Pathological Fractures
Diagnosis, Pathophysiology and treatment.

Learning Objectives

- Understand the biology of Pathological #
- Diagnostic workup
- Treatment options –Which is best
- Future areas of development

Pathologic fractures- Introduction

- Occur in abnormal bone.
- Weakened bone fractures after minor trauma

Recognition, diagnosis, and treatment of the condition affecting the bone

Problem Statement

- 10 million Americans have osteoporosis
- 34 million have osteomalacia
- 55% of people who are 50 years or older.
- Eighty percent of those affected by osteoporosis are women.
- 2 million people sustain a pathologic fracture each year.[31] Of patients over 50 years of age
- 24% who sustain a hip fracture die within 1 year.
- One of every two women will have an osteoporosis-related fracture in her lifetime

Non Metabolic causes?

- 1.4 million new cancer cases
- 50% of these tumors can metastasize to the skeleton.
- With improved medical T/t- patients are living longer.
- There is an increased prevalence of bone metastasis

Problem Statement-Skeletal metastases

- Considerable morbidity
- Predispose to pathological fractures.
- Advances in the medical management of malignancy- life expectancy is increasing
- Risk of skeletal metastasis- pathological fractures.

  Conventional modes of trauma fixation may not be appropriate.

Primary benign or malignant bone tumors

- Actual or impending pathologic fractures
- Requires a multidisciplinary approach
- Different principles applied to fracture fixation.

Factors Suggesting a Pathologic Fracture

- Spontaneous fracture
- Fracture after minor trauma
- Pain at the site before the fracture
- Multiple recent fractures
- Unusual fracture pattern (“banana fracture”)*
- Patient older than 45 years
- History of primary malignancy

Evaluation

- History: thyroid, breast, or prostate nodule
- Review of systems: gastrointestinal symptoms, weight loss, flank pain, hematuria
- Physical examination: lymph nodes, thyroid, breast, lungs, abdomen, prostate, testicles, rectum

Investigations

- Plain x-rays: chest, affected bone (additional sites as directed by bone scan findings)
- 99mTc total body bone scan (FDG-PET scan lymphoma)
- CT scan with contrast: chest, abdomen, pelvis

Labs

- Complete blood count,ESR
- S .calcium, phosphate
- Urinalysis
- PSA, immuno-electrophoresis, and alkaline phosphatase
- *Biopsy:* needle versus open

Where is the lesion?

- Epiphysis vs. metaphysis vs. diaphysis
- Cortex vs. medullary canal
- Long bone (femur, humerus) vs. flat bone (pelvis, scapula)

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- Intact but abundant periosteal reaction-Aggressive
- Periosteal reaction that cannot keep up with tumor (Codman triangle)
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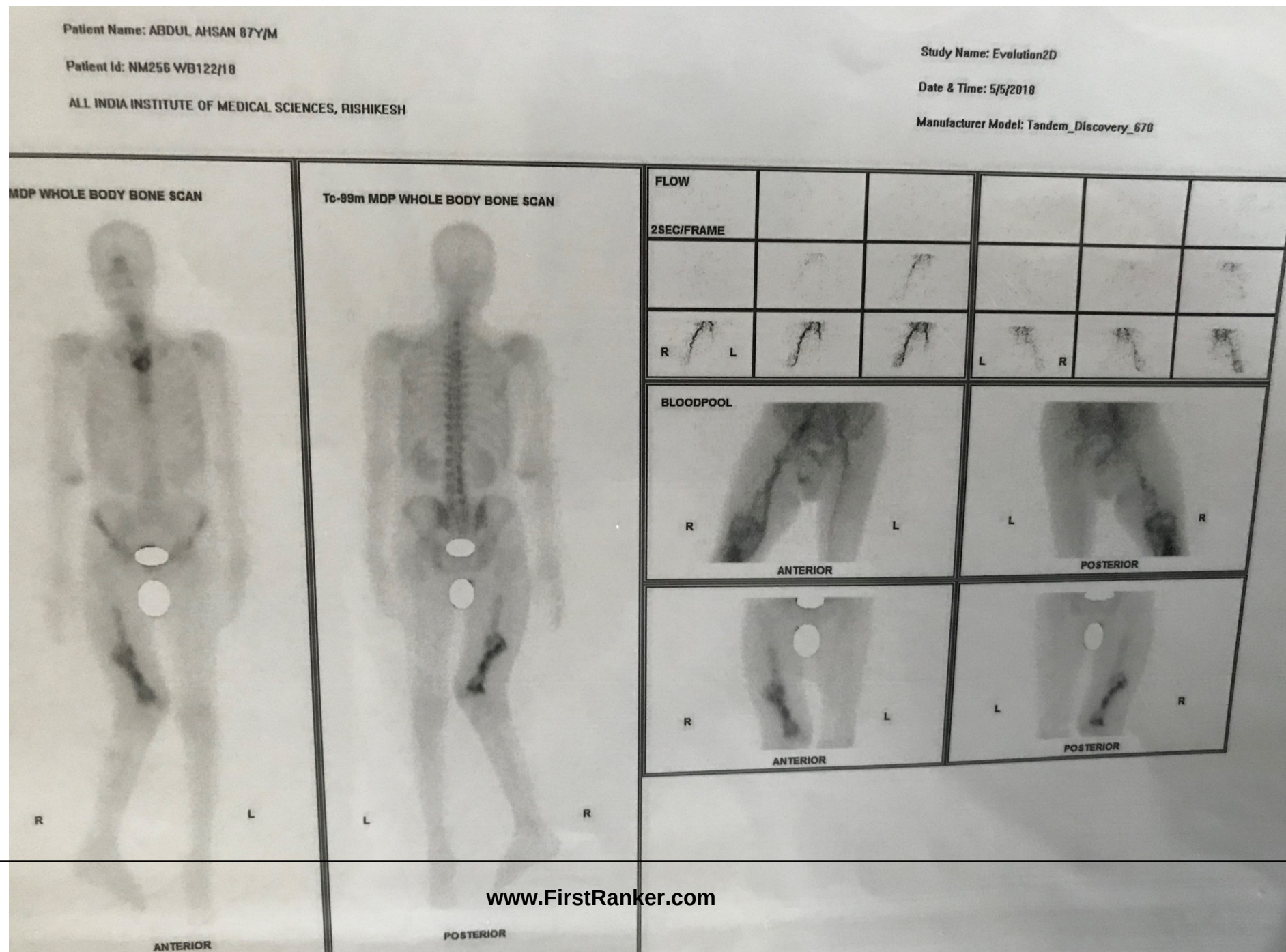
What are the clues to the tissue type within the lesion?

Calcification	Bone infarct/cartilage tumor
Ossification	Osteosarcoma/osteoblastoma
Ground-glass appearance	Fibrous dysplasia



IMPRESSION : Referred case of pathological fracture distal 3rd of right , current 99mTc-MDP bone scan findings reveal.

- Skeletal metastasis in manubrium sterni & right distal femur with pathological fracture and malunion.
- Suggested HPE evaluation from infiltrative lesion involving right distal femur & further clinical workup to rule out Carcinoma Lung/ Kidney/Thyroid.

Evaluate

Analysis

- Epiphysis
- Medulla
- Neck femur
- Destruction- total osteolysis
- No bony reaction

Mirel's Classification

Component	1	2	3
Site	upper limb	Lower limb	Peritrochanteric
Pain	Mild	Moderate	Functional
Lesion	Blastic	Mixed	Lytic
Size	< 1/3	1/3 to 2/3	> 2/3

Systemic Non –Neoplastic Causes?

Correctable conditions

- Renal osteodystrophy
- Hyperparathyroidism
- Osteomalacia

Uncorrectable conditions

- Osteogenesis imperfecta
- Polyostotic fibrous dysplasia
- Postmenopausal osteoporosis
- Osteopetrosis.

Benign Causes?

- Benign tumours - unicameral bone cyst, ABC,GCT.

B/L Neck femur- Osteomalacia

Goal- Metastatic bone disease

- Palliation
- Pain relief
- Restoration of function
- Improvement in quality of life.

Inappropriate treatment can lead to fixation failure

Problem Statement

- Most common site for skeletal metastases- axial skeleton
- Most pathological fractures -long bones
  - Two-thirds -femur
  - Proximal Humerus- most others

Impending Fractures?

- Osteolytic lesions
- Lesions larger than 25 mm
- Areas subject to high anatomical stress
- Resorption exceeding more than 50–75% of the original bone diameter.

Morbidity?

- Pain
- Hypercalcaemia
- Reduced mobility
- Fractures of lower limb- mobility
- Fractures of the upper limb can compromise functional independence

End-stage of the malignant disease?

- Probably limits of medical management
- Half of patients who undergo surgery for a pathological fracture will die within 6 months

Poor Prognosis

- Visceral metastases
- Haemoglobin level less than 7g%
- Lung cancer

73 Yrs Breast Ca right hip pain

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Primary bone malignancy with

- Sarcomas -1% of all malignant tumours
- Osteosarcoma followed by chondrosarcoma and Ewing's sarcoma.
- The incidence of fractures in osteosarcoma
  - 5-10%

Cause of Fracture ?

- Underlying malignancy-bone destruction
- Biopsy induced weakness
- Radiotherapy induced necrosis
- Chemotherapy induced osteoporosis

Patient presents with Solitary Mets

- Suspicious bone lesion or pathological fracture
- Absence of known malignancy
- Expeditious cautious approach must be undertaken.

Fixation should be avoided until a definitive diagnosis is established

Metastatic disease

- More common than primary bone tumours
- More than 50% of all primary cancers –Mets
- Breast, lung, prostate, kidney and thyroid
- Pathological fractures - 30% of patients

Facilities/Expertise not available

- Early referral
- Immobilised in a cast/ traction
- External fixation -pins should be placed outside the pathological segment of bone.

Biopsy?

Does this patient require a biopsy?

- Necessary for tissue diagnosis
- Carefully planned-Needle biopsy
- Definitive treatment in mind
- Pathologist involvement is best

Treatment- Principles

- Prophylactic fixation of impending fractures.
- Stabilisation or reconstruction of bones affected by pathological fracture
- Spinal disease- decompression and mechanical stabilisation

Management of metastatic pathological fractures

- The prognosis should exceed the anticipated recovery time from surgery
- Intervention should address all areas of weakened bone/ weaken subsequently
- Construct employed - allow immediate full weight-bearing.
- All patients should be considered for post-operative radiotherapy.

Bone cement -role

- Percutaneously -prevent vertebral collapse
- Lone stabilisation device in cases of focal disease following curettage
- Important augment for internal fixation including intramedullary or plate fixation.
- Cemented arthroplasty is preferred to uncemented.

Post-operative radiotherapy is indicated for almost all patients- negatively affect bone ingrowth in uncemented prostheses

Pathological fractures of the femoral neck

- Most common site in the appendicular skeleton.
- Preferred strategy -HRA or THR.
- Cemented long-stem femoral implants is the workhorse.
- Bypass the distal part of the lesion by two bone diameters.

Metastatic Ca Lung- Bipolar Cemented

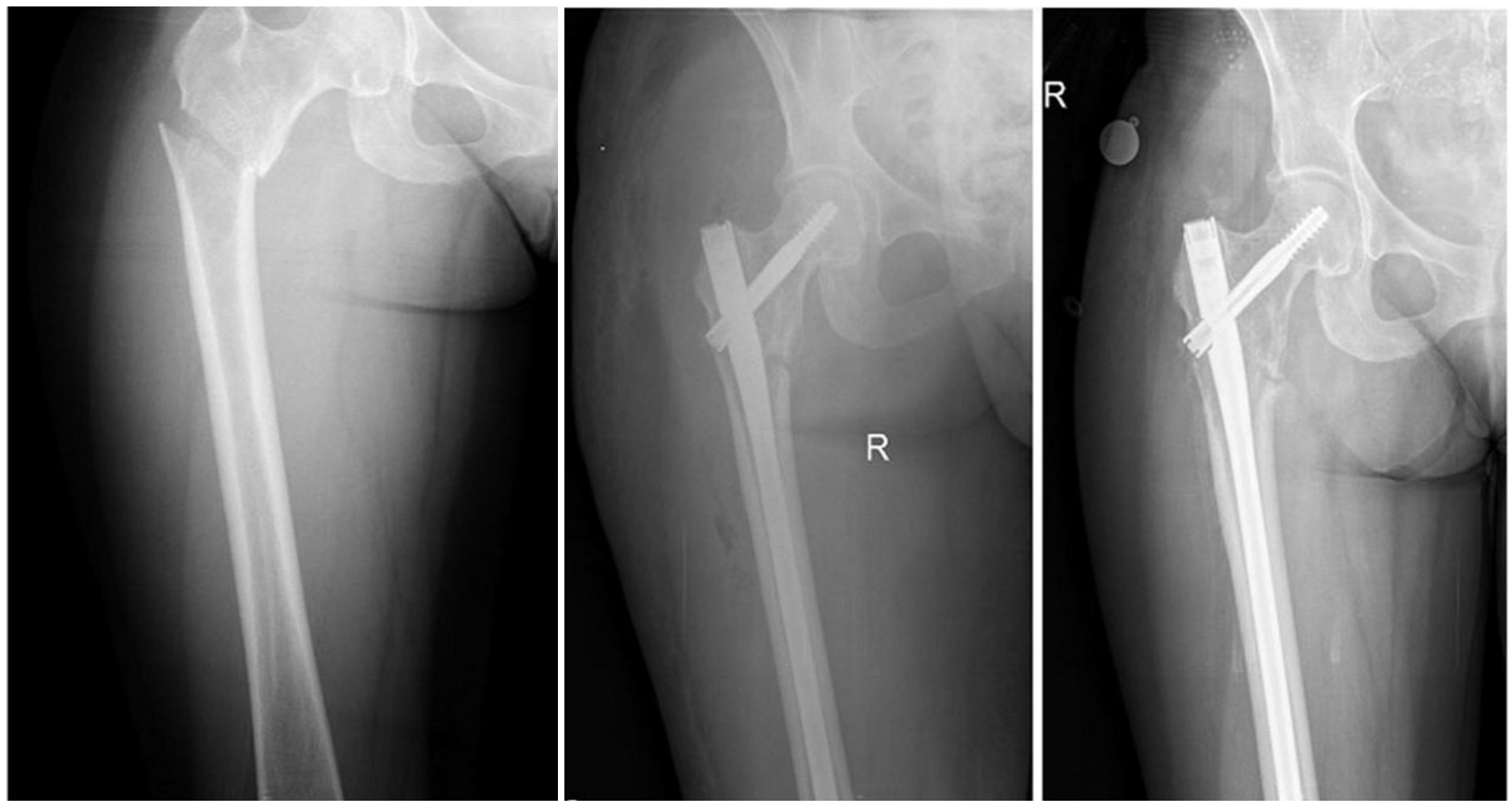
Peritrochanteric fractures

- Plate and screw osteosynthesis, augmented with cement.
- Cephalo-medullary nails- good choice

Biomechanical advantage of a centro medullary position- resists medialisation seen in DHS

Metastatic Renal Ca-EPR

Metastatic Breast Ca- Nailing 2 yrs later



Subtrochanteric and diaphyseal femoral fractures

- Locked cephalomedullary nails
- Safe, effective and reliable, provide pain relief
- Allows early postoperative mobilisation and weight-bearing

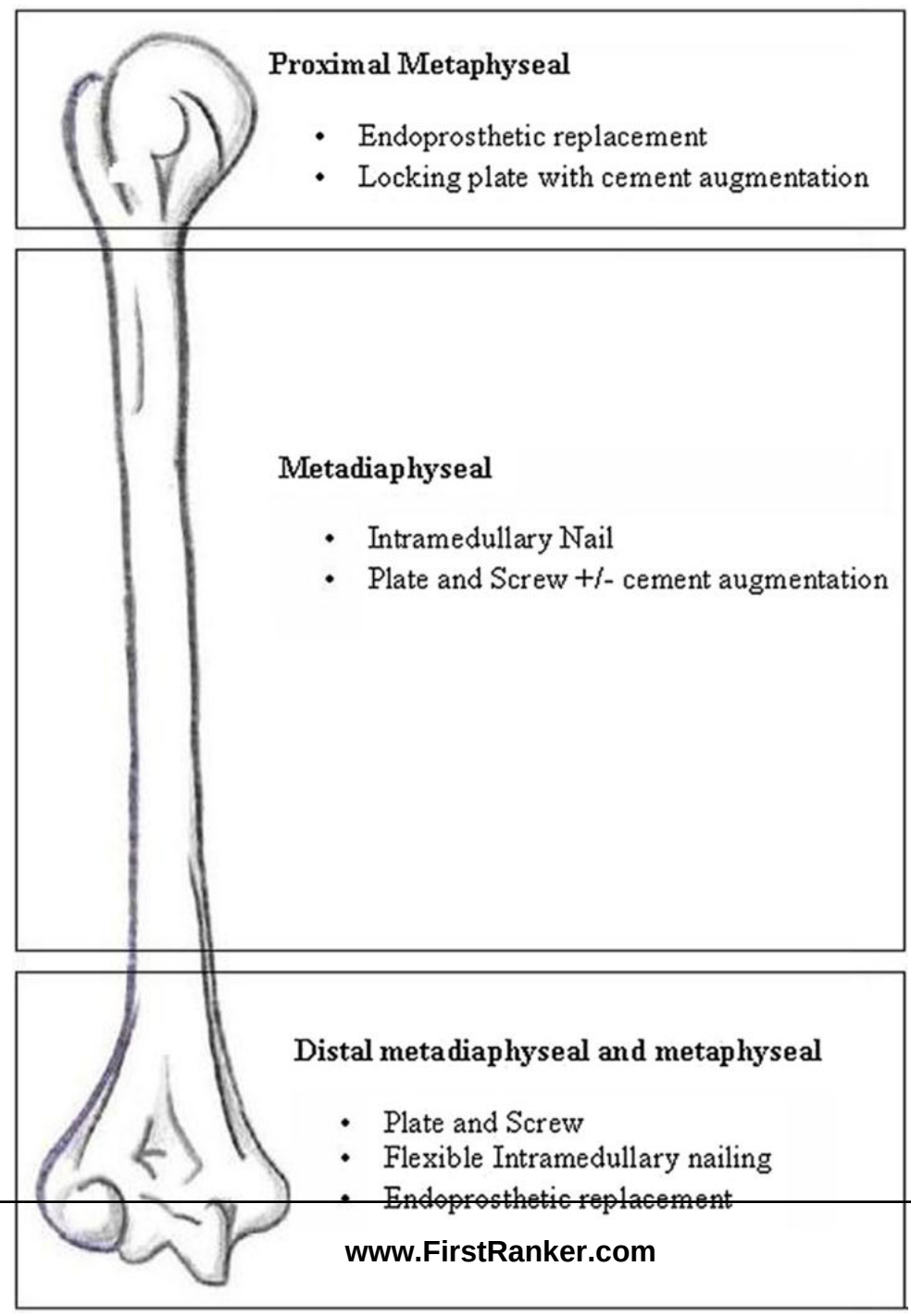
Pathological Femur diaphysis- Renal Ca

The distal femur

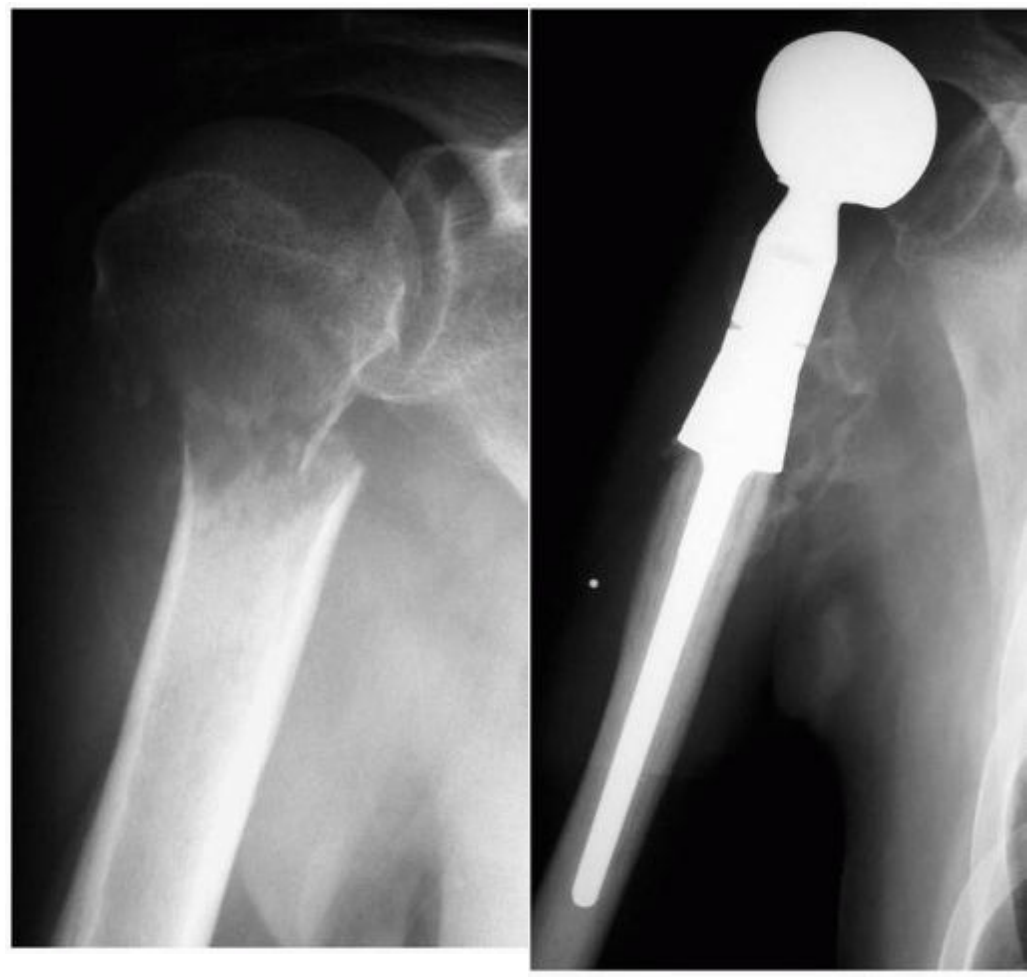
- Retrograde nailing
- Curettage and internal fixation augmented with PMMA
- Endoprosthetic replacement

The humerus

- Second most common long bone site
- Proximal 1/3 and diaphysis frequently affected
- Endoprosthetic replacement or locking plate with cement aug
- Cemented, long stem prosthesis spanning the diaphysis is ideal



EndoprostHetic Replacement



Humerus -Diaphyseal

- Intramedullary nailing
- Plate and screw fixation (with or without cement augmentation)

Advantages

- Plate fixation avoids violation of the rotator cuff

Disadvantages

- Risks damage to the radial nerve
- Fails to protect as much humeral length
- Leads to stress risers

Multiple myeloma- IF Final result

The tibia

- Rare –(4.4%)
- Proximal tibia- curettage, PMMA augmentation and locking plate fixation.
- Endoprosthetic replacement- necessitates major soft tissue reconstructive procedures
  - Gastrocnemius flaps and split skin grafting

Tibial diaphysis/Distal

- Locked antegrade intramedullary nailing is preferred +- augmented with cement.
- Distal tibial involvement- curettage and internal fixation with cement augmentation

Renal Cell Ca with distal tibial mets

Nonoperative Treatment?

- Not a surgical candidate -Bracing.
- Limited life expectancies
- Severe comorbidities
- Small lesions
- Radiosensitive tumors

Amputation

- Failure of internal fixation with painful non-union
- Local recurrence, involvement of the skin, soft tissues and neurovascular structures
- Severe lymphoedema, post-radiation neuropathy and fibrosis

Radiotherapy

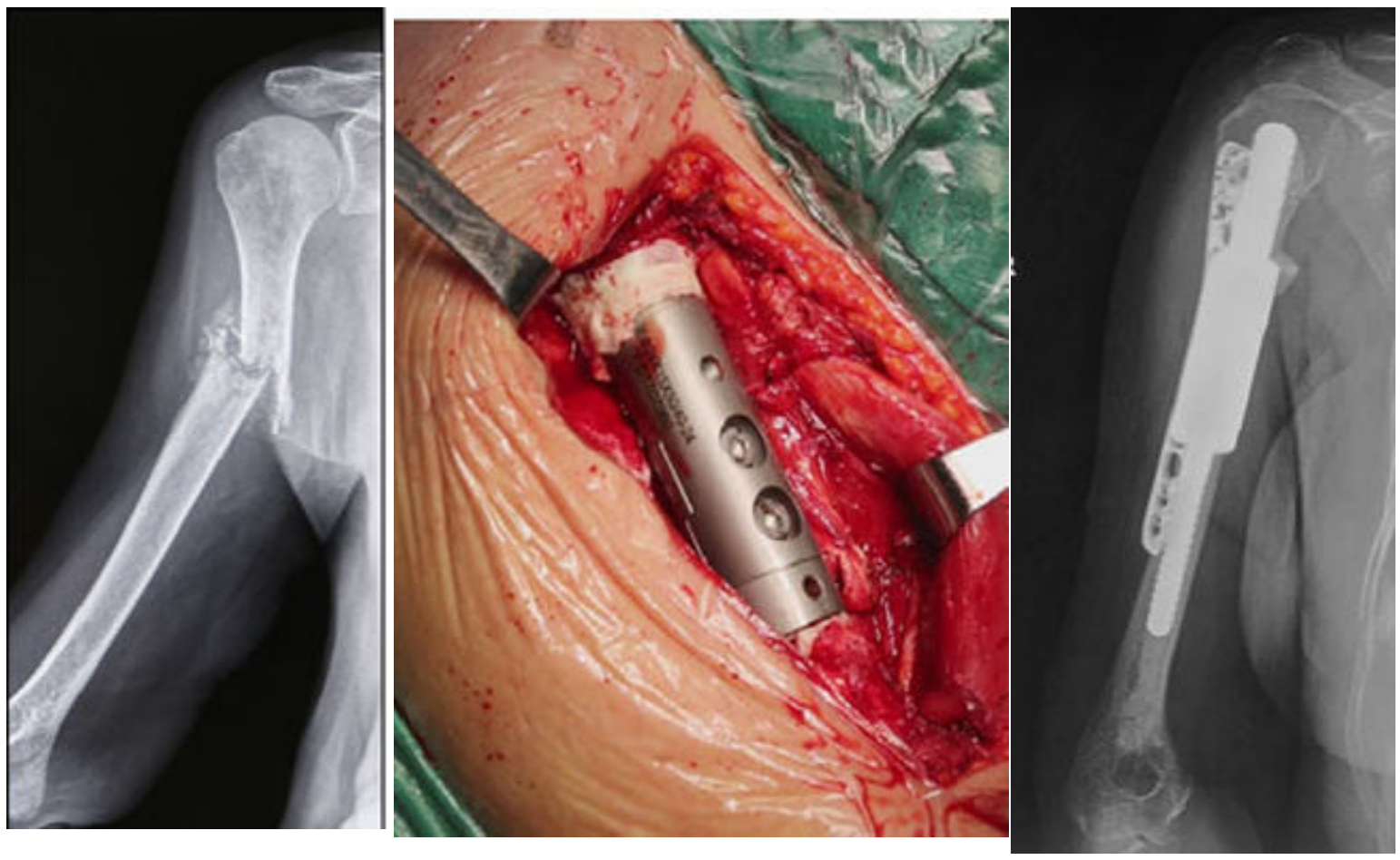
- Vital adjunct in patients with metastatic disease
- 90% of patients can expect some pain relief
- 50–60% experiencing complete pain relief.

Entire surgical field should be the default position and considered in every case.

Medical therapy

- Bisphosphonates
- Denosumab
- Chemotherapy
- Radiopharmaceuticals
- Hormonal therapy

Future-Intercalary Prosthesis



Carbon fiber Nail

Favorable mechanical properties
Eases radiation therapy
Evaluation of fracture healing
Evaluate progression or relapse