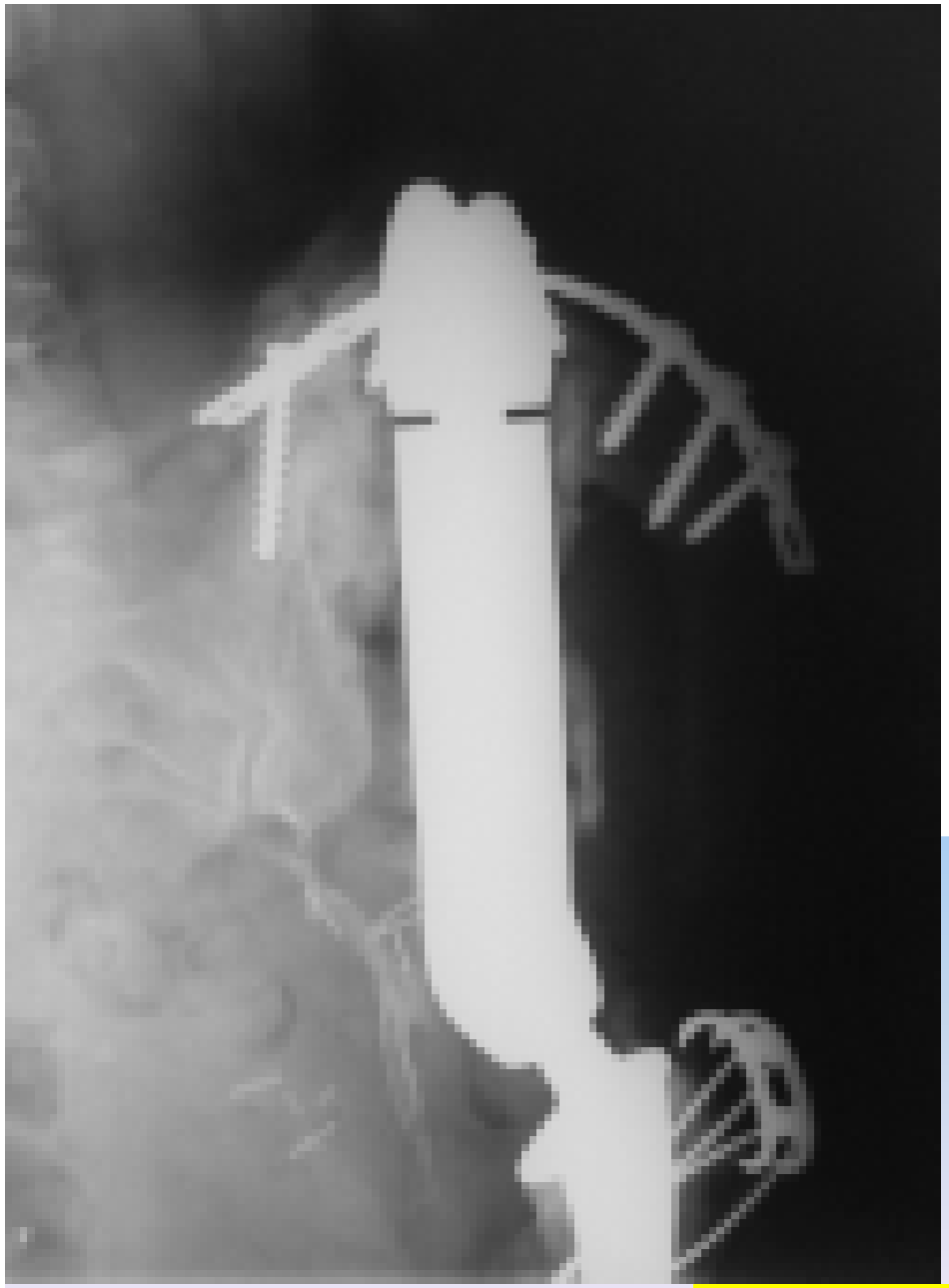


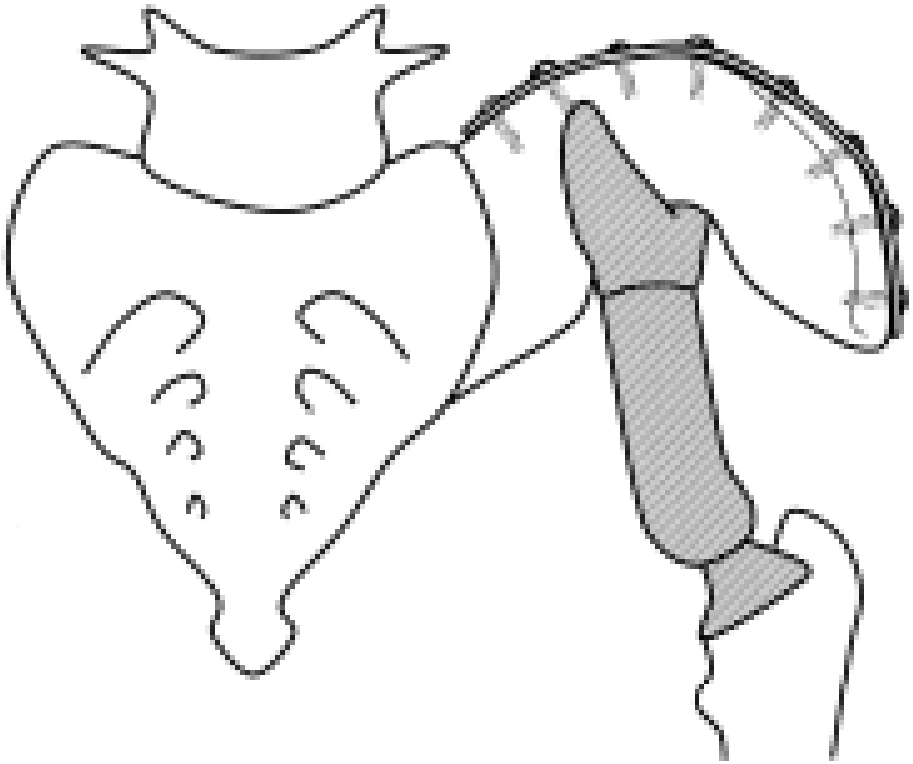
A 59 year-old female

Breast Ca.

Introduction
The GMRS™ Pro
a decade of clinic
to improve range
patient anatomie
are fully compatil
The components
standard and troc
left and right ank

Saddle Prosthesis





Kitagawa. J Orthop Surg. 2006

4-Lower Extremities Metastasis

Harrington's Definition of an impending path. # of a long bone

= Cortical bone destruction of 50%
= lesion of 2.5 cm in the proximal part of the femur
= Pathological avulsion # of the lesser trochanter,
= Persistence of pain despite radiation therapy.

Harrington. Instr Course Lect. 1986

Neck femur

If destruction is limited to the femoral neck or head

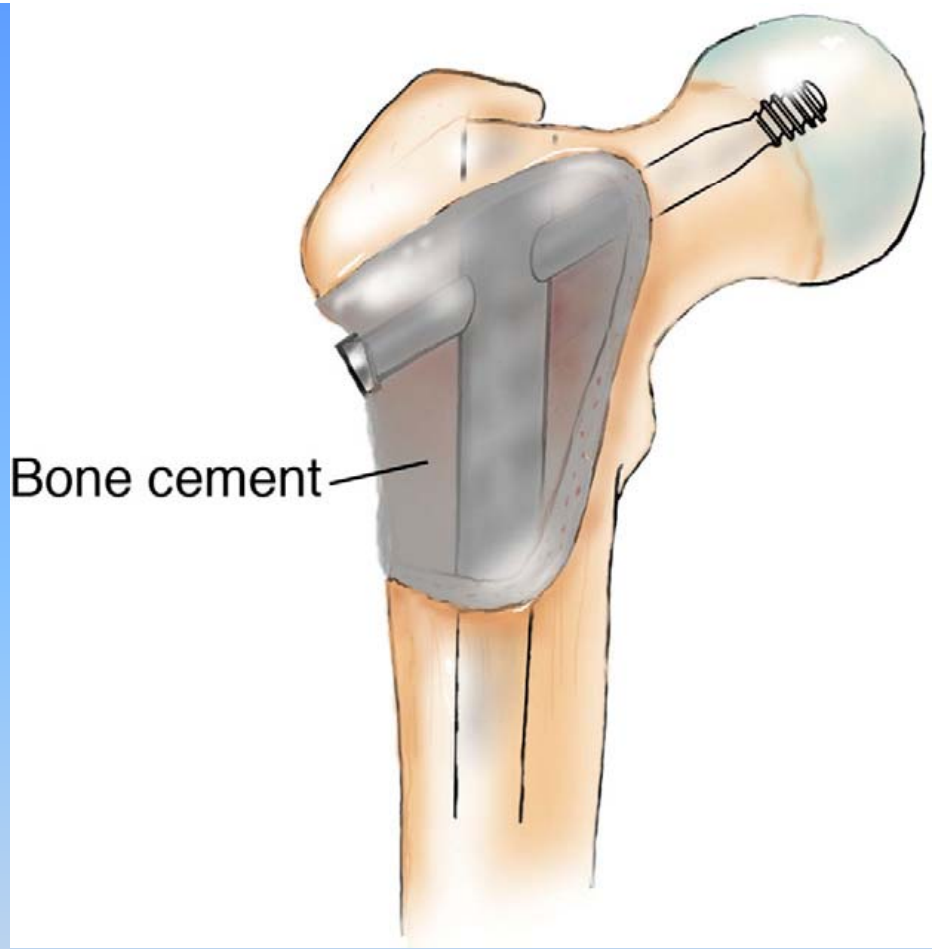
= Cemented Hemi arthroplasty

= Cemented Total Hip replacement.

Long Stem Cemented Hemiarthroplasty

Trochanteric fractures

May require cemented arthroplasty if there is significant destruction of bone.

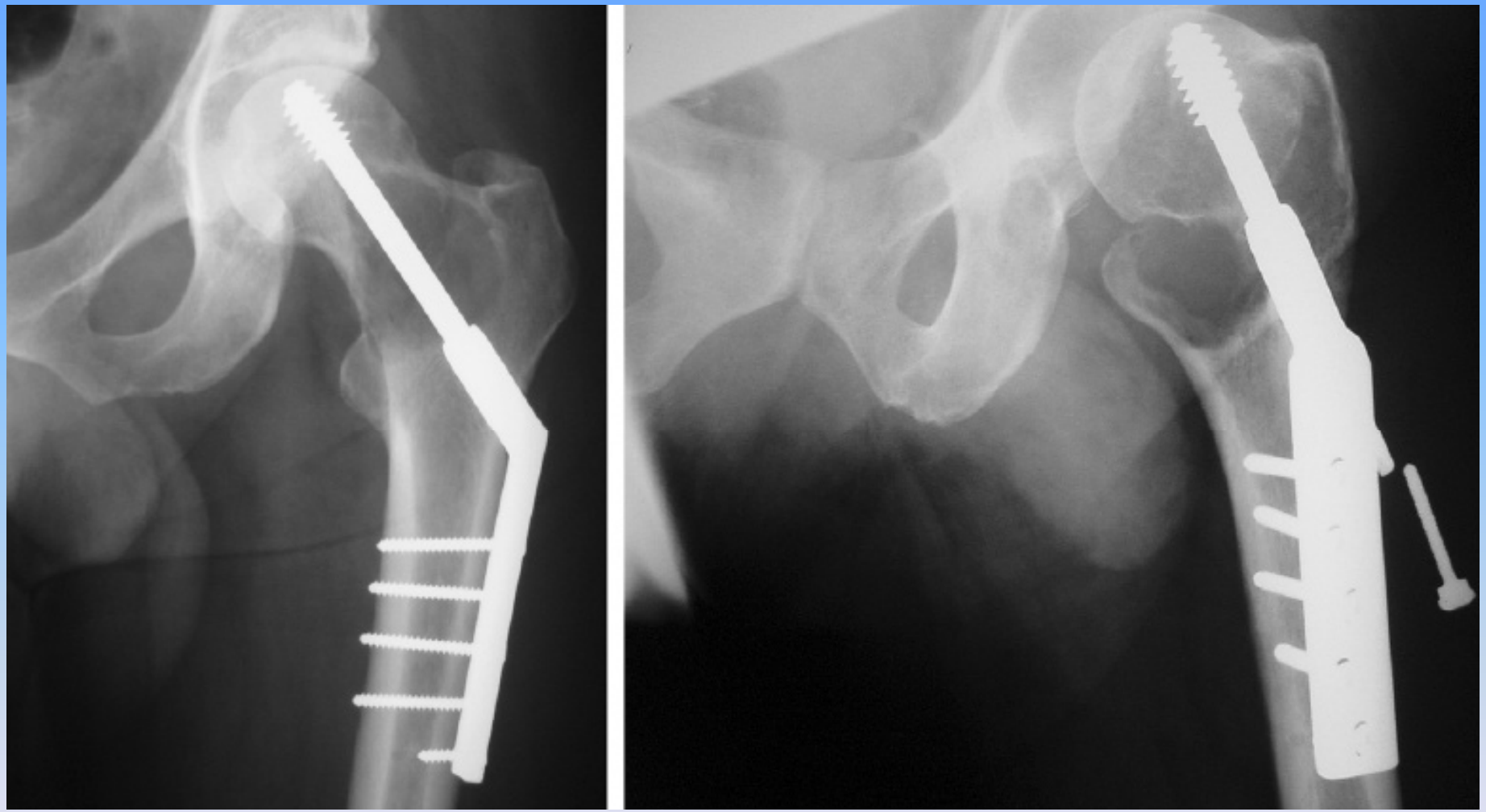


Cemented IMN

Onlay devices e.g DHS are seldom indicated in pathological #

→ high rate of mechanical failure

(breakage or cutting-out of the screws)

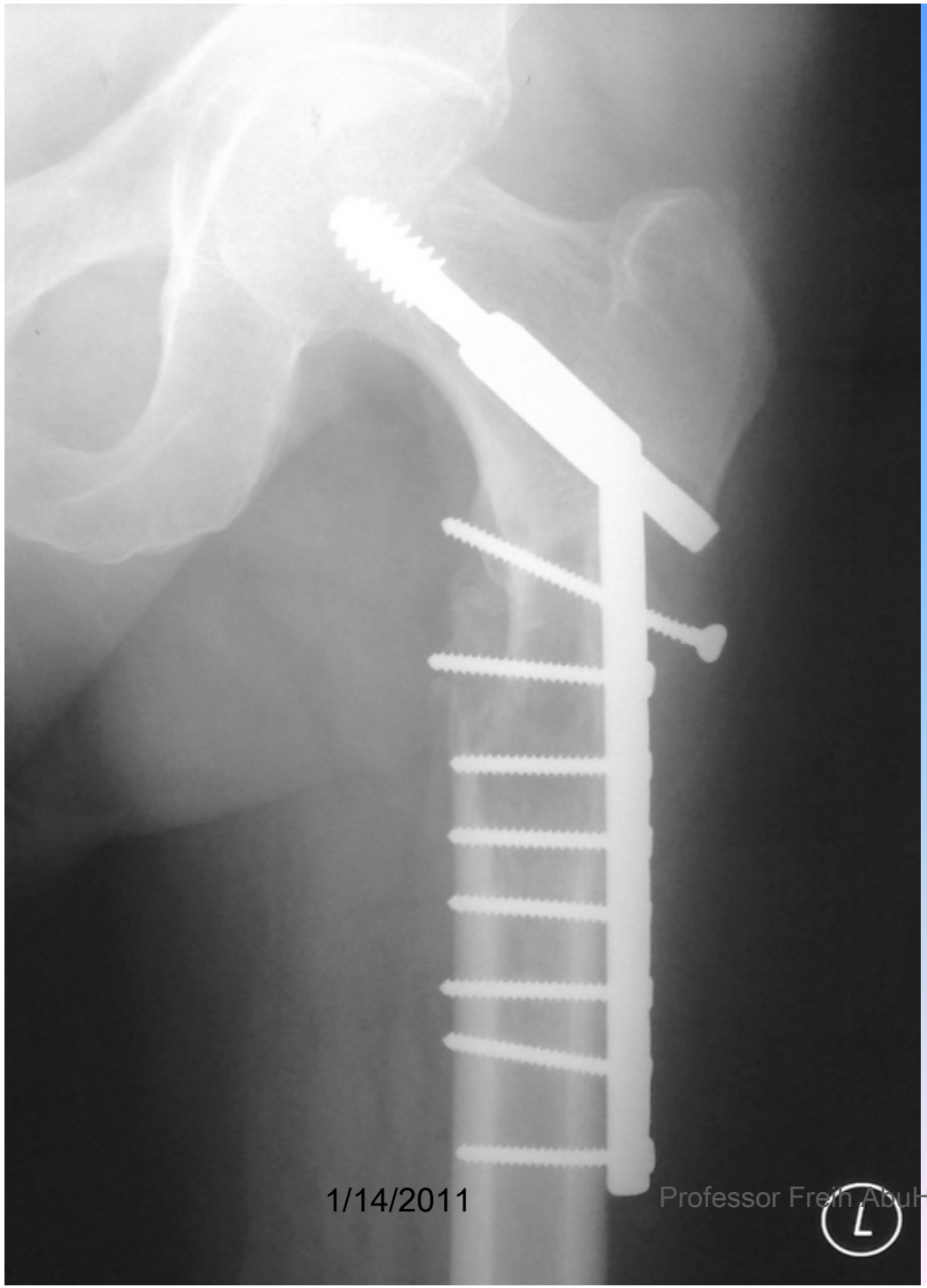


Subtrochanteric fracture

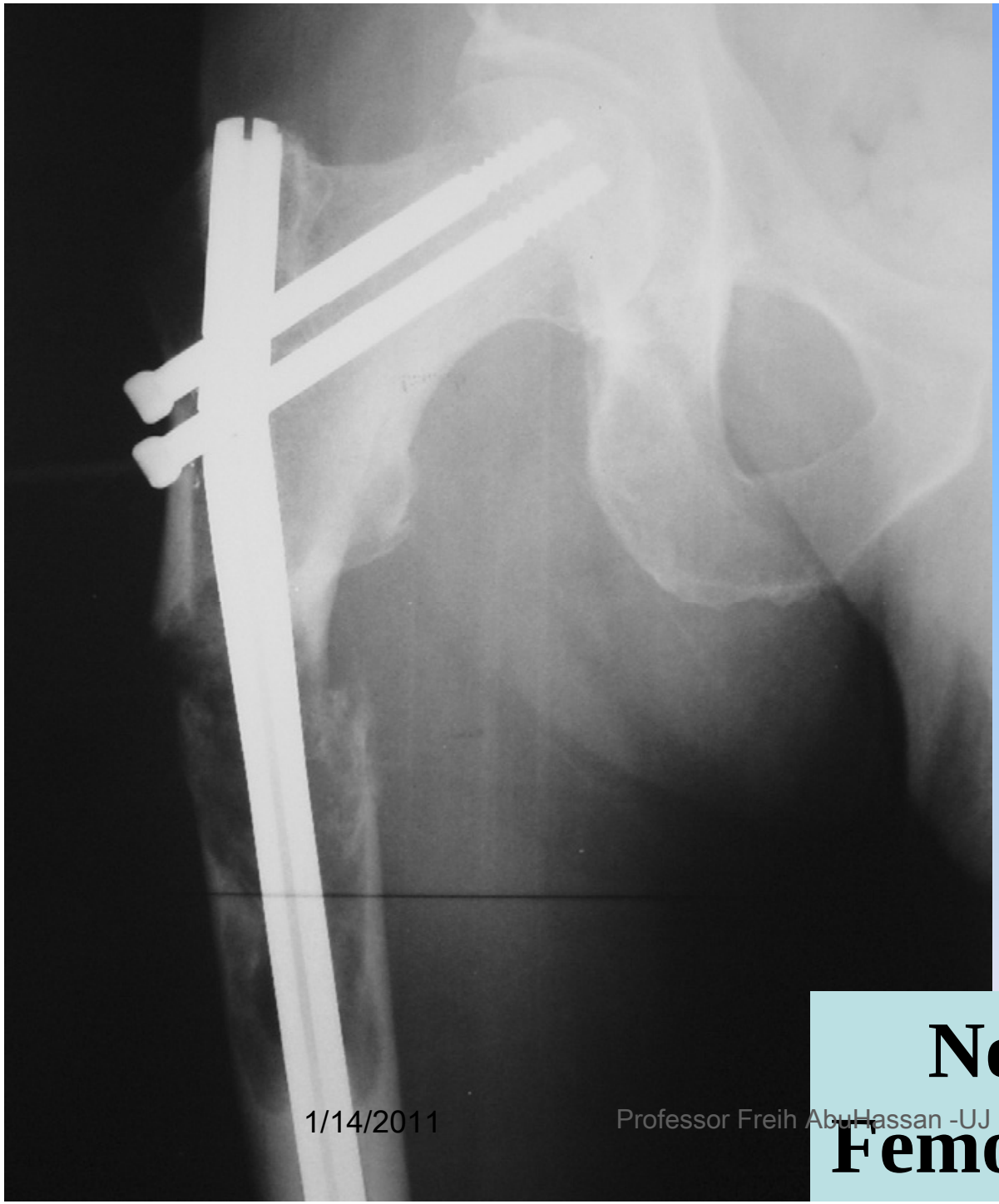
Reconstruction nail with locking screws along the femoral neck.

→reduces the risk of subsequent NOF fracture

if the fracture fails to unite, persisting pain may result in revision surgery or even **Proximal Femoral Replacement**.



Renal Cell Ca



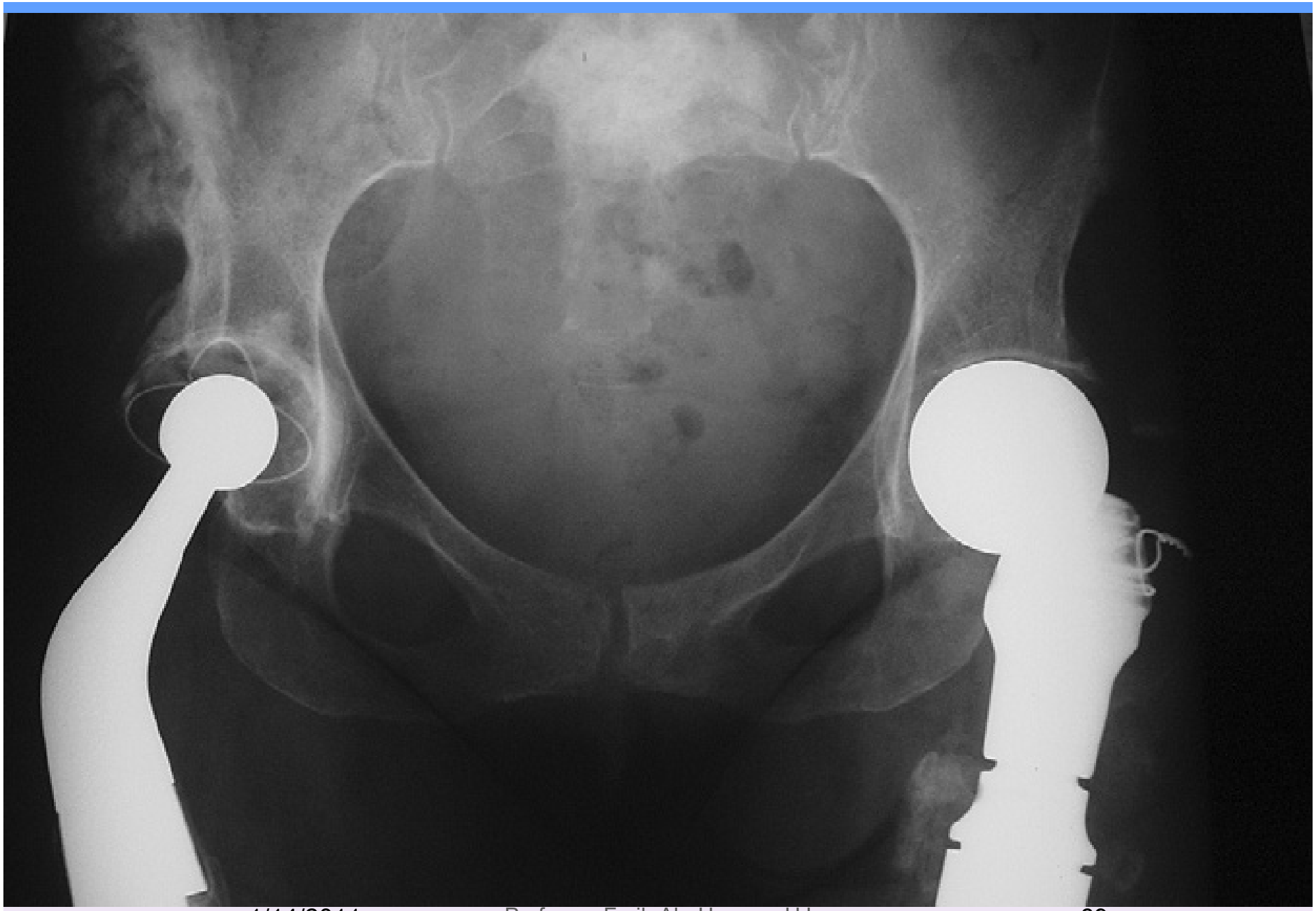
Needs Proximal Femoral Replacement

Metastatic Sq.CC

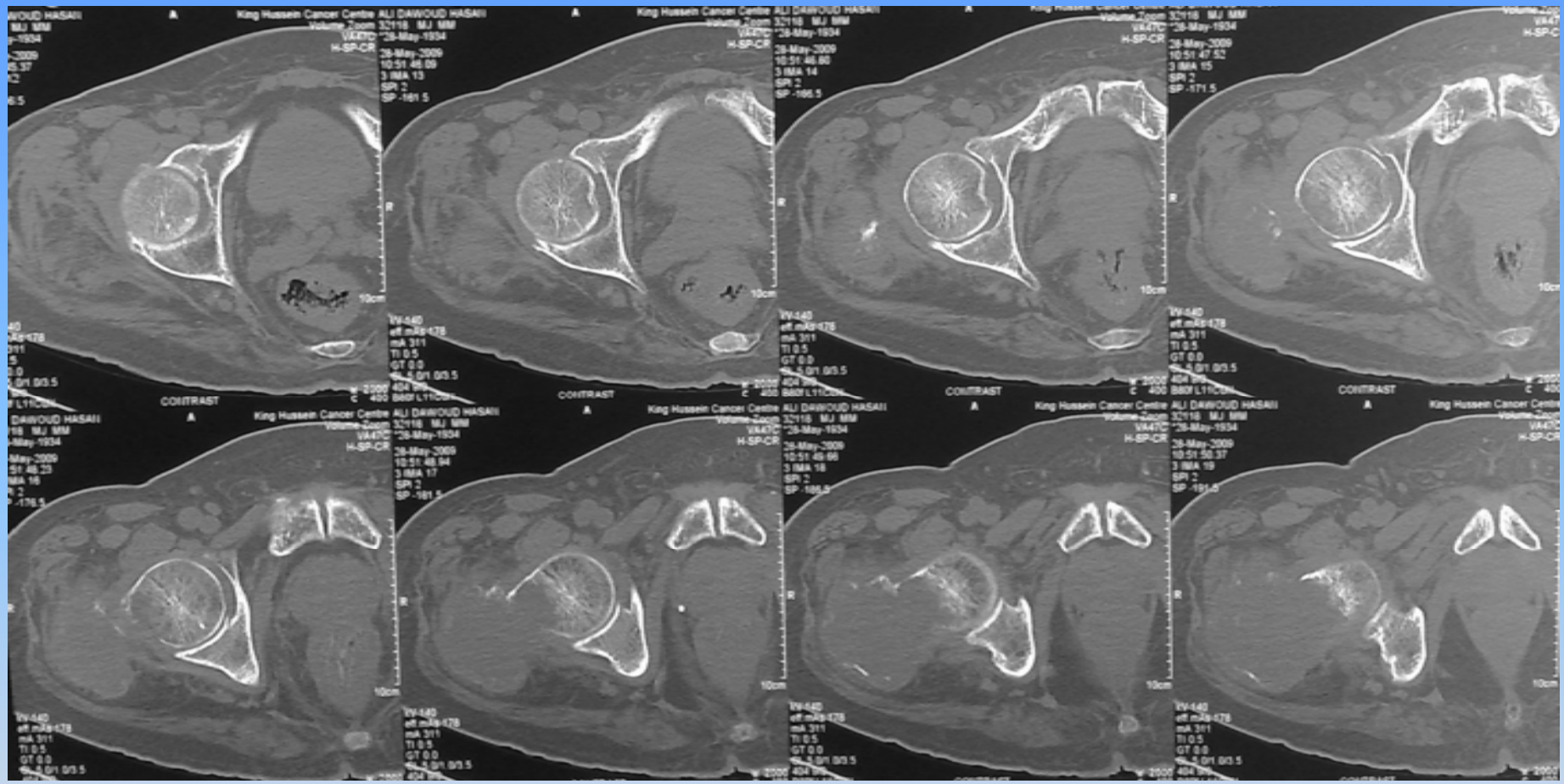
Endoprosthetic Surgery

Extensive destruction of major long bones, particularly in the metaphyseal region (hip, knee,)

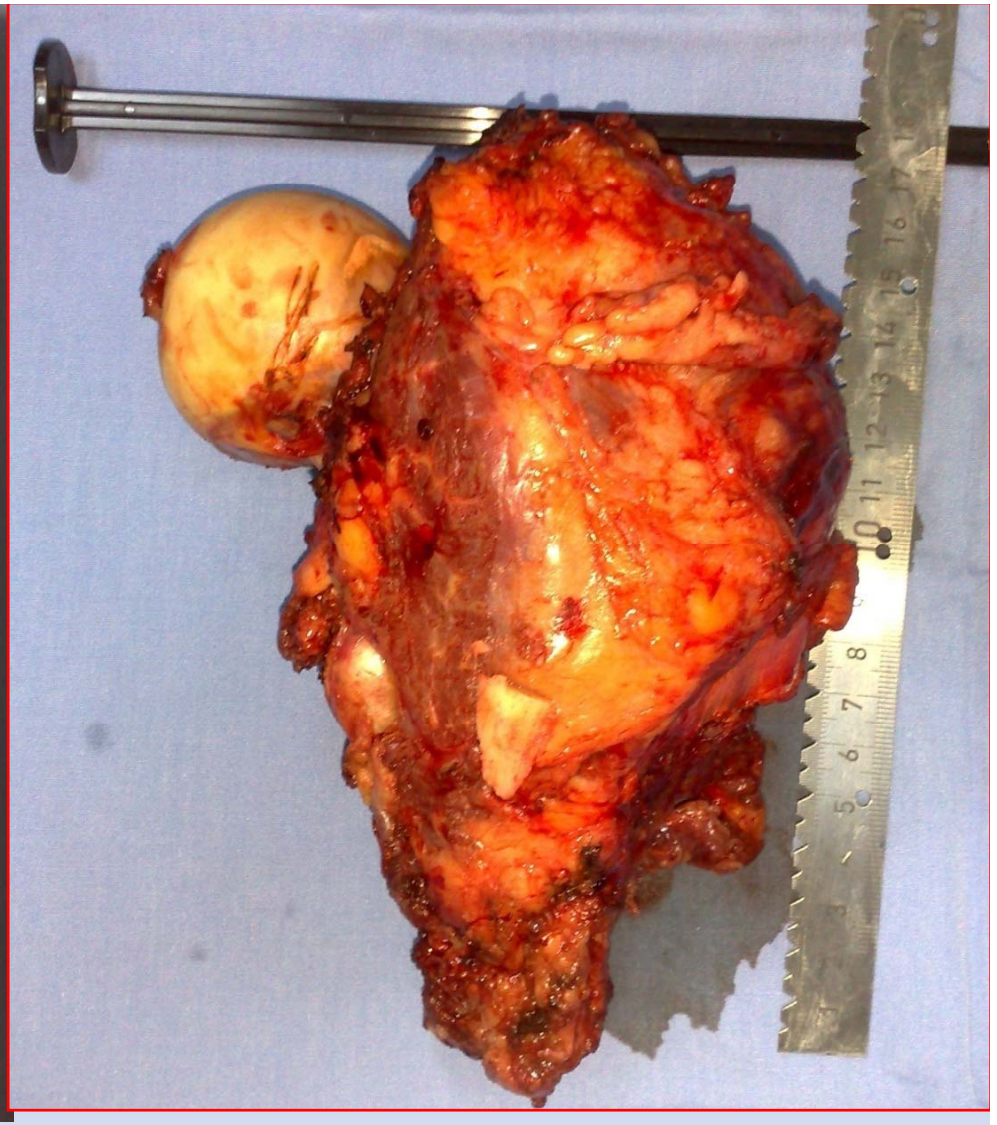
Custom or modular endoprostheses ('megaprostheses')



70 Y old male, Colon Cancer



Extensive bone destruction and soft tissue mass



17cm resection

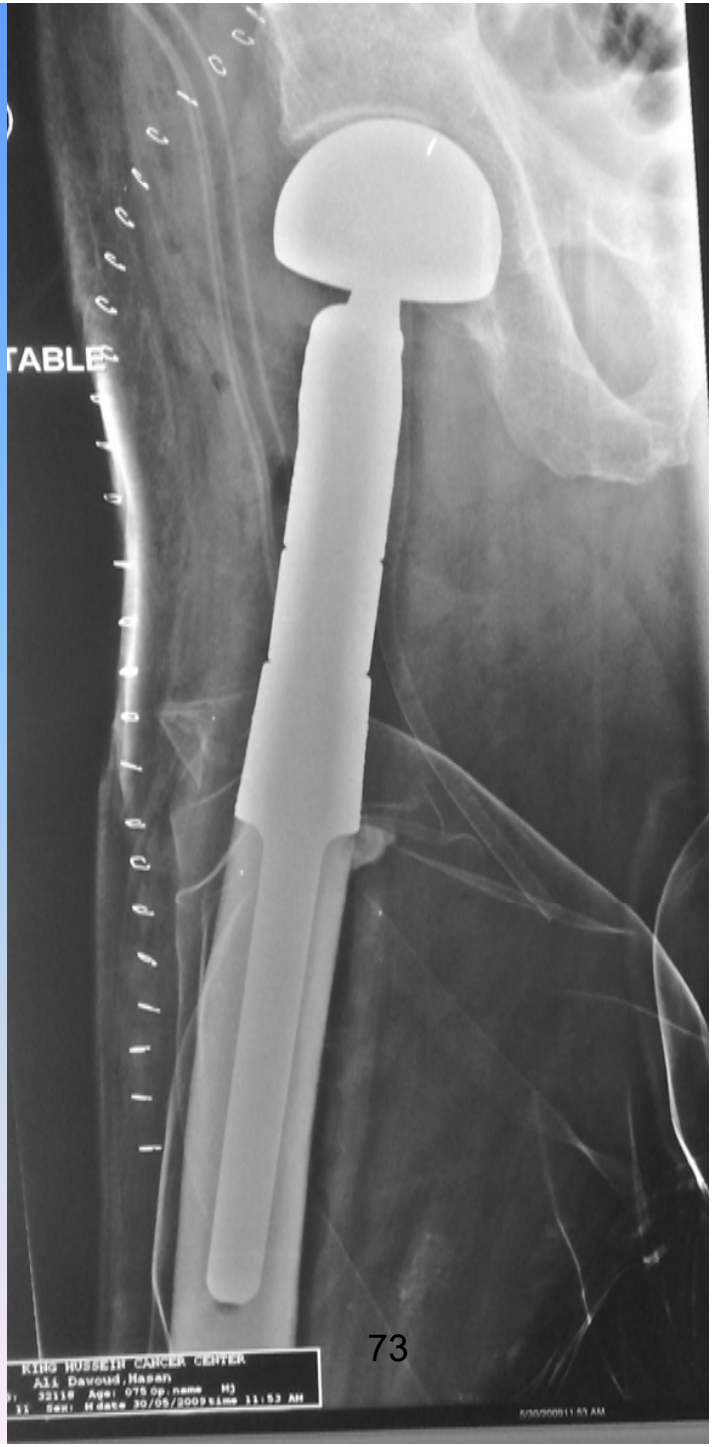


TABLE
KING HUSSEIN CANCER CENTER
Ali Davoud,Hasan

Histopathology

Chondrosarcoma
High grade

Operation for long bone metastases

= Adequate exposure of the tumor site

= Large cortical window

=Tumor removal with curets and a high-speed burr.

=Introduction of an IMN

=Proper positioning and length are verified,

=The nail is partially withdrawn

=The entire tumor cavity is filled with PMMA

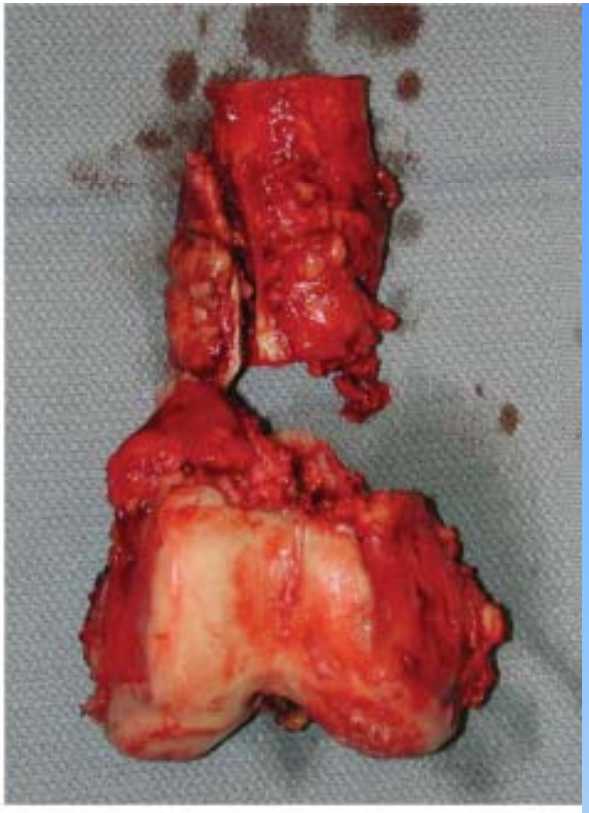
=The nail is then pushed back into the medullary canal and fixed with interlocking screws

Supracondylar Femoral mets

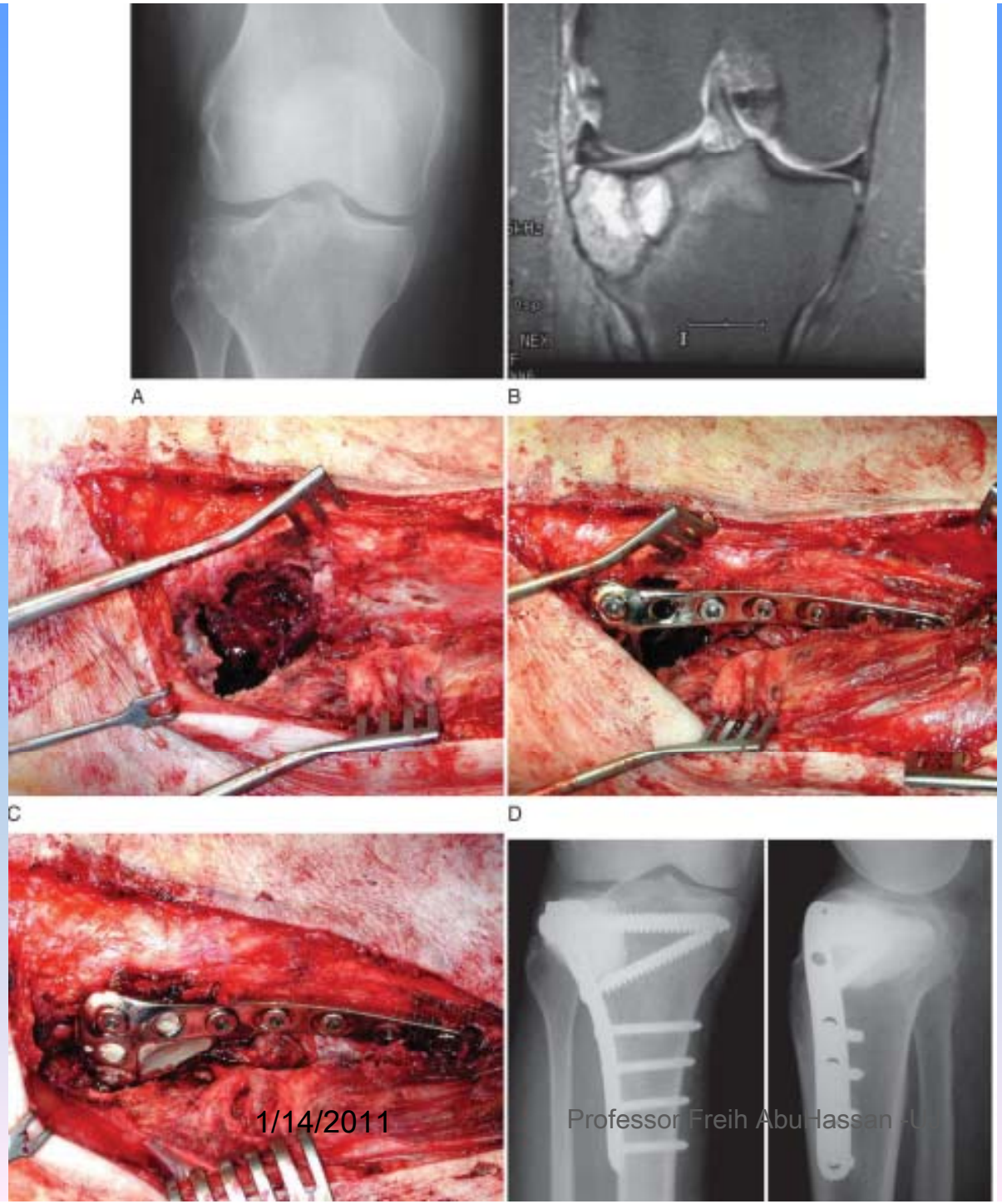
Metastatic lesions of the distal femoral diaphysis & condyles are best treated by medial and lateral Zickel rods with PMMA.

Large distal femoral metaphyseal lesions, especially those associated with intra-articular extension and/or large soft-tissue components, → Custom or modular distal femoral endoprosthetic replacement.

A



B



Metastatic lung Ca.

78-year-old woman with metastatic Renal Ca. Treated by curettage and PMMA .

General Postoperative Care

Rehabilitation

= **If stability OK** → FWB and ROM exercises to the adjacent joints

= **Early discharge** →enhance the patient's morale and minimize the interruption of an ongoing oncological program of treatment.

Frassica. Clin Orthop Relat Res. 2003

Points to Remember

1= Detailed preoperative evaluation

2= Curettage to remove all gross disease.

3=Use immediate rigid fixation consisting of PMMA or Cemented Prosthetic Replacement.

4= Adjuvant RadioR + - ChemR after 2W

5- ORIF of mets # around the hip, with trauma implants e.g DHS, (loadsharing rather than loadbearing) is not good

→Pathological # will not unite → breakage of the implant or cutting out of the fixation screws.

6-Preop. embolization if needed.

7- Fixation of a solitary lesion as a metastatic deposit or fracture but without prior confirmation of disease.

If the lesion proves to be a primary sarcoma → dissimination of tumour to medulla and soft tissue→ rendering limb salvage surgery impossible.

Multidisciplinary Care Team

1-Oncologist

2-Pathologist

3-Radiologist

4-Cancer nurse

6-Rehabilitation

5-Pain Specialist

7-Radiotherapist

8-Orthopaedic Surgeon

9-Palliative Care Specialists

Can we prevent Bone Metastasis?

Bisphosphonates

The gold standard therapy for Breast Cancer with bone metastases

Effective for reducing Skeletal complications

=Bone pain

=Pathological fracture

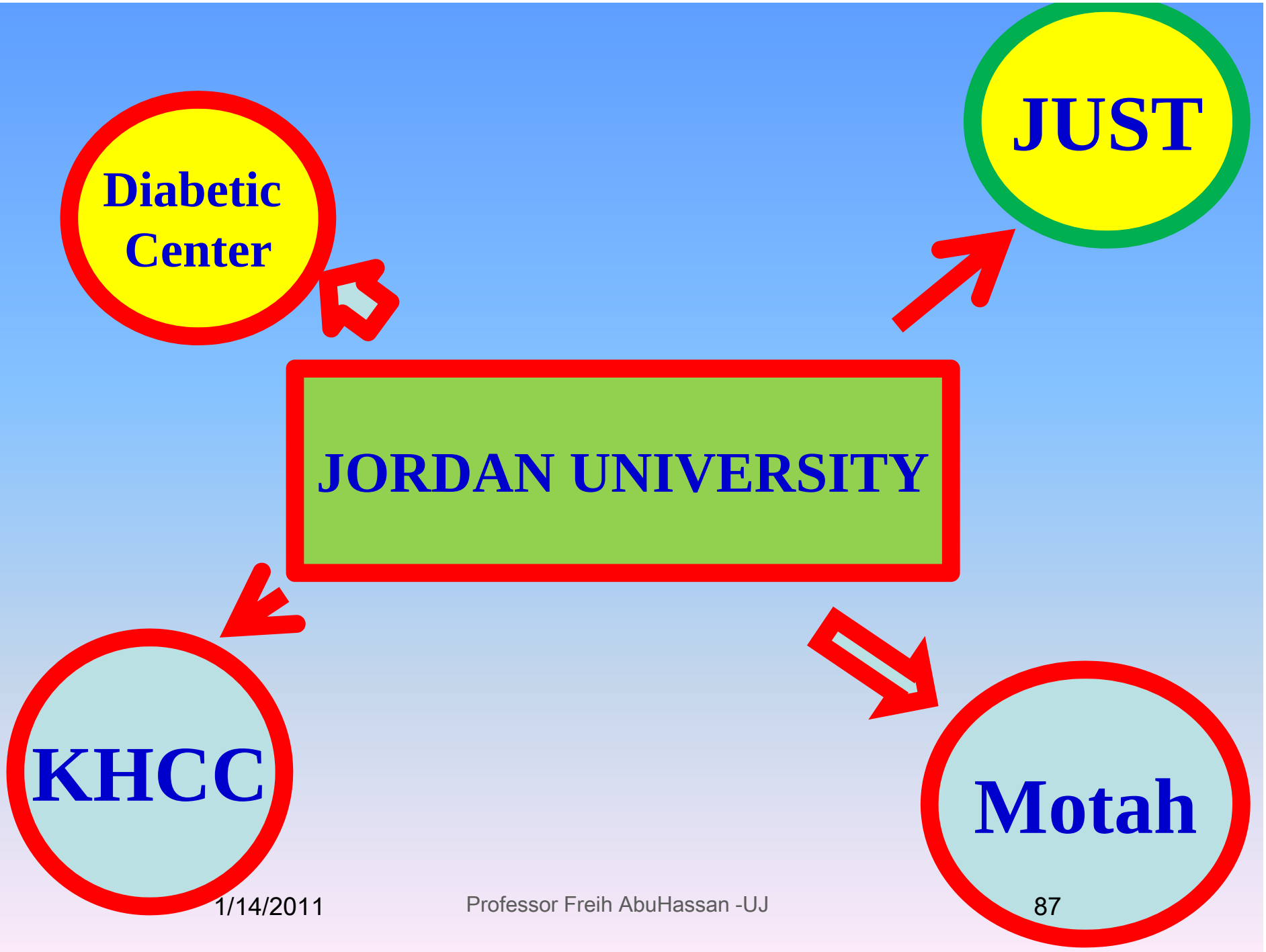
=Bone surgery

=Hypercalcemia.

Actions of Bisphosphonates

1- Potent inhibitors of osteoclastic bone resorption
2- Bind to hydroxyapatite crystals (active sites of bone remodeling)
3- Inhibit osteoclast-mediated bone resorption
4- Cause osteoclast apoptosis, thereby inhibiting bone loss
5-Has antineoplastic effects.

Bickels. JBJS. 2009


Diabetic Center
JUST
JORDAN UNIVERSITY
KHCC
Motah

Reminder

Limb Salvage Clinic KHCC
Sunday 10.00 am

Advanced Ped. Orthopaedic Course

-Call for Jordanian Speakers

-CTEV Workshop registration

Thank You