Orthopaedic Oncology Sins to Avoid

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Pearl #1- Bone

- Most common primary tumor of bone
  - Myeloma/Plasmacytoma
- Most common tumor of bone – METS!!!
  - **PT B**arnum **L**oves **K**ids
  - **T & K** BLEED A LOT!!!
  - Know Enneking X-ray Criteria
    - Where, Action, Response & Content

Pearl #1- Bone

- Bone Scan – can be negative in Myeloma/Kidney
- Differential – **OOEE**
- Most common tumor of bone
  - METS
  - **PT B**arnum **L**oves **K**ids
  - **T & K** BLEED A LOT!!!
  - Know Enneking X-ray Criteria
    - Where, Action, Response & Contents

Pearl #2 – Soft Tissue Masses

- MORE COMMON – 6 to 8 times
- Often painless versus bone
- Most are benign – small; superficial; mobile
- However…RARE...bad things:
  - Large - > 5cm
  - Deep
  - Firm
  - Fixed

Pear #3 - Pain

- **Malignant Soft Tissue painless; Malignant bone tumors painful!**

Pear #4 - Approach

- **HAVE ONE!**

Pearl #5 - Biopsy

- LAST THING THAT IS DONE!
- NEVER TRANSVERSE!
- DONE THEN STOP!

Recognition of Sarcomas

- Difficult because…..RARE!

Lipoma
Ganglion
Muscle strain
Hematoma
Infection
Stress fx
Tendonitis

Recognition of Sarcomas

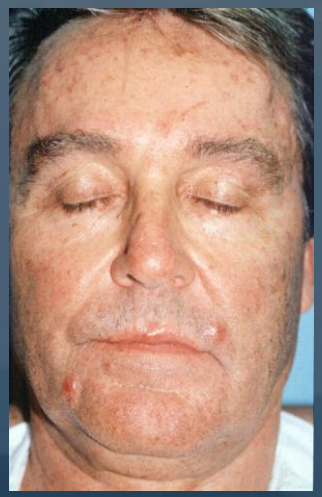
- Difficult because…..RARE!

Lipoma
Ganglion
Muscle strain
Hematoma
Infection
Stress fx
Tendonitis

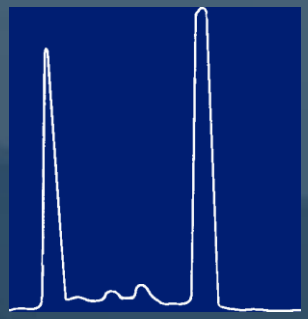
Malignancy!

3 Main Treatment “Phases”: Phase I- Recognition

Phase II - Obtain Diagnosis



#1 Exam; H&P



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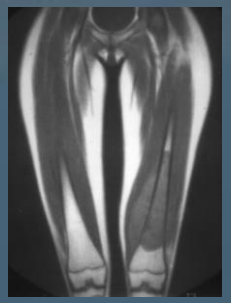

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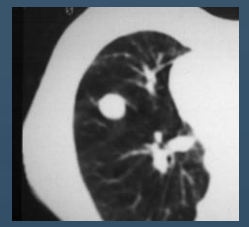
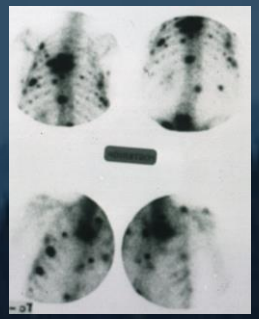
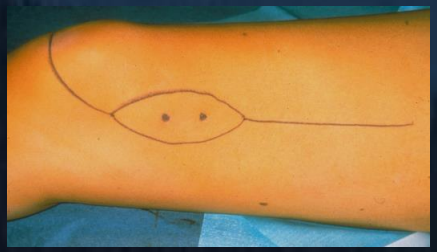




#4 Staging



#5 Differential Diagnosis

LAST #6 Biopsy

Phase III- Definitive Treatment

Recognition

- Difficult because…..RARE!

Annual incidence in U.S.:

Lipomas……..300,000

Soft tissue sarcomas……8,300

Bone sarcomas……..2,500

Acta Orthop Scand. 1983 Dec;54(6):929-34
Cancer Facts and Figures, ACS, 2004

Practicing Orthopedic Practice

- Less than 1 sarcoma every **3 years**
  - 2,400 primary bone sarcoma
  - 8,300 primary soft tissue sarcomas
- However….remember bone metastases
  - 1.5 million new cancer patients
  - ~ 24-40% patients present with bone mets and no prior diagnosis of cancer
  - PT B L K
  - **You will see these patients!**

Work-up of Bone Tumors

- History&Physical
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

Work-up of Bone Tumors

- **History - AGE!!!**

- **OOEE** < 20; **MMOE** > 20; **MMLC** > 40

Bone Tumors: Age 0-5 years

- **O**steomyelitis
- **O**steosarcoma
- **E**G – Histiocytosis
- **E**wing’s
- Wilm’s metastases
- Neuroblastoma
- Leukemia
- Rhabdomyosarcoma

Bone Tumors: Age 5-20 years

- **O**steomyelitis
- **E**wing's
- **O**steosarcoma
- Osteoid osteoma
- **E**G
- UBC, ABC
- Fibrous dysplasia
- Non-ossifying fibroma

Bone Tumors: Age >20 years

- Giant cell tumor
- **M**yeloma
- **M**etastasis
- **O**steosarcoma
- **E**wing's
- Chondrosarcoma

Bone Tumors: Age >40 years

- **M**etastasis
- **M**yeloma
- **L**ymphoma
- **C**hondrosarcoma

Bone Tumors: *Pain Quality*

- Deep, aching
- Constant, progressive
- Night pain
- Referred pain
- Weightbearing pain

Bone Tumors: *ROS*

- Weight loss
- Night sweats
- Trauma
- Prior h/o CA

Minor tr g fibron

Bone Tumors: Reason for Presentation?

- Mass
- Deformity
- Fracture
- Incidental Finding

Minor trauma, non-ossifying fibron

Family History

Pitfalls to Avoid:

Symptoms attributed to:

- Arthritis, inflammation
- Minor trauma
- Other procedures
- Other conditions
- Prior diagnoses/Red Herrings

Work-up of Bone Tumors

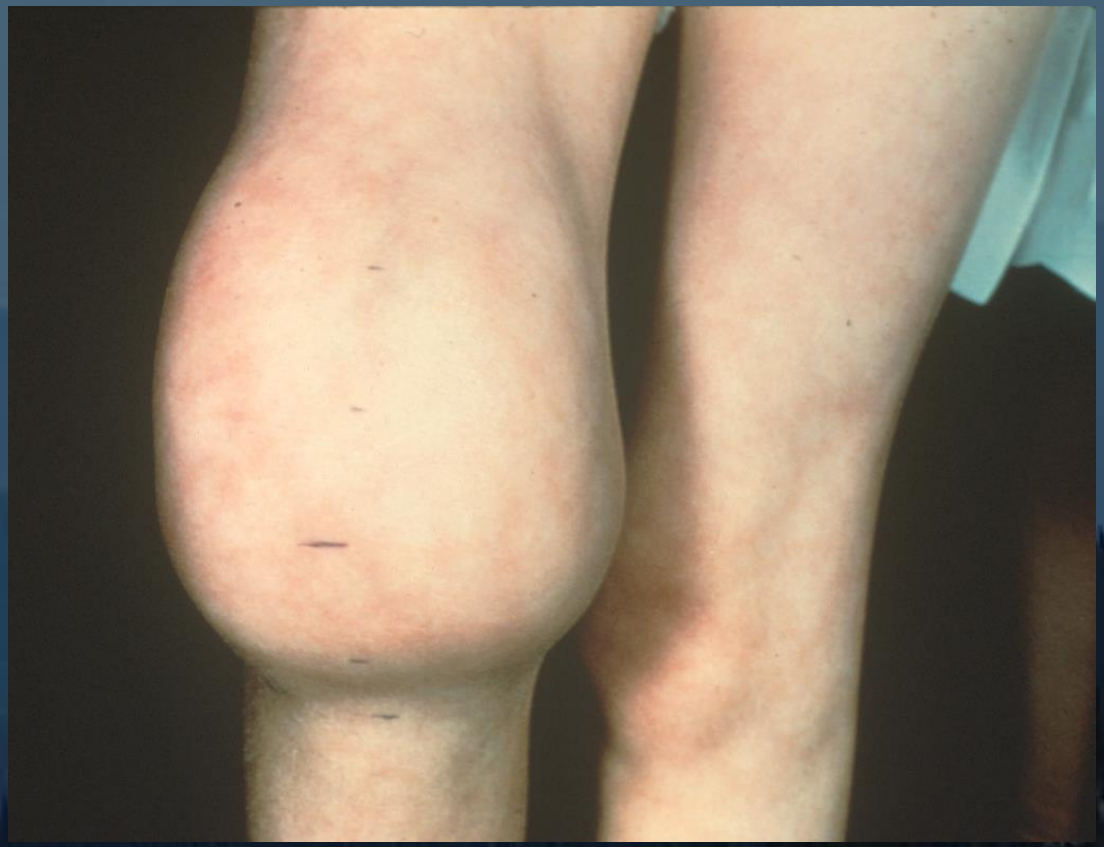
- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

Bone Tumors: Physical Exam

- General exam
- Local exam
  - NV status
  - Symmetry
  - Skin changes
  - Temperature
  - Drainage
  - ROM
  - Lymphadenopathy



Work-up of Bone Tumors

- History
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Broad Differential

Definitive Diagnosis

Bone Tumors: Laboratory Data

- CBC; INR
- Chemistry
- Alk Phos
- Ca++
- ESR
- PSA/TSH/FT4
- U/A
- SPEP/UPEP
  - 24 hr urine for Bence-Jones protein

Met prostate Ca

↑ Alkaline Phosphatase

Marker of bone turnover

- Osteosarcoma
- Paget’s disease
- Myeloma
- Metastases

Osteosarcoma

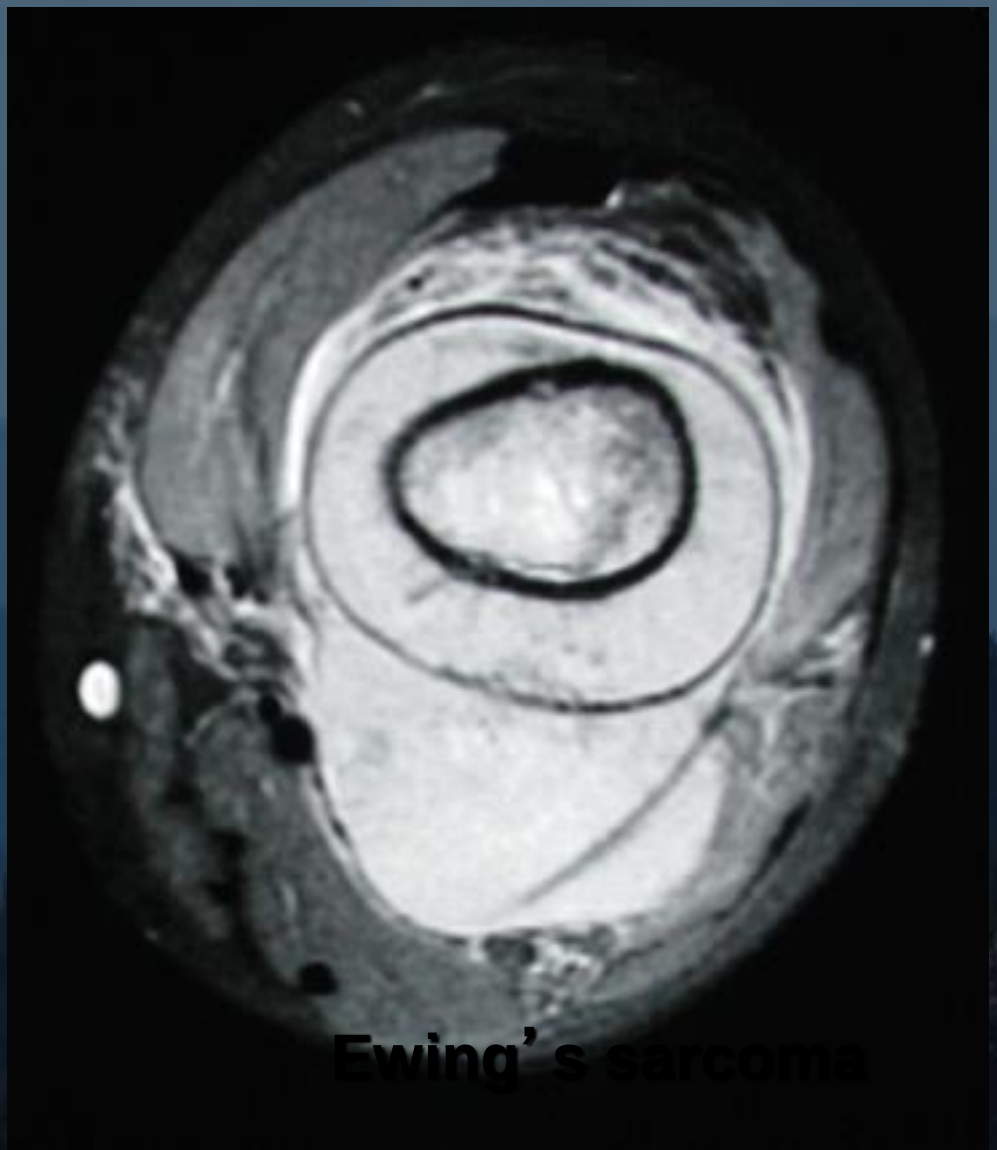
↑ Serum Calcium

- Myeloma
- Metastases
- Hyperparathyroidism

Multiple myeloma

↑ ESR/CRP

- Osteomyelitis
- Ewing’s sarcoma



Work-up of Bone Tumors

- History
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Broad Differential

Definitive Diagnosis

Bone Tumors: Radiographic Studies

- A plain x-ray is the single most important test

Osteochondroma

Radiographic Studies Rule of 2's

- 2 views; 2 joints

Osteochondroma

Plain Radiograph Assessment: *Enneking Critera*

- Where is it?
- Action – what's it doing to bone; lytic, blastic; zone of transition?
- Response – what's bone doing to it?
- Contents – what's in it?

Where is it - *Epiphysis*

- Giant cell tumor
- Chondroblastoma
- Clear cell chondrosarcoma

Giant cell tumor

Where is it - *Metaphysis*

- Osteosarcoma
- Enchondroma
- ABC, UBC, NOF
- Chondrosarcoma

Osteosarcoma

Where is it - *Diaphysis*

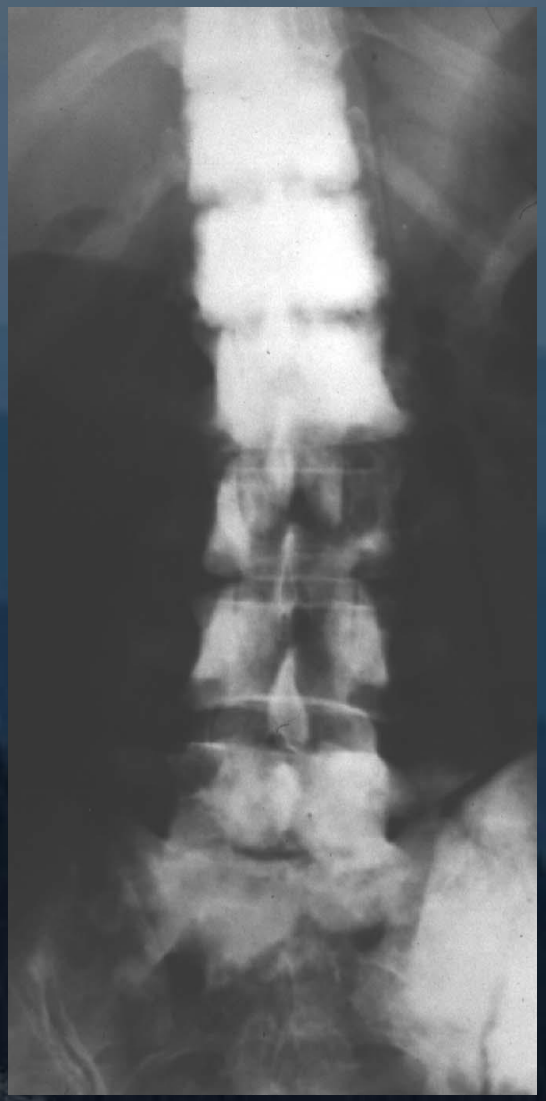
- Ewing’s
- Adamantinoma
- EG
- Enchondroma
- Osteoid osteoma
- Fibrous dysplasia

Adamantinoma

What Is It Doing to Host Bone?

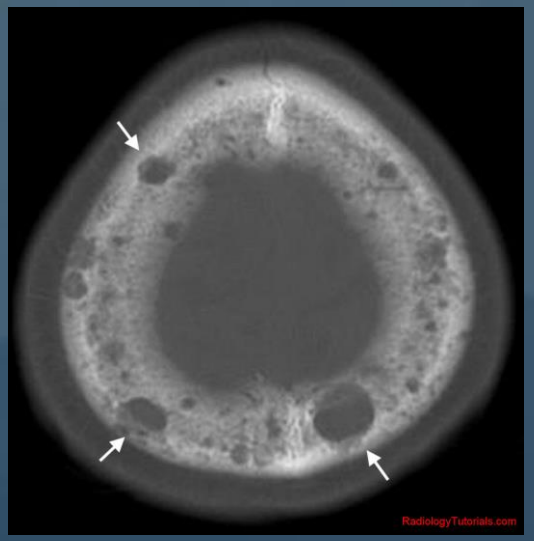
- Lytic
- Blastic
- Mixed
- Permeative
- Transition

“Blastic”
Prostate cancer



“Lytic”
Lung Cancer

Myeloma



How Is the Host Responding?

Benign

Aggressive

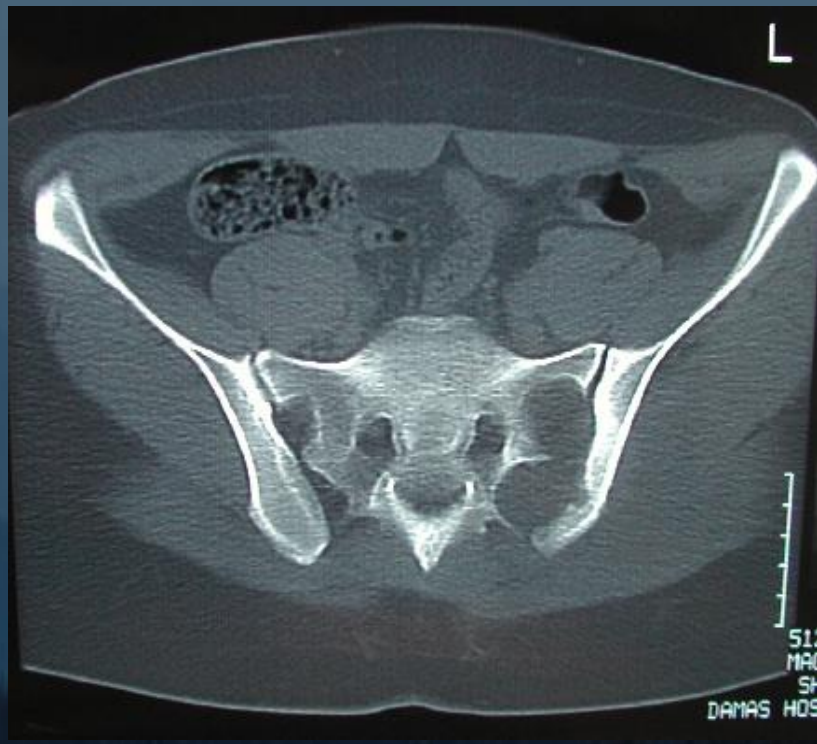
Malignant

What Is in It?

- Radiolucent …non-specific
- Calcified …cartilage
- Ossified… bone forming neoplasm

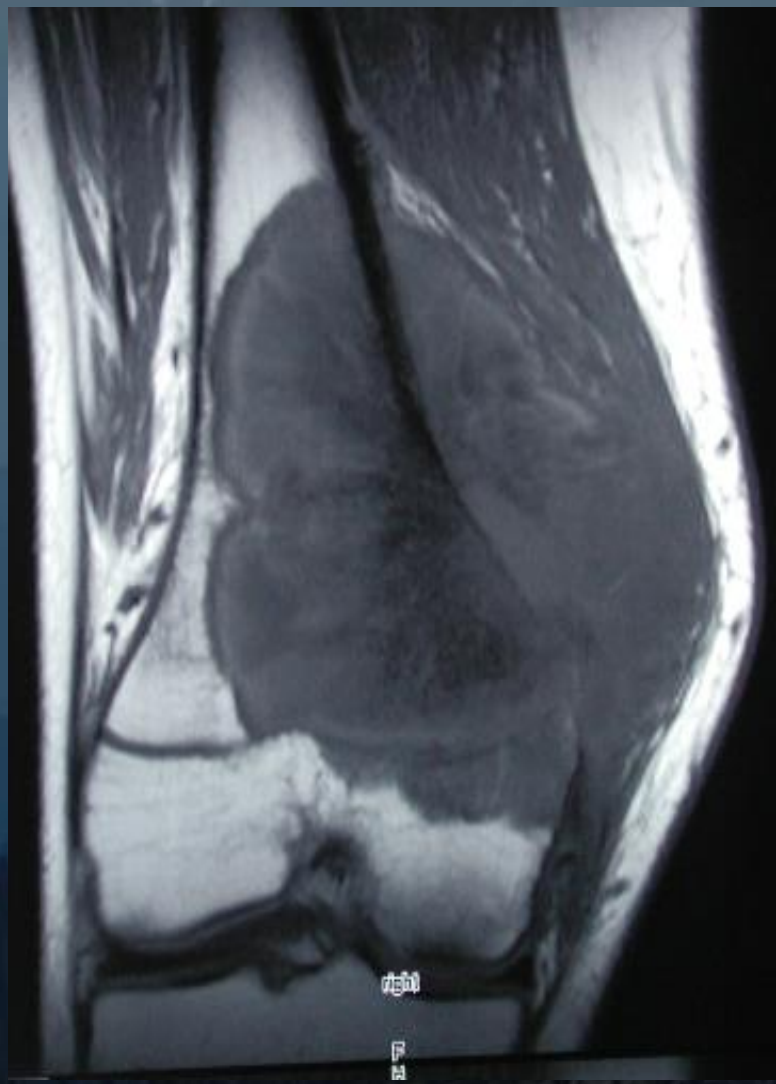
CT – Superior for Bone:

- Assess Complex anatomy
- Soft tissue calcification
- Cortical/bony evaluation
- Surgical planning

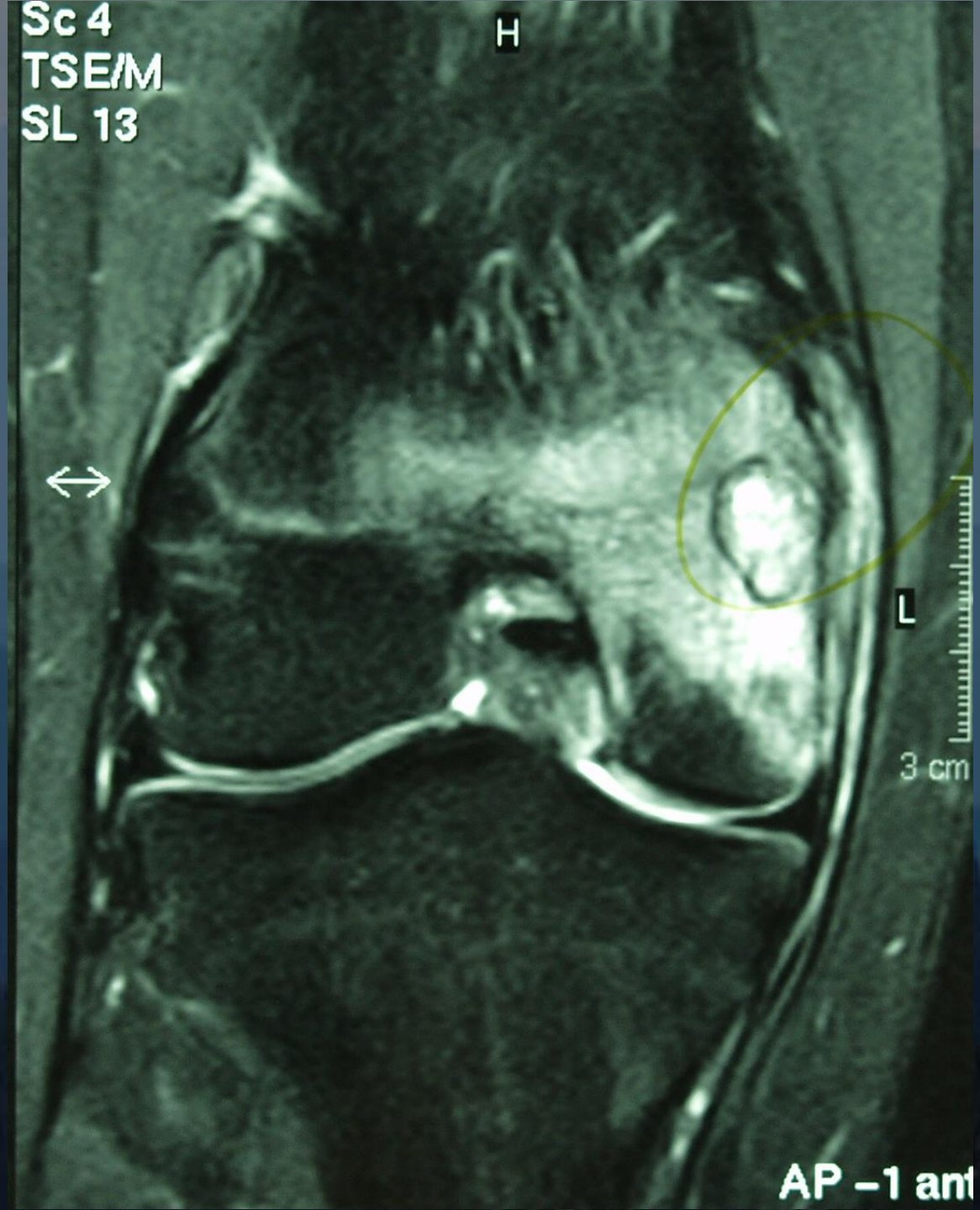


MRI:

- Extent of:
  - Marrow changes
  - Soft tissue involvement
  - Edema
- Signal characteristics
  - Areas of tumor necrosis
  - Cystic lesions

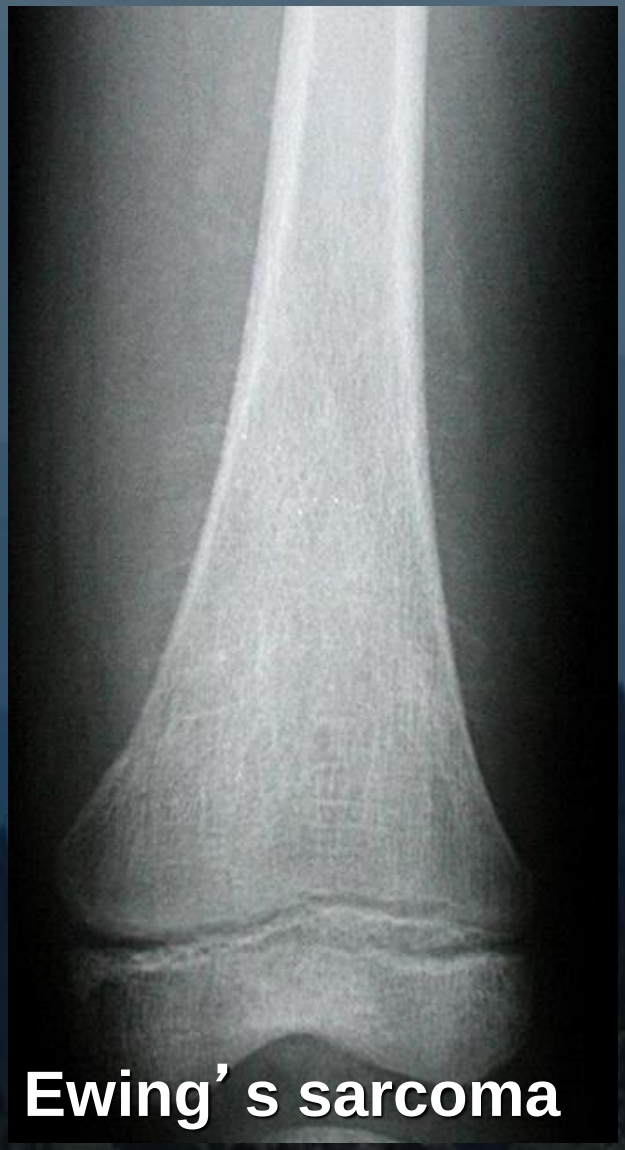


Osteosarcoma


Sc 4
TSE/M
SL 13
H
L
3 cm
AP -1 ant

Pitfalls to Avoid:

- Look carefully at the x-ray…



Ewing's sarcoma

Pitfalls to Avoid:

- Get two views

Work-up of Bone Tumors

- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

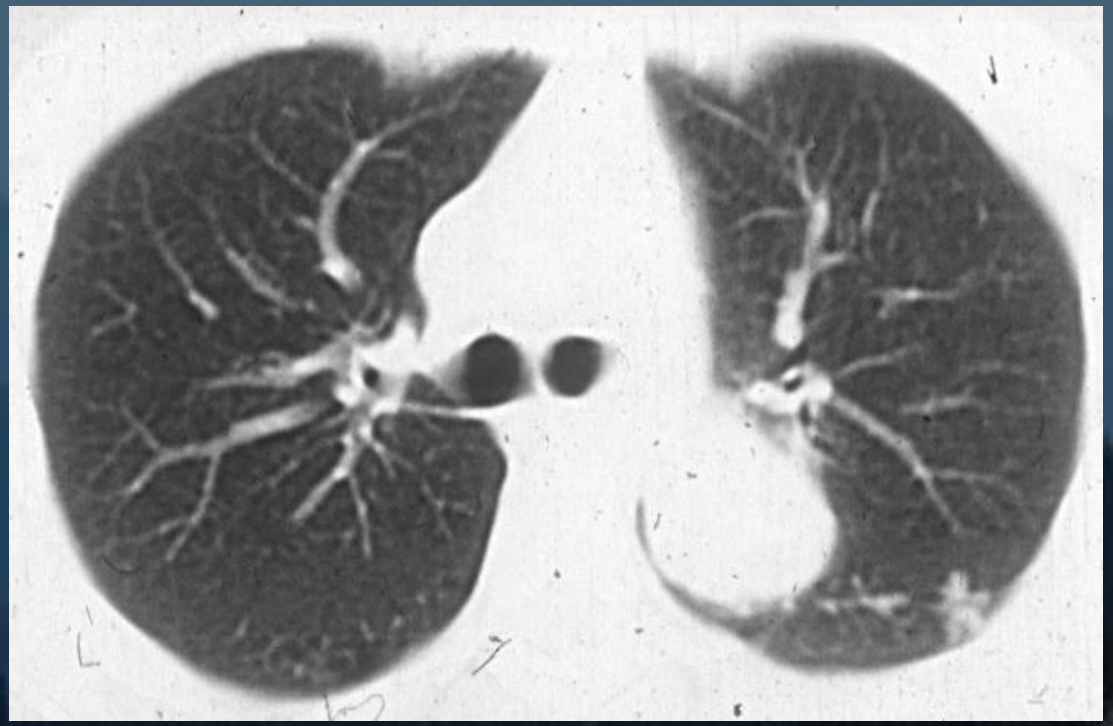
Bone Scintigraphy: *Staging Study*

- Identify osseous metastases
- Extent bone involvement
- Can be negative in myeloma and aggressive tumors

Osteosarcoma

Computed Tomography: Chest /Abd/Pelvis

- Pulmonary
- Mets
- Kidney tumor
- Other lesions



Metastatic Ewing's sarcoma

Occult Mets: Diagnosis with PET

- Early mets can be missed on bone scan which detects osteoblastic response as opposed to tumor itself
- PET: measures metabolic activity of tumor; high grade malignancies with greater FDG uptake

PET Detection of Bone Metastases

- Data: as sensitive as bone scan for breast and lung mets but superior in specificity
- Not reliable in prostate and renal cancers
- Difficult to detect skull mets due to brain activity

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Definitive Diagnosis

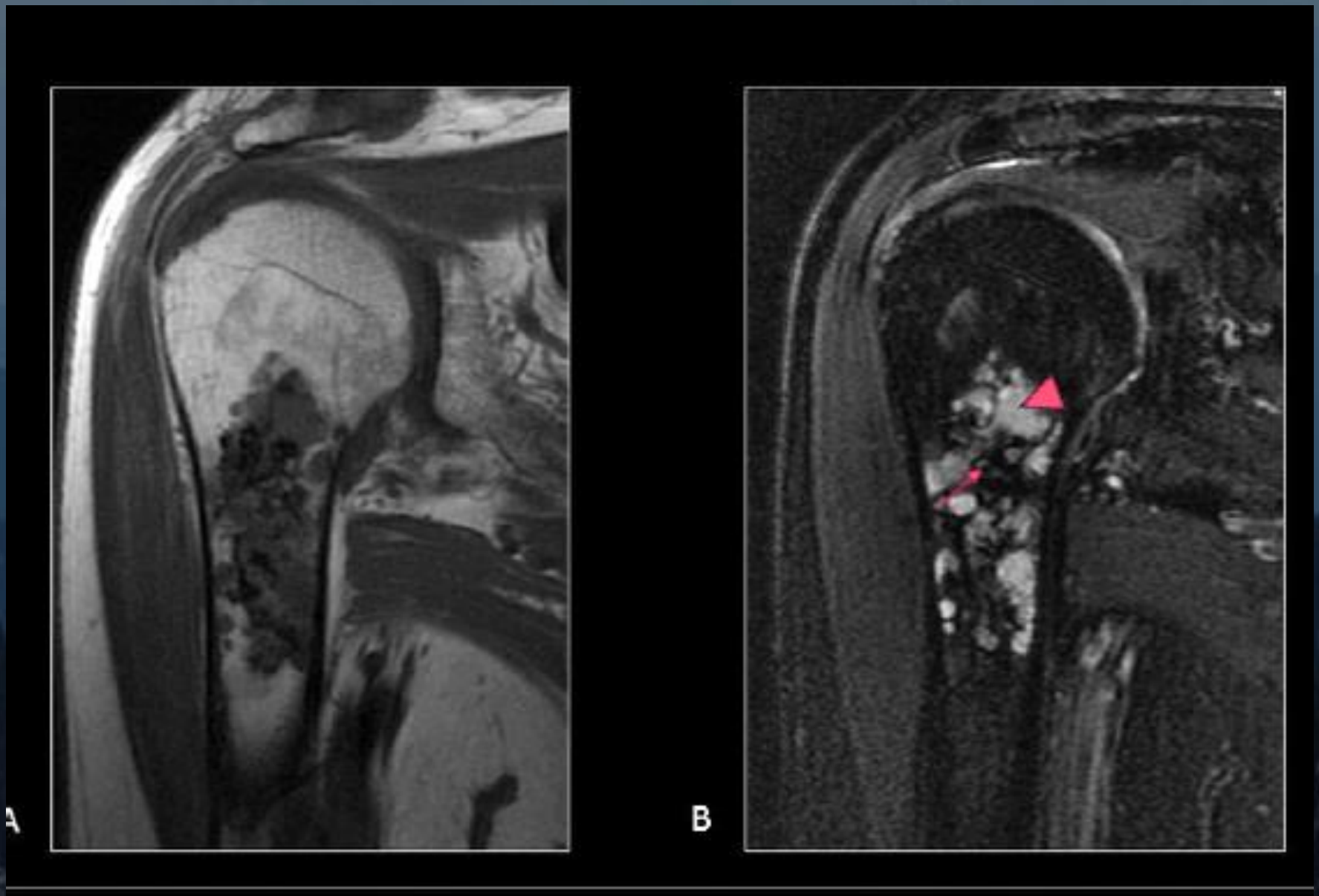
Work-up of Bone Tumors

- **History - AGE!!!**
- **OOEE** < 20; **MMOE** > 20; **MMLC** > 40

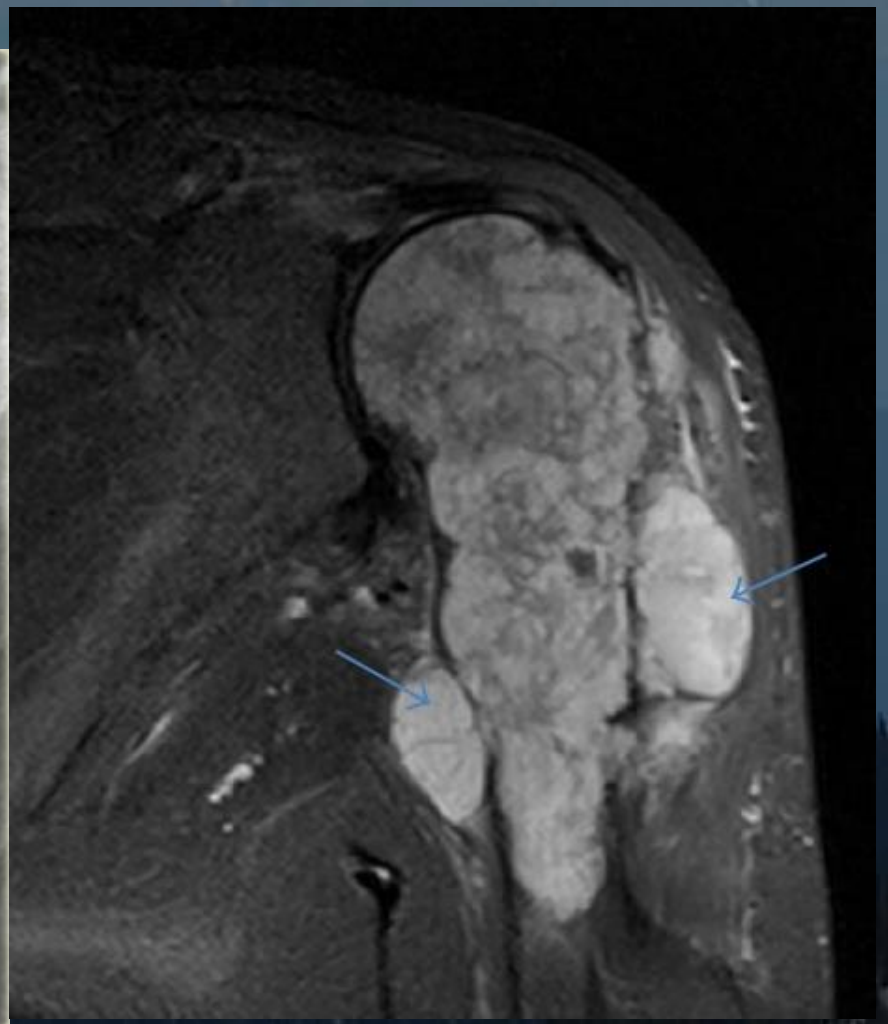
Cartilage Lesions

- Most common bone tumor referral
- Aggressive signs:
  - Endosteal scalloping
  - Soft tissue extension
  - Surrounding edema
  - Myxoid Change

Cartilage Lesions



Cartilage Lesions



SOFT TISSUE SARCOMA
Annual Incidence in the U.S.

8,300

Pearl #2 – Soft Tissue Masses

- MORE COMMON – 6 to 8 times
- Often painless versus bone
- Most are benign – small; superficial; mobile
- However…RARE...bad things:
  - Large - > 5cm
  - Deep
  - Firm
  - Fixed

SOFT TISSUE SARCOMA

Distribution

50%	Extremities
15%	Retroperitoneum
15%	Viscera
10%	Trunk
10%	other

Work-up of Soft Tissue Tumors

- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

SOFT TISSUE SARCOMA
History

1. How long has mass been present?
2. Is mass increasing in size/fluctuate in size?
3. Is mass painful?
4. Has there been penetrating or nonpenetrating trauma?

Work-up of Soft Tissue Tumors

- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

SOFT TISSUE SARCOMA
Physical Exam

- Local
- Determine size, depth, consistency, mobility of mass
- Motion contiguous joints
- Weakness/sensory loss
- Pulses/bruit
- Trans-illuminate

SOFT TISSUE SARCOMA
Physical Exam

- Regional lymph glands
- Hepatosplenomegaly

Pearl #2 – Soft Tissue Masses

- MORE COMMON – 6 to 8 times
- Often painless versus bone
- Most are benign – small; superficial; mobile
- However…RARE...bad things:
  - Large - > 5cm
  - Deep
  - Firm
  - Fixed

SOFT TISSUE SARCOMA Evaluation

Physical

- Malignancy
  - large (>5 cm)
  - firm, deep
  - Fixed
  - Moderate tenderness
  - Regional adenopathy

- Benign
  - small
  - superficial
  - mobile


1
2
3
4

Work-up of Soft Tissue Tumors

- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

Soft Tissue Tumors: Laboratory

- CBC; INR
- Chemistry
- Ca++; LDH
- ESR; CRP

Work-up of Soft Tissue Tumors

- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

SOFT TISSUE SARCOMA Evaluation

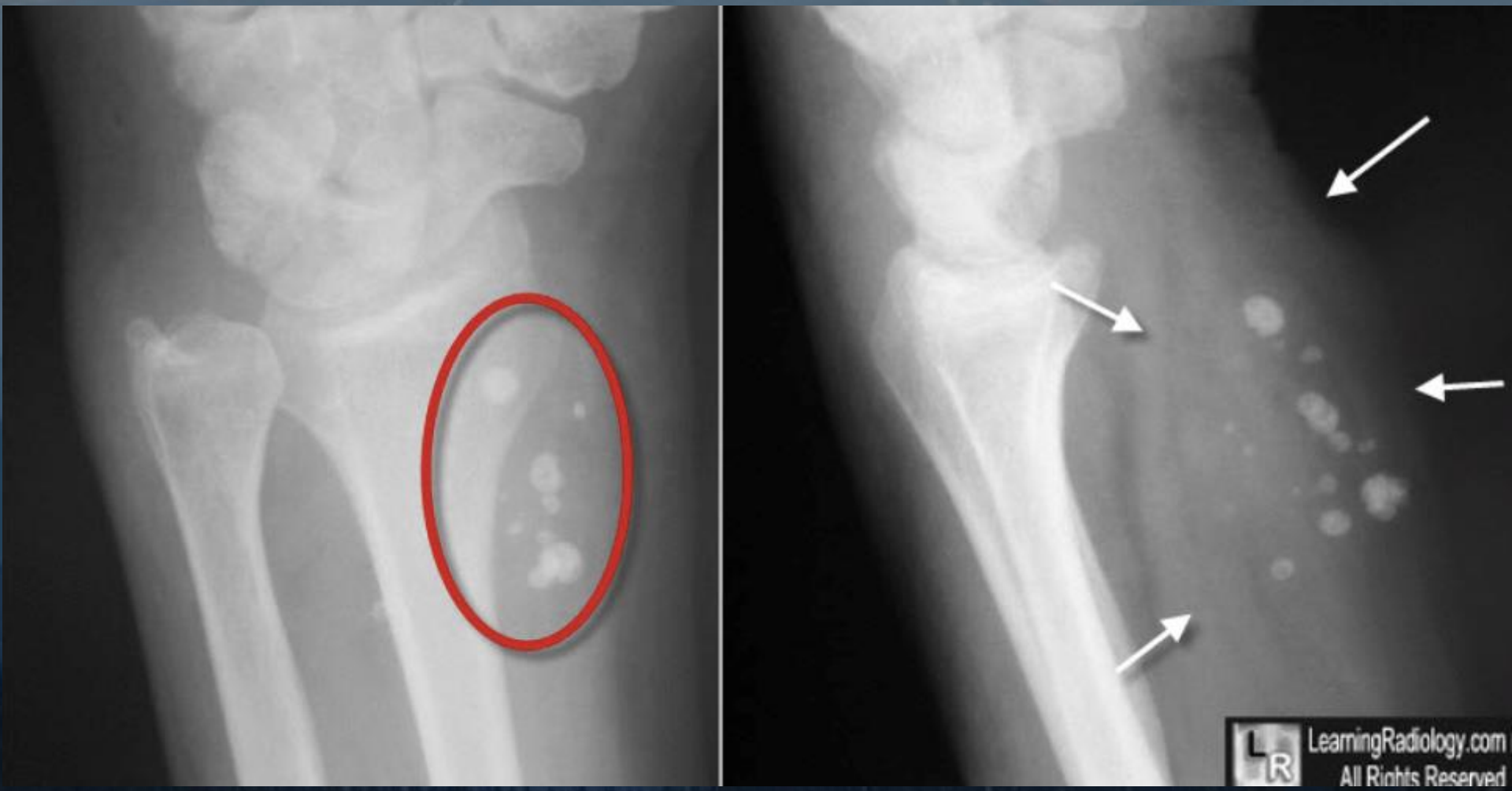
- **Must know** extent of local disease
  - Depth
  - Size
  - Consistency
  - Proximity to structures
  - Pathological diagnosis
  - Metastatic disease

SOFT TISSUE SARCOMA Evaluation

Imaging

Dual plain radiographs:

- Alteration in size
- Alteration in fascial plains
- Calcification
- Extrinsic compression/scalloping of bone
- Periosteal reaction
- Well circumscribed, fat density location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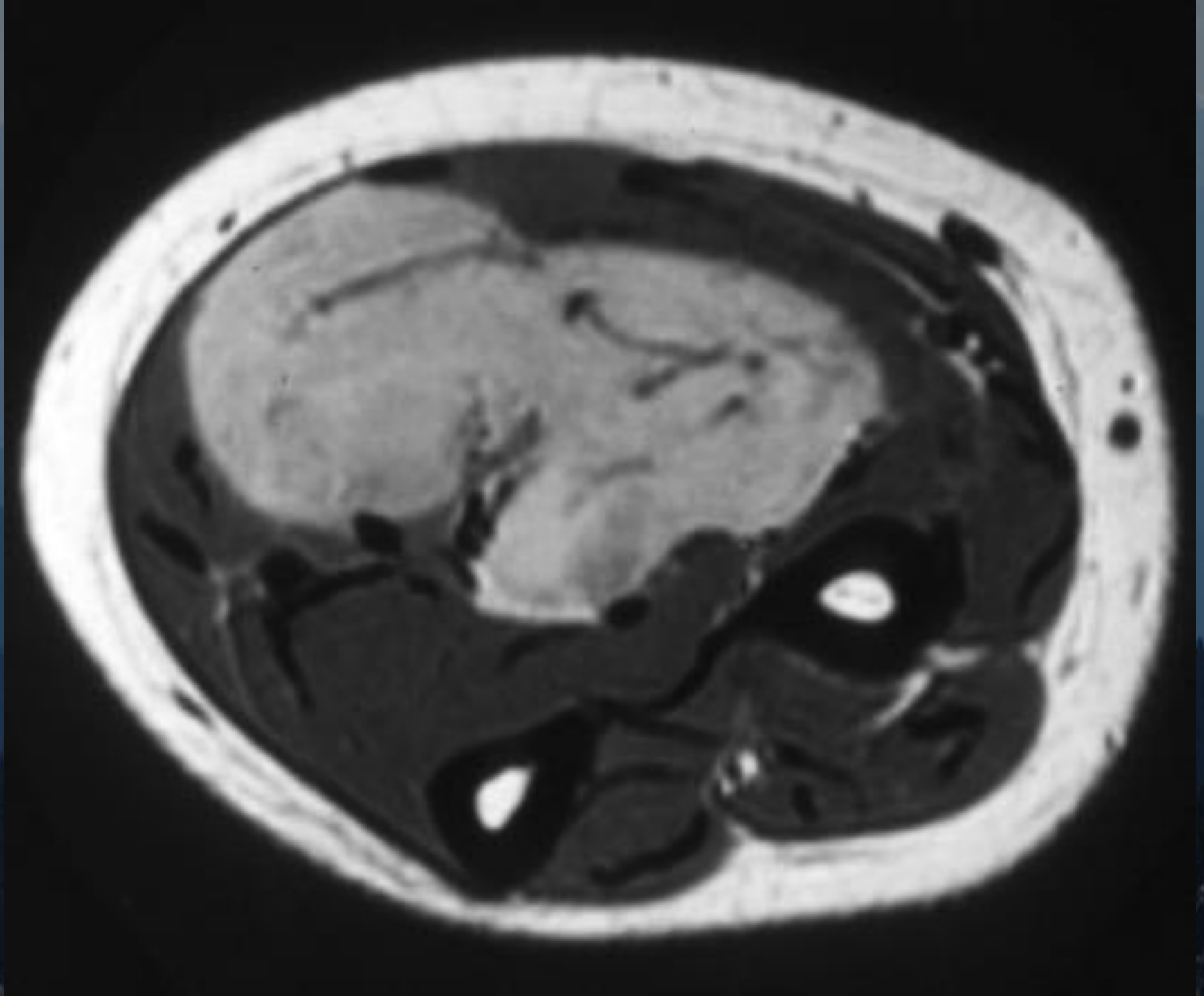
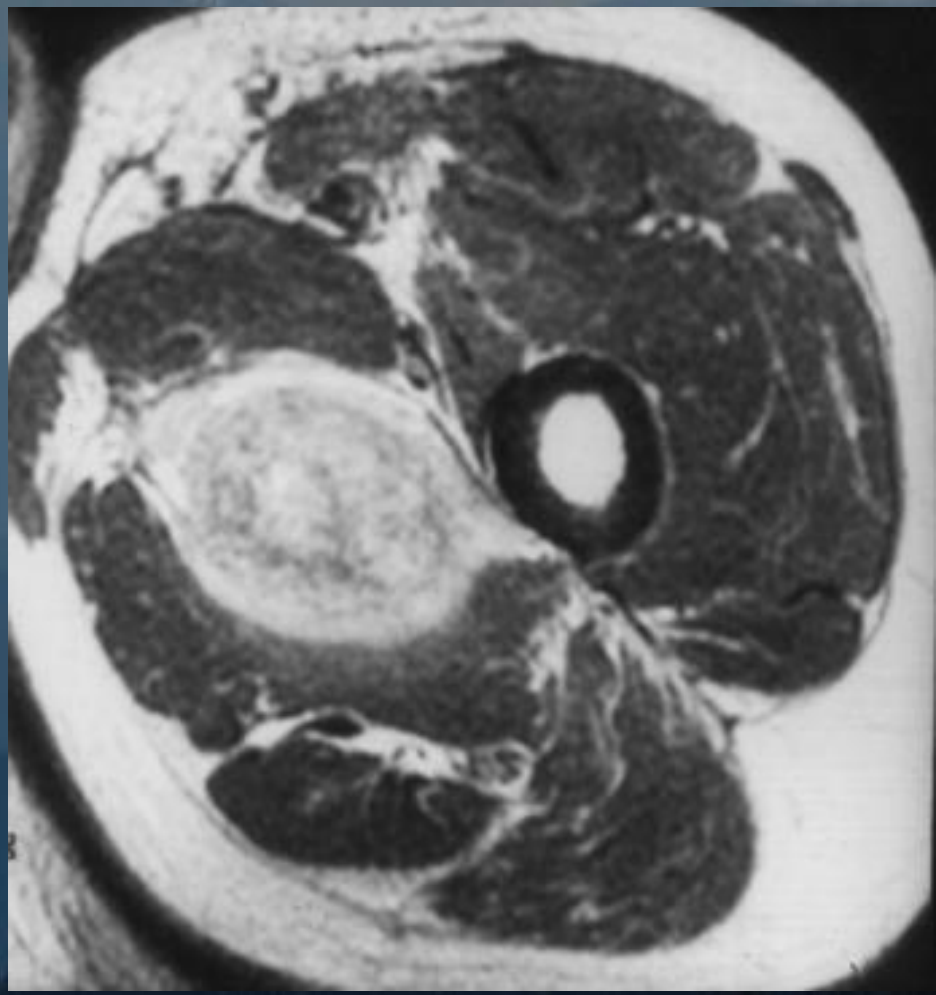
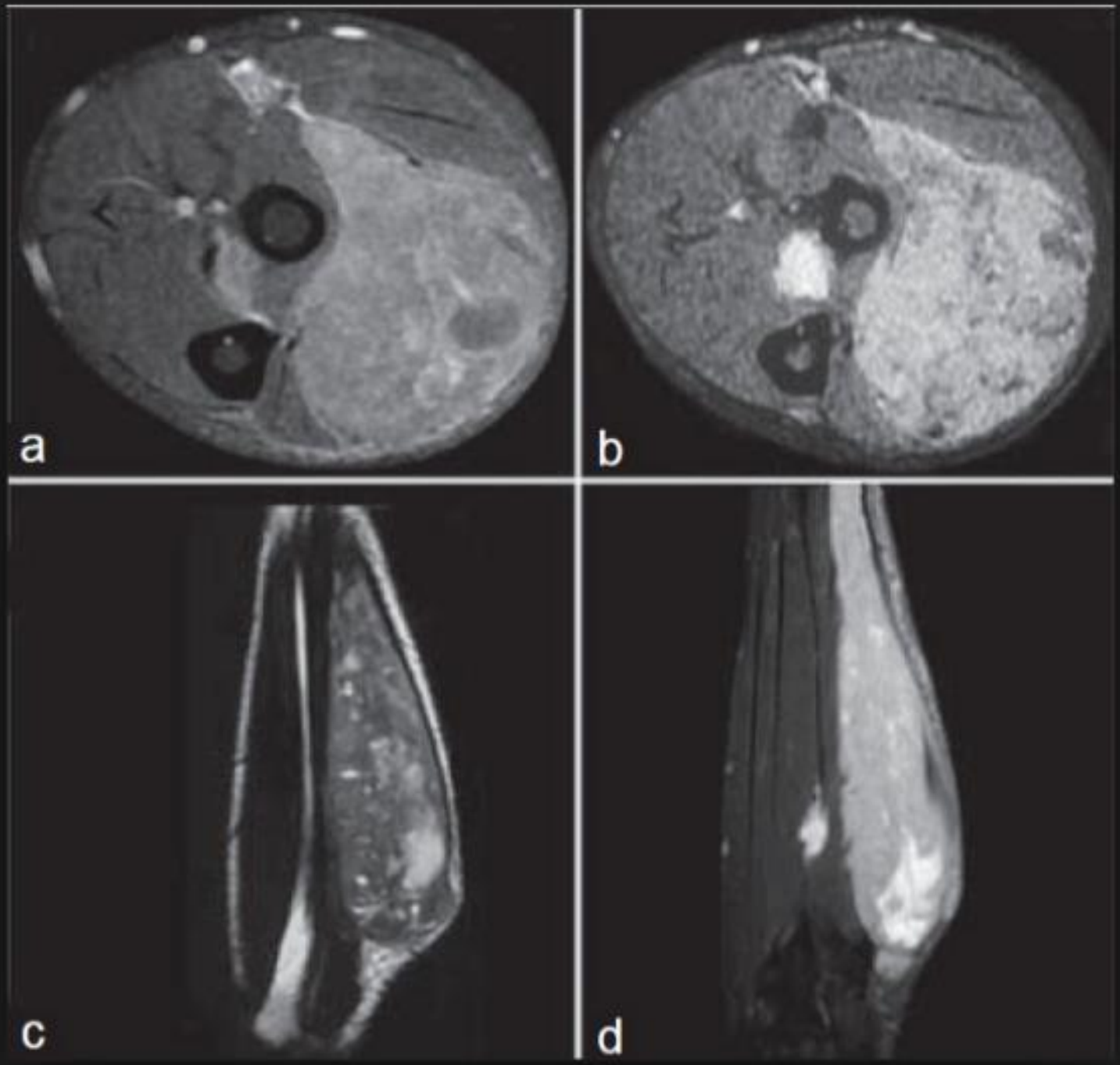
SOFT TISSUE SARCOMA MRI

Magnetic Resonance Imaging

- Multiplanar, high resolution image allows for accurate depth, size, consistency, proximity to structures determination
- Regional lymph nodes easily included
- Efficacy of neoadjuvant treatment can be inferred
- Imaging modality of choice for soft tissue sarcomas



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Work-up of Soft Tissue Tumors

- History
- Physical exam
- Laboratory data
- Radiographic studies
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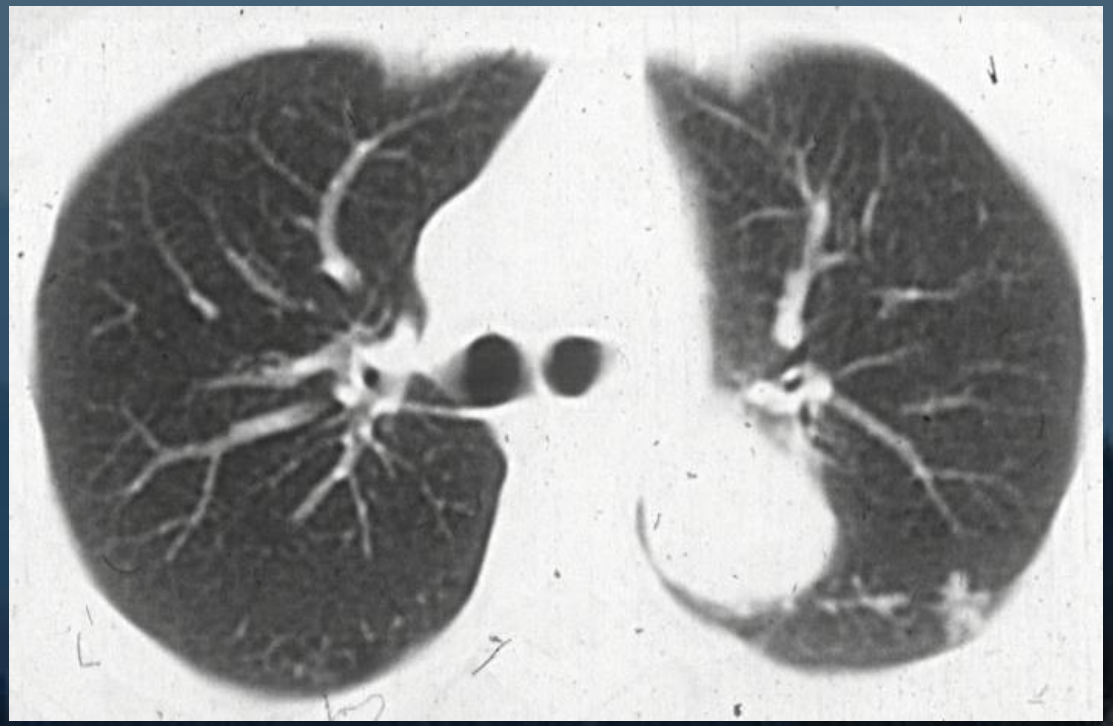
Broad Differential

Definitive Diagnosis

Computed Tomography: Chest /Abd/Pelvis

- Pulmonary
- Mets
- Kidney tumor
- Other lesions



Metastatic Ewing's sarcoma

Work-up of Soft Tissue Tumors

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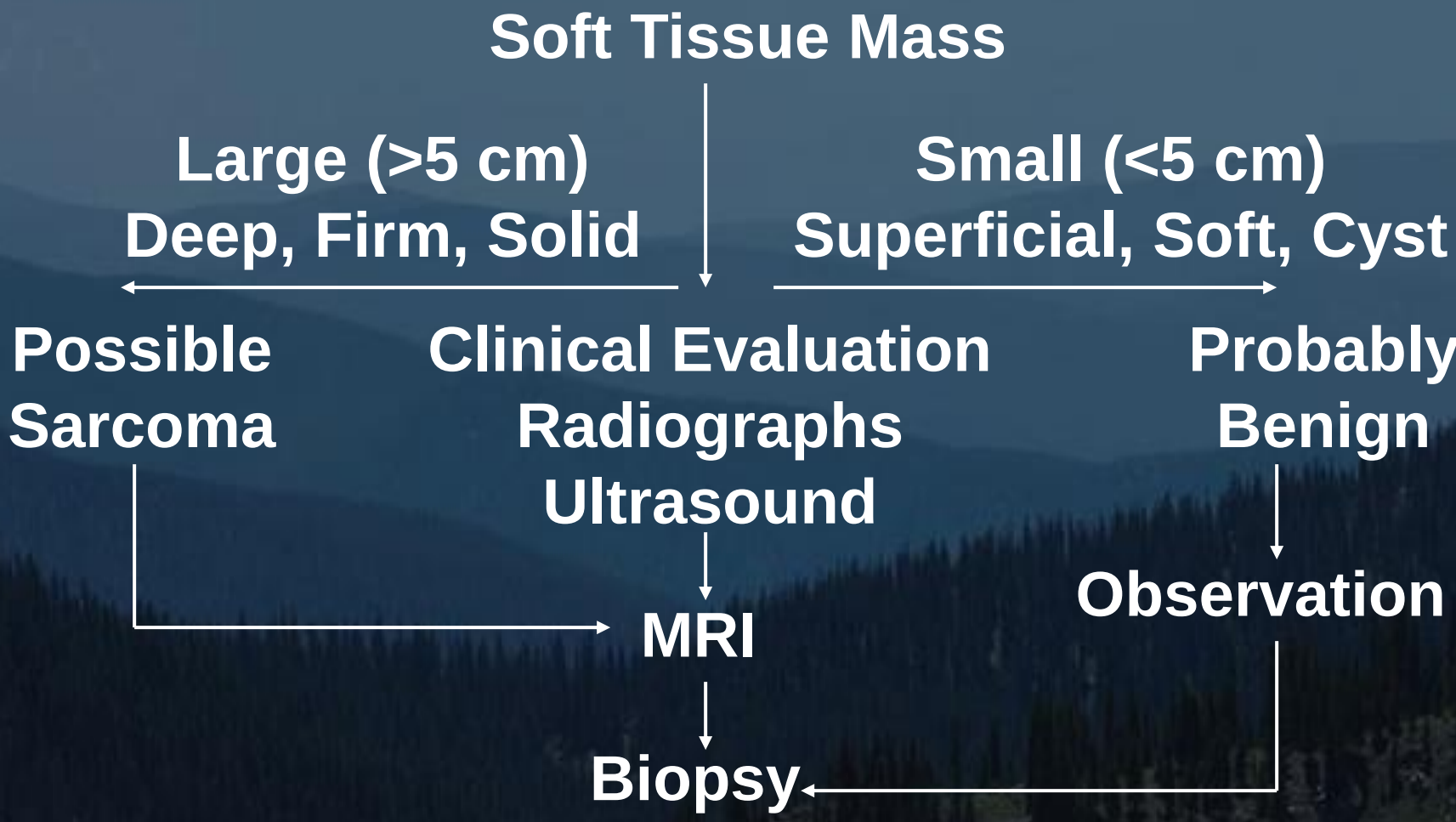
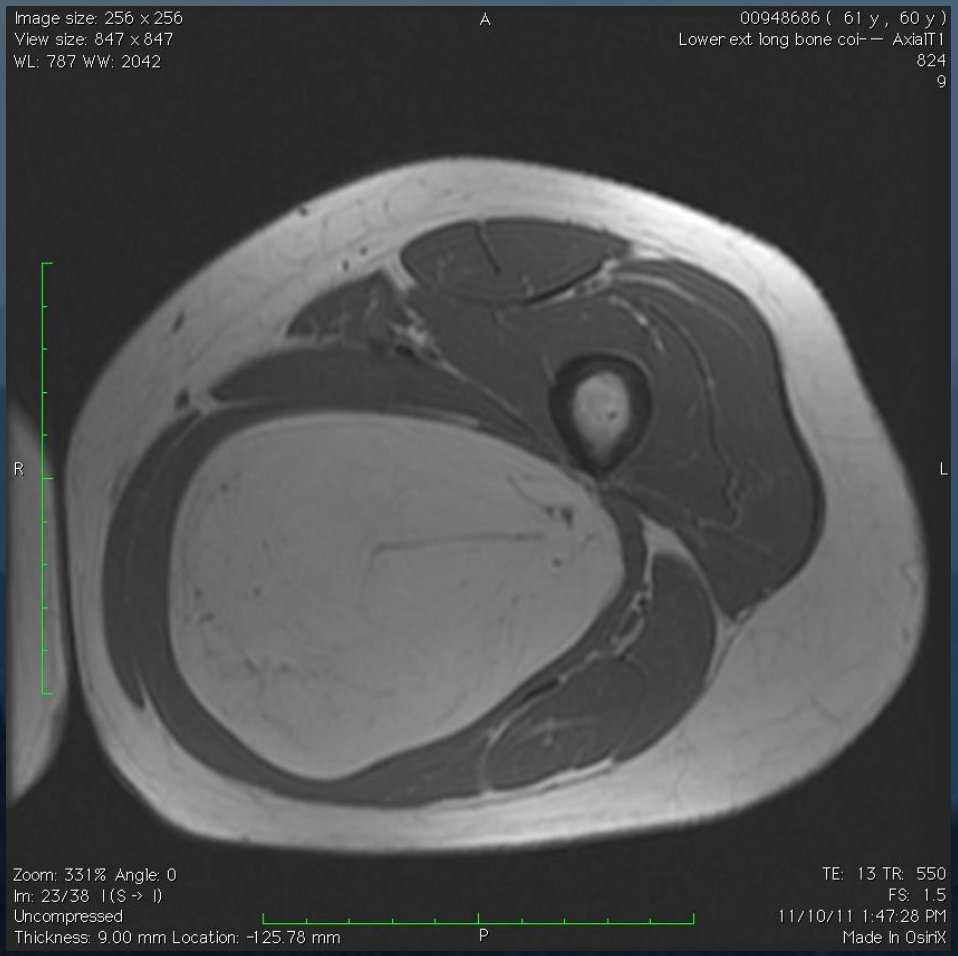
Broad Differential

Definitive Diagnosis

SOFT TISSUE SARCOMA



Fatty Tumors



Work-up of Tumors - Biopsy

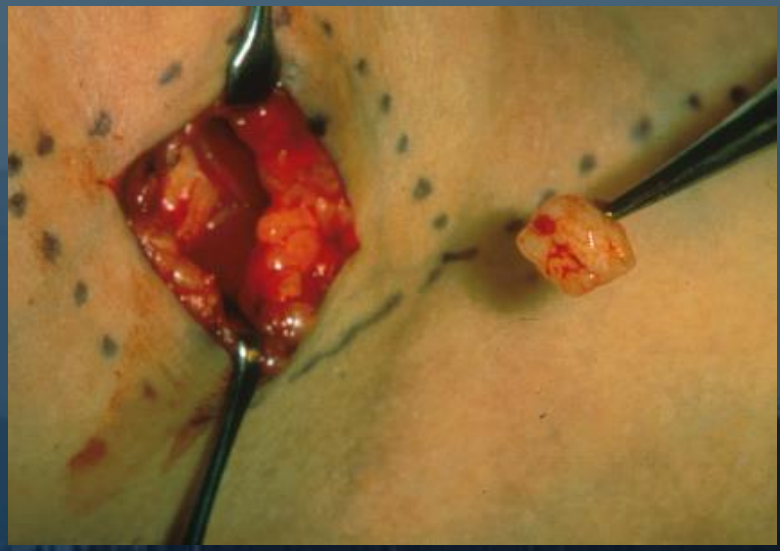
- History
- Physical exam
- Laboratory data
- Radiographic studies
- Staging
- DDx
- Biopsy

Broad Differential

Definitive Diagnosis

Goal of a Biopsy:

- Obtain sufficient tissue from lesion to make diagnosis
- Contaminate as little normal tissue as possible
- When contamination cannot be avoided, contaminate the least important local tissues.



Biopsy Options: Core Needle Biopsy

- Advantages
  - Safe
  - 85-90% correct
  - effective
  - good reliability
  - cost effective

Beauchamp et al. AAOS, 1989.

Skzinski et al. JBJS(Am), 1996.

Open Biopsy Principles:

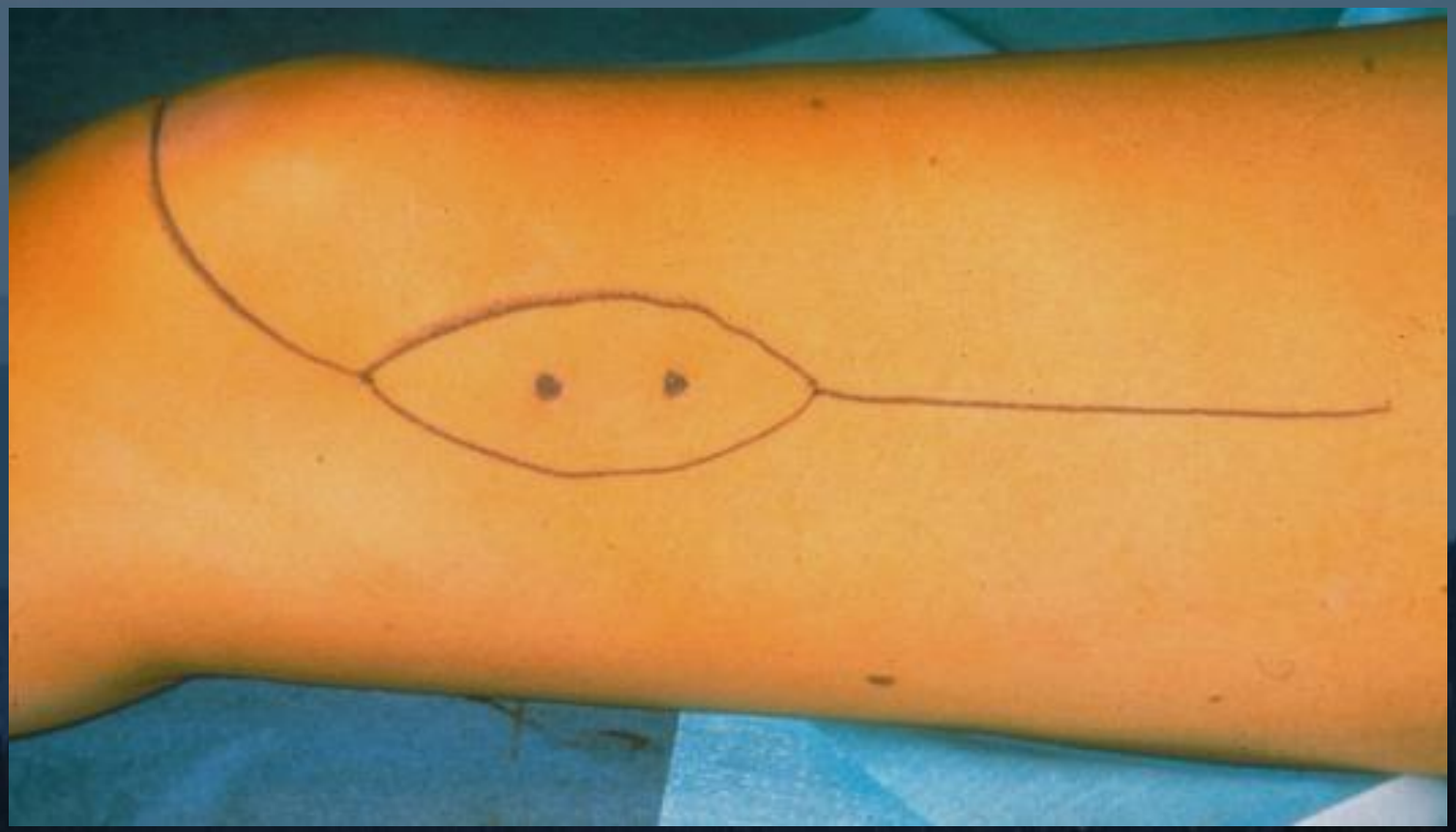
- Longitudinal incision
- Place biopsy in line with incision for definitive procedure
- Direct approach, avoid contamination
- Sample representative portion of tumor
- Meticulous hemostasis
- Drains if required in line with incision

STOP

Bone Biopsy Principles: Surgical Technique

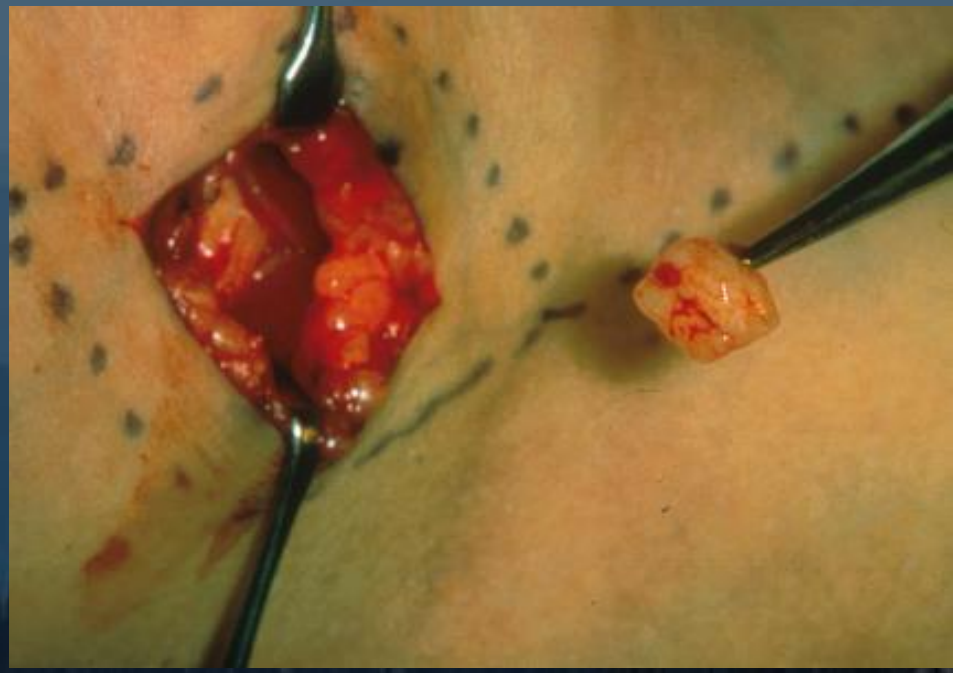
- Oval bone window
- Use bone cement to plug
- Hemostasis

Biopsy Principles:



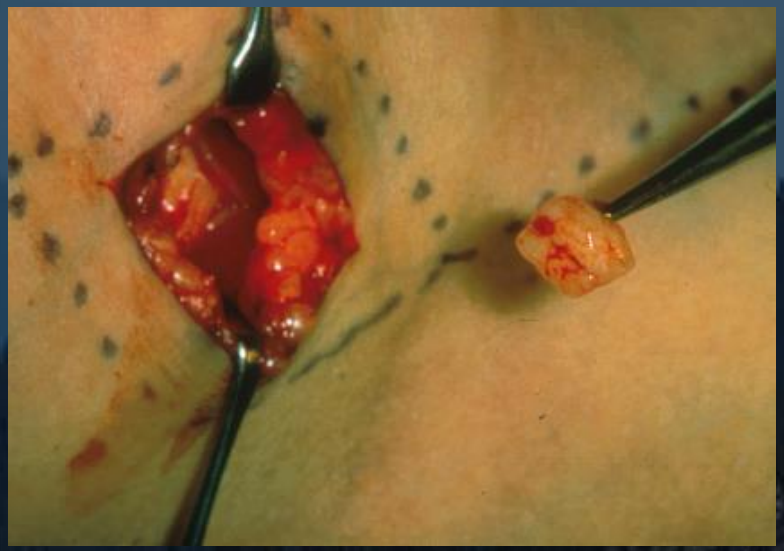
Biopsy options: Open biopsy

- Advantages
  - Adequate tissue sampling for diagnosis
  - Tissue for studies or research protocols



Biopsy options: Open biopsy

- Disadvantages
  - Problems with incision placement
  - Problems with biopsy technique
  - Not cost effective
  - Req anesthetic



MSTS Study: 1982
The Hazards of Biopsy

- Review 329 malignant primary bone/soft tissue tumors

	Referring inst	Treating inst
Error in Dx……	43 (30.1%)	17 (19.1%)
Biopsy error……	28 (19.6%)	6 (3.2%)
Plans altered due to biopsy……..	45 (31.5%)	15 (8.1%)
Change in outcome due to error..	19 (13.3%)	9 (4.8%)

Mankin et al. JBJS(Am), 1982.

MSTS Study: 1996
The Hazards of Biopsy

	1982	1996
# of patients……	329	597
Error in diagnosis……..	19%	17.8%
Change plan (surg/chemo/rad)	18%	19.3%
Change outcome (fnctn/surv)	8.5%	10%
Unnecessary amputations	15	18

**JBJS (Am) 1982, 1996 Mankin et a

Error in Biopsy: Why?

Lesion assumed to be:

…benign

…metastatic

…a hematoma

…a lipoma

Path fx, presumed met
MFH of bone, hip disartic

Error in Biopsy: Why?

- No preop images
  - “It needs to come out anyway”
  - “The fracture needs to be fixed anyway”
  - “We can remove that lump for you at same time”

Error in Biopsy: Why?

- Not referred to trained specialists
- Inadequate communication between physicians and/or specialists

Pearl #1- Bone

- Most common primary tumor of bone
  - Myeloma/Plasmacytoma
- Most common tumor of bone – METS!!!
  - **PT B**arnum **L**oves **K**ids
  - **T & K** BLEED A LOT!!!
  - Know Enneking X-ray Criteria
    - Where, Action, Response & Content

Pearl #1- Bone

- Bone Scan – can be negative in Myeloma/Kidney
- Differential – **OOEE**
- Most common tumor of bone
  - METS
  - **PT B**arnum **L**oves **K**ids
  - **T & K** BLEED A LOT!!!
  - Know Enneking X-ray Criteria
    - Where, Action, Response & Contents

Pearl #2 – Soft Tissue Masses

- MORE COMMON – 6 to 8 times
- Often painless versus bone
- Most are benign – small; superficial; mobile
- However…RARE...bad things:
  - Large - > 5cm
  - Deep
  - Firm
  - Fixed

Pear #3 - Pain

- **Malignant Soft Tissue painless; Malignant bone tumors painful!**

Pear #4 - Approach

- **HAVE ONE!**

Pearl #5 - Biopsy

- LAST THING THAT IS DONE!
- NEVER TRANSVERSE!
- DONE THEN STOP!

Thank You

Thank You!