

MRI - Technique

- Obtain an adequate history
- Correlate with x-rays, CT and scintigraphy
- Always before biopsy (needle or open)
- Mark the lesion
- Make patient comfortable



Neurofibroma of median nerve 27F Sag T2FS

MRI - Technique

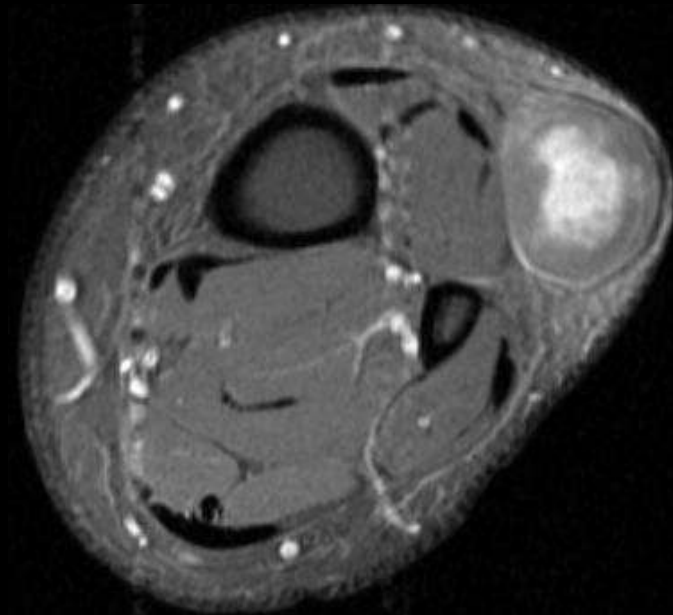
- High field strength helps - not essential
- T1 and T2 to characterize
- FS for sensitivity, cartilage, and fatty tumors
- Multiple planes
- Shaft
 - Axial,
 - Sagittal and Coronal
- Adjacent to Joint
 - Sagittal and Coronal
 - Axial



Osteochondroma T1FSGd

MRI Contrast

- May add a little to conspicuity
- Helps define tumour v's necrosis
- Greatly enhanced by T1FS
- Useful Post Chemotherapy/XRT
- Occasionally diagnostic



Neurofibroma T1FSGd

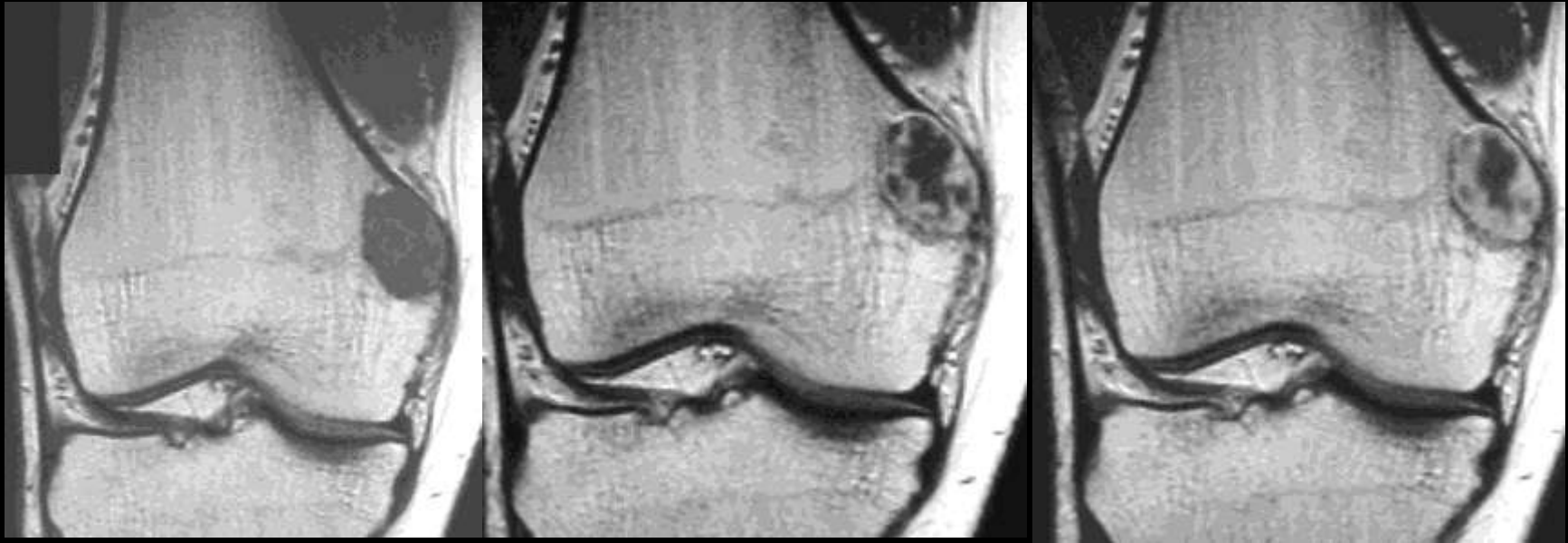
Gd-DTPA

- Substitute ultrasound
- Helpful in selected cases
 - Next to fluid
 - Epidural or intraarticular
 - Homogeneous solid vs cystic
 - Assess vascularity prior to biopsy
 - Post-treatment
- Indications are controversial for tumor imaging



Sag T1FS post Gd

Dynamic Enhancement



Cor T1

Cor T1

Cor T1

15m delay

- 84% of malignant tumors had contrast enhancement slopes $>30\%$
- 72% of benign tumors had contrast enhancement slopes $<30\%$
- Areas of necrosis and peritumoral edema enhanced significantly less and more slowly than viable tumor

MR Angiography

- Defines anatomy of major vessels and their relation to neoplasms
- Differentiates masses from vascular pathology (eg. aneurysm or pseudoaneurysm)



Detection

- Initial examination conventional radiography
- **Bone neoplasms**
Higher sensitivity with CT, scintigraphy and MR
- **Soft tissue neoplasms**
Higher sensitivity with CT, ultrasound and MR



Histological Characterization

- Benign tumors, metastases, round cell tumors and **pseudotumors** are managed differently than sarcoma
- Management of sarcomas depends on grade and anatomic extent rather than on histologic type



Histologic Characterization

- Emphasis of radiology training
- Surgeon more interested in where it is than what it is
- Biopsy necessary in sarcoma for accurate diagnosis



Osseous Tumors

- Metastatic disease most common
- Primary benign tumors more common than primary malignant tumors
- Most common primary malignancies are myeloma, osteosarcoma and Ewing sarcoma
- Other primary skeletal malignancies rare



Cor T2

Benign V's Malignant

- Signal intensity
- Tumor margin
- Signal inhomogeneity
- Neurovascular invasion
- Growth rate
- Tumor size
- Tumor location
- Soft tissue extension
- Multicompartment involvement
- Bone destruction



Histological Characterization

- Epidemiology

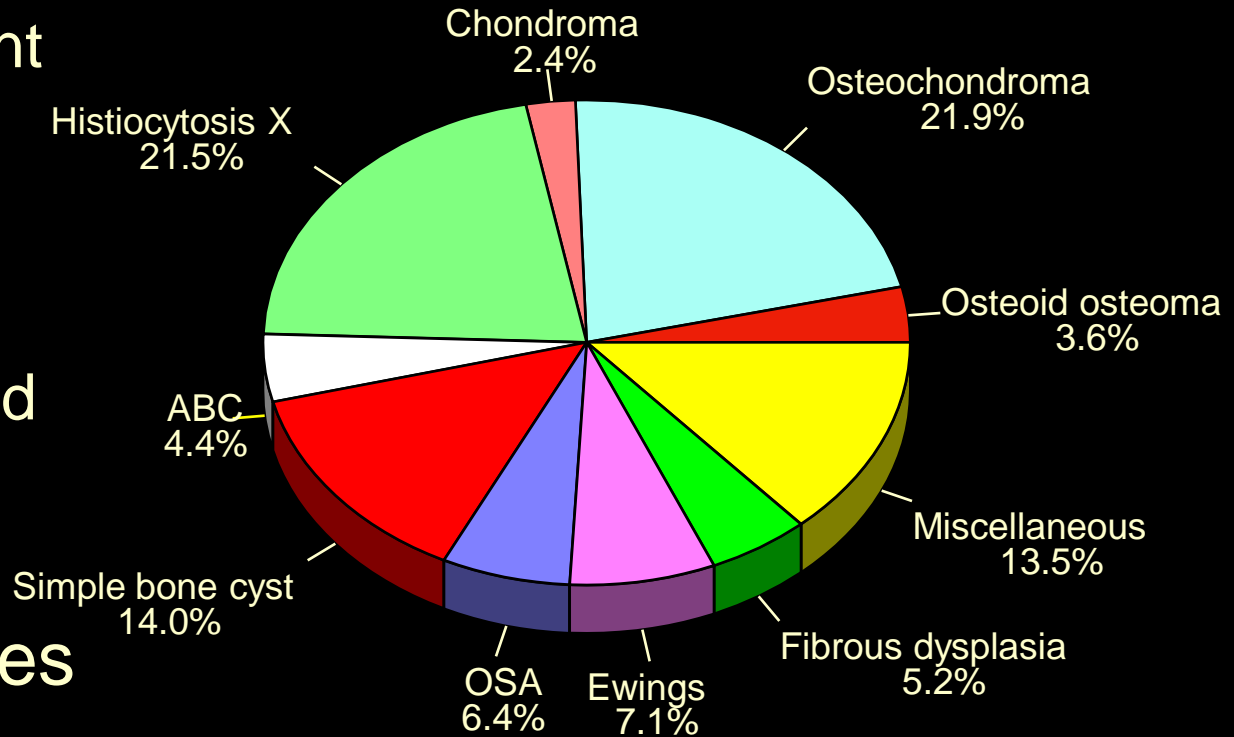
- Age of patient

- Distribution

- Diffuse
- Disseminated
- Solitary

- Tumor features

- Location
- Biologic activity
- Matrix



Distribution

- Diffuse
 - All bone is histologically abnormal
- Disseminated
 - Multiple distinct lesions
- Few
- Solitary



Diffuse Distribution

- Radiographically, disease may appear diffuse, disseminated or even focal
- Pattern seen with dysplastic, metabolic and endocrine disease
- Less commonly, seen with neoplastic infiltration



Sag T1

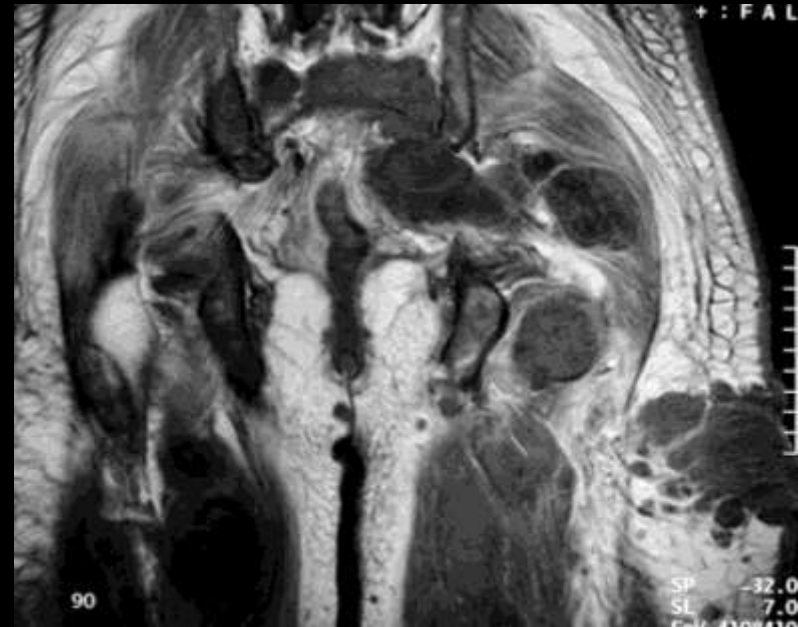
Disseminated Distribution

- Normal intervening bone
- Lesions may be synchronous or metachronous
- Not all lesions may be evident radiographically
- Metastatic disease
- Multiple myeloma
- Paget disease
- Eosinophilic granuloma
- Fibrous dysplasia
- Enchondromatosis
- Multiple osteochondromatosis



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Metastases ST and bone

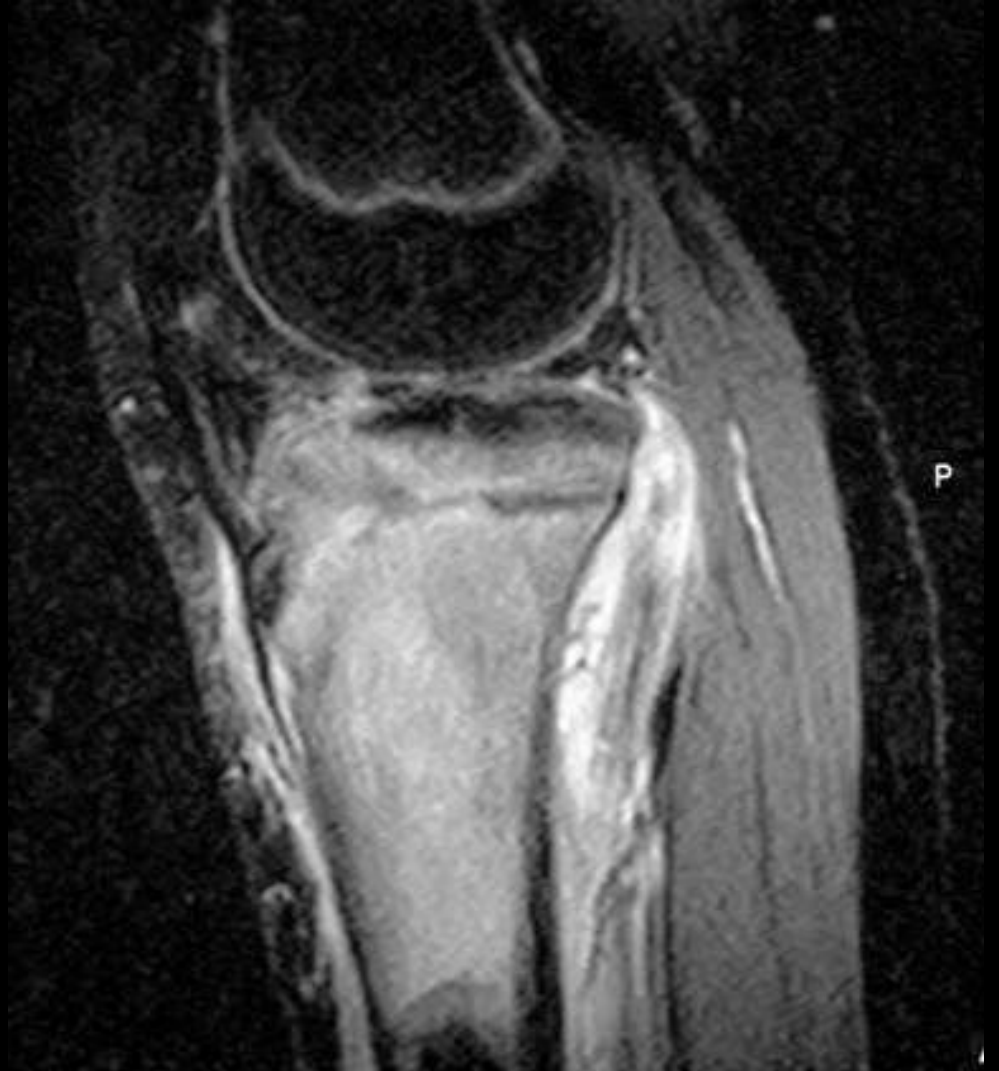
Distribution - Solitary lesion

- 10-15% of mets
- Ability to identify lesion radiographically depends on what it does to underlying osseous matrix



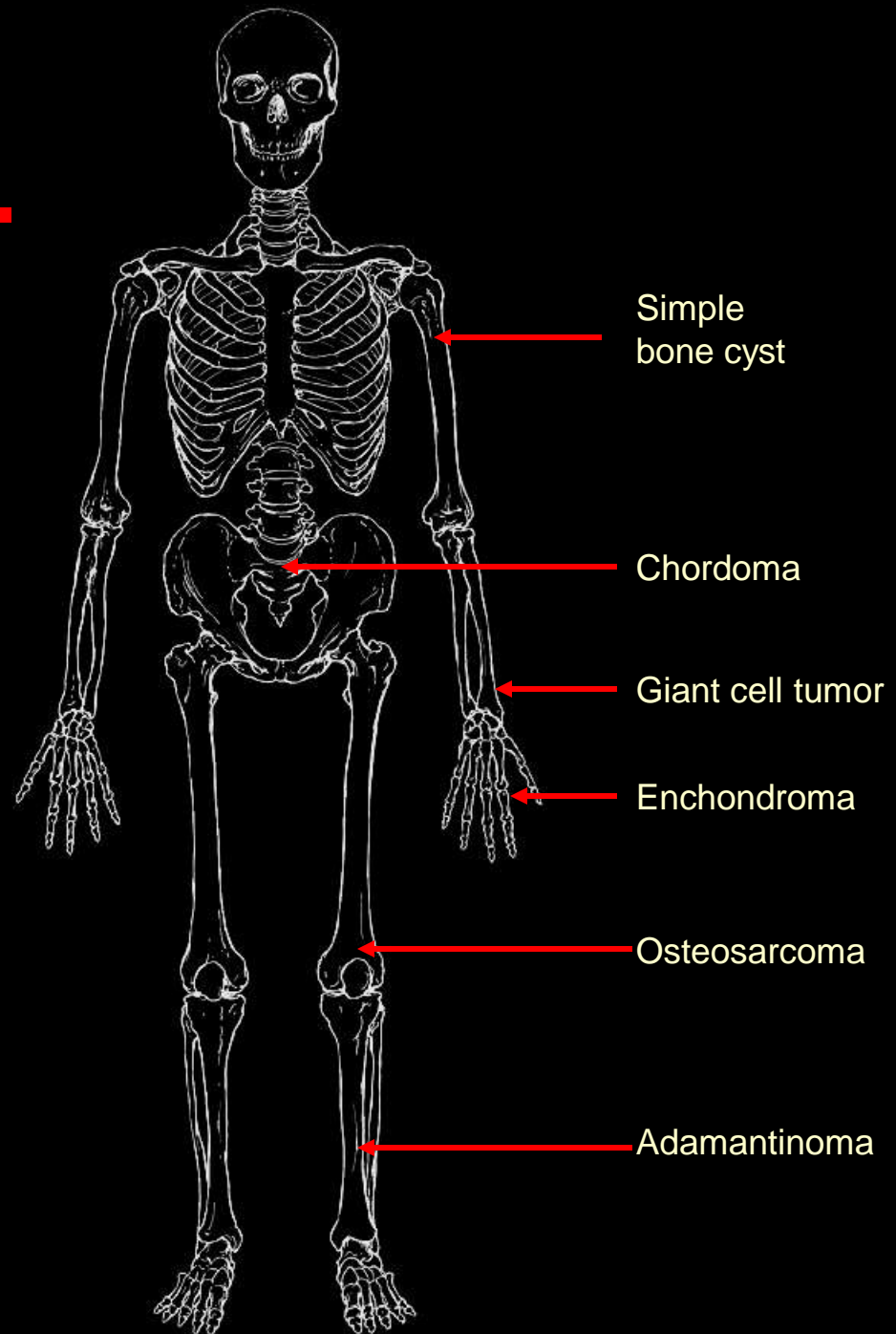
Location

- Osseous
- Soft tissue
- Intraarticular



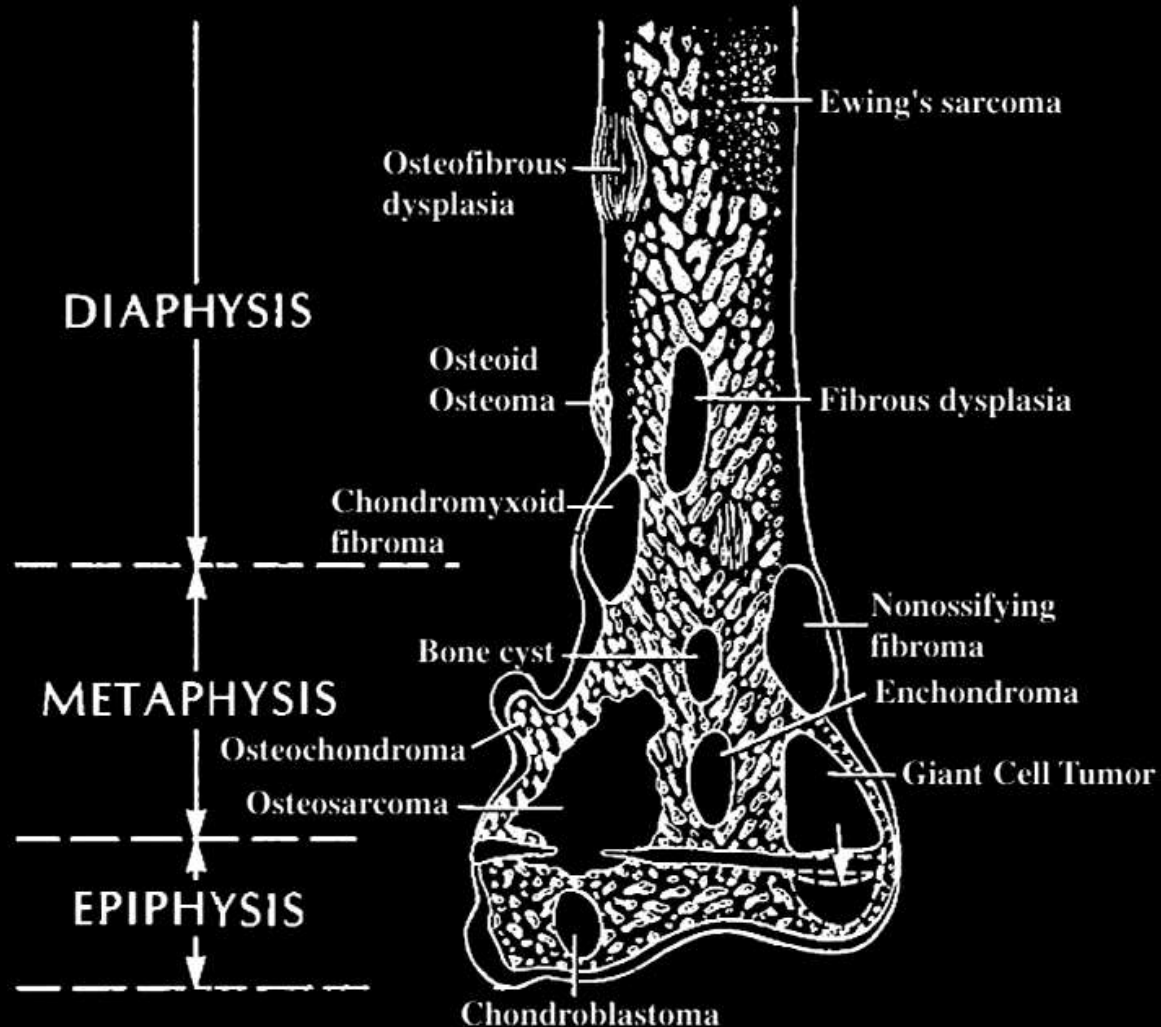
Location

- Which bone is involved?
- Each neoplasm has a tendency to involve particular bones



Location

- Longitudinal
 - Epiphysis
 - Metaphysis
 - Diaphysis
- Transverse
 - Central
 - Eccentric
 - Cortical
 - Surface



Location - Joint

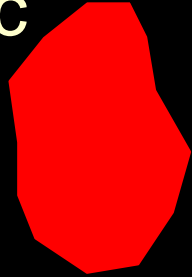
- PVNS
- Synovial osteochondromatosis
- Hemangioma
- Synovial sarcoma



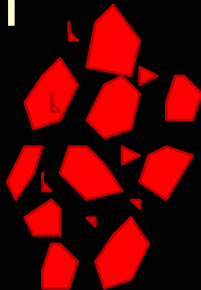
Sag T1Gd

Biologic activity

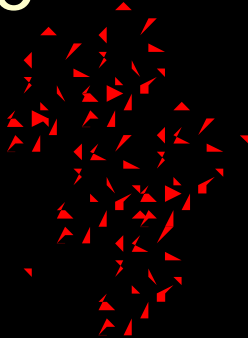
- Geographic



- Moth-eaten



- Permeative



Margin

- Difficult to distinguish tumor from peritumoral edema
- Benign and malignant tumors can have peritumoral edema
- Tumor and edema enhance with Gd
- Gadolinium flow rate may be helpful

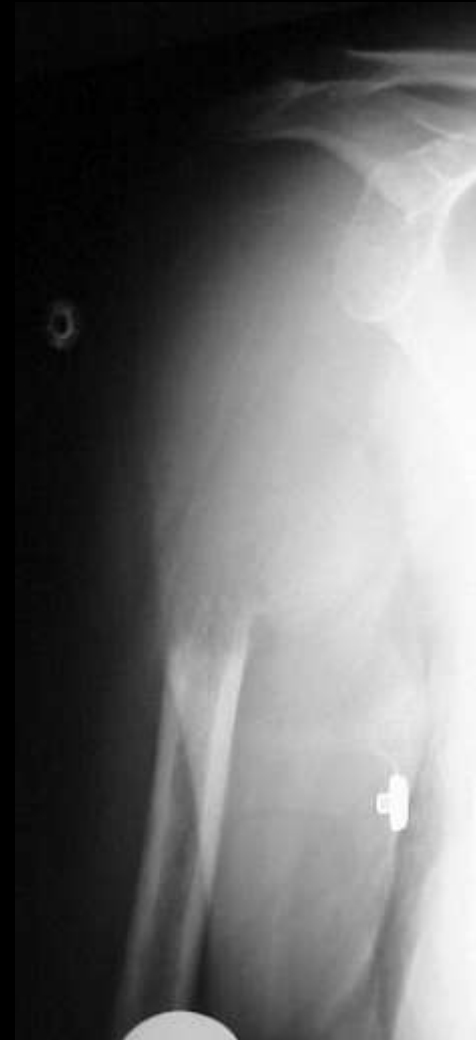
Peritumoral edema

- Osteoid osteoma
- Chondroblastoma
- Eosinophilic granuloma



Expansion

- Deposition of solid periosteal layer around periphery of lesion
- Expansion implies loss of original cortex
- Generally seen in slowly growing lesions
- Does not mean that the lesion is benign



Expansile lytic lesions of bone

- Metastases

- Renal, Thyroid, Breast, Lung, Melanoma, Phaeo

- Primary malignant

- Plasmacytoma

- Primary benign

- ABC, GCT, Enchondroma

- Non-neoplastic

- Hemophilia, Brown, Hydatid, Fibrous dysplasia

Biologic activity

- Mildly expansile
 - Unicameral bone cyst
 - Giant cell tumor
 - Nonossifying fibroma
- Markedly expansile
 - Aneurysmal bone cyst
 - Plasmacytoma
 - Hemophilic pseudotumor



Types of periostitis

- Uninterrupted solid
- Uninterrupted single linear
- Interrupted "onion-skin"
- Interrupted "Codman's triangle"
- Perpendicular "sunburst"
- Perpendicular "hair-on-end"



Solid



Onion-skin



Sunburst



Linear



Codman's triangle



Hair-on-end

Soft tissues

- Soft tissue component
- Distortion of fat planes
- Soft tissue edema
- Matrix in soft tissue



Histologic Characterization - Matrix

- Acellular substance produced by the lesion
- Helps define histology of lesion
 - Ossific
 - Chondroid
 - Lipoid
 - Myxoid
 - Collagenous



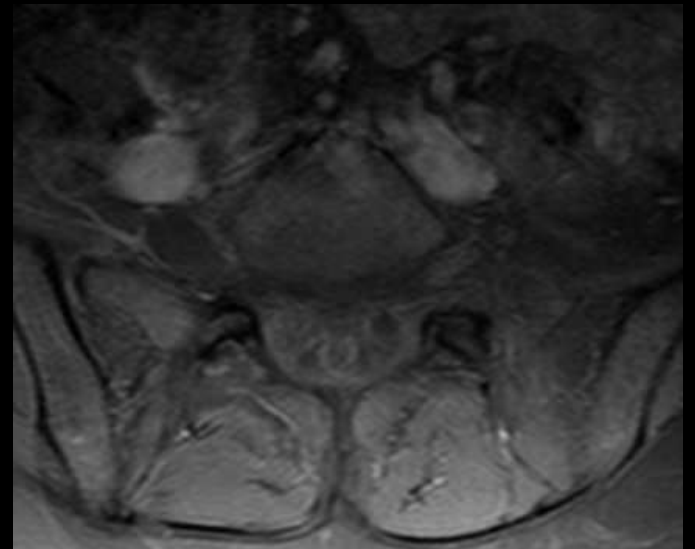
Matrix – MR signal - \downarrow T1, \uparrow T2

- Nonspecific
- Majority of benign and malignant lesions show this pattern
- History, location and configuration help establish differential diagnosis

AxT2



Ax T1FSGd



↑T1, ↑T2

- Fat
 - Lipoma
 - Well-differentiated liposarcoma
 - Hemangioma
- Subacute blood
- Paramagnetic substances



Hematoma

↓T1, ↓T2

- Calcification
- Ossification
- Crystalline structures
- Dense fibrous tissues
- Hemosiderin
- Flowing blood
- Gas
- Foreign bodies



Fibrous dysplasia

Staging

- Assess anatomic extent of the lesion
- Guide treatment
- Provide prognosis
- Ultimately, improve longevity



Staging

Surgical Staging System	American Joint Committee
Orthopedic surgeons	Oncologists
Benign and malignant lesions	Malignant lesions only
Bone and soft tissue	Soft tissue only
Compartmental anatomy important	Tumor size important
Nodal metastasis treated same as distant metastasis	Nodes are evaluated separately

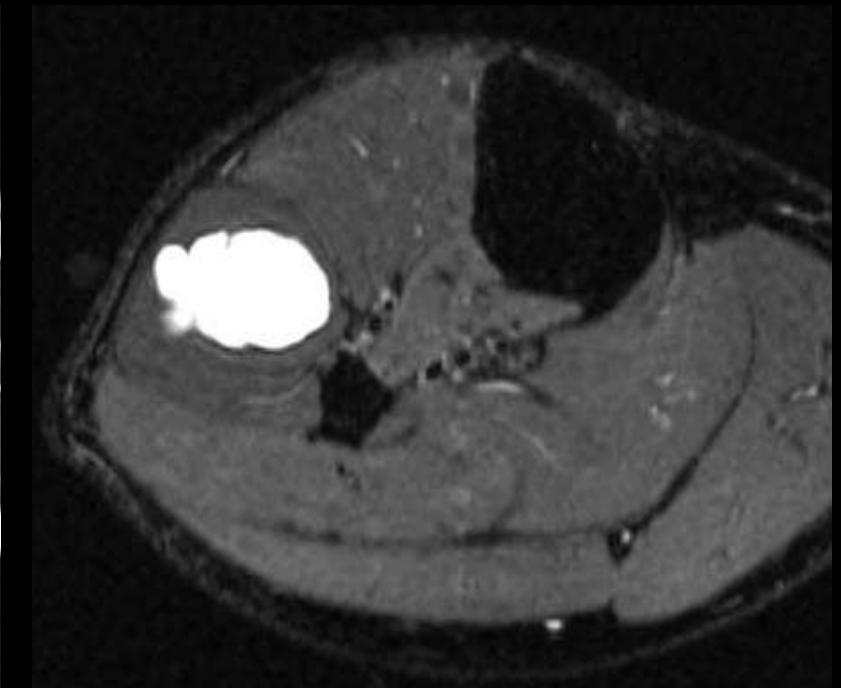
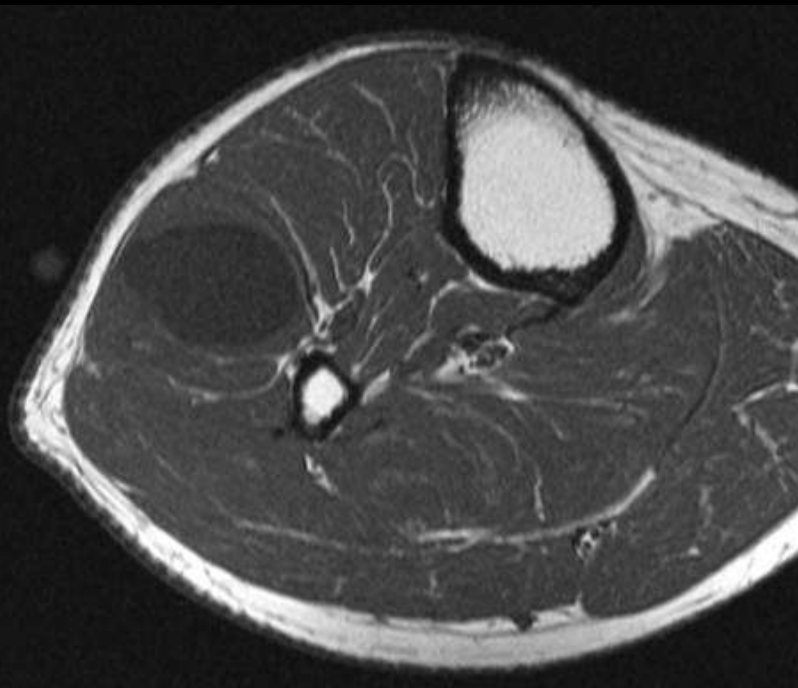
Surgical staging system

- The number describes the biological activity of the lesion
- The letter describes the anatomic extent of the tumor

Stage	1A	1B	2A	2B	3
Grade	G1	G1	G2	G2	G1-2
Tumor	T1	T2	T1	T2	T1-2
Mets	M0	M0	M0	M0	M1

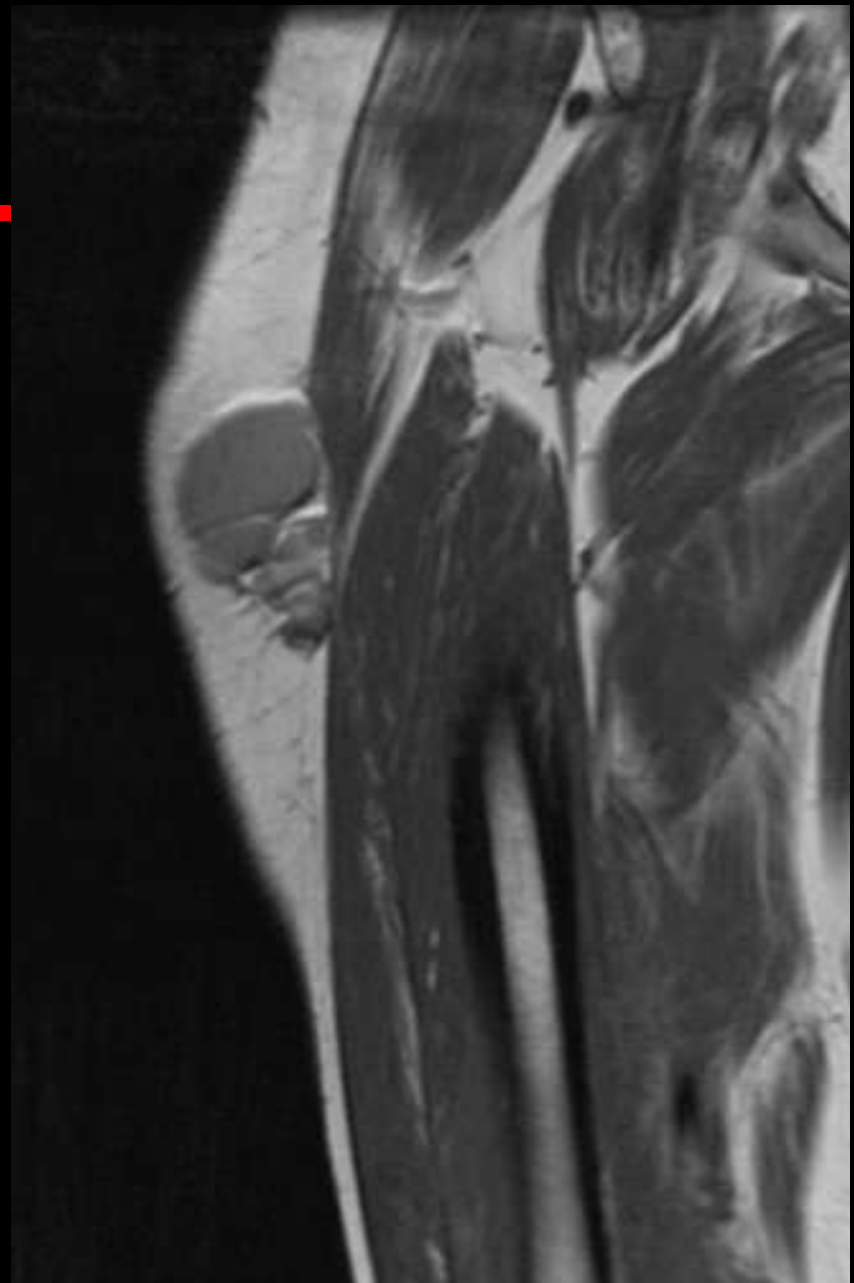
SSS Tumor

T0	True capsule surrounds tumor
T1	Extracapsular, but still intracompartmental
T2	Extracapsular and extracompartmental Abutment of NV bundle



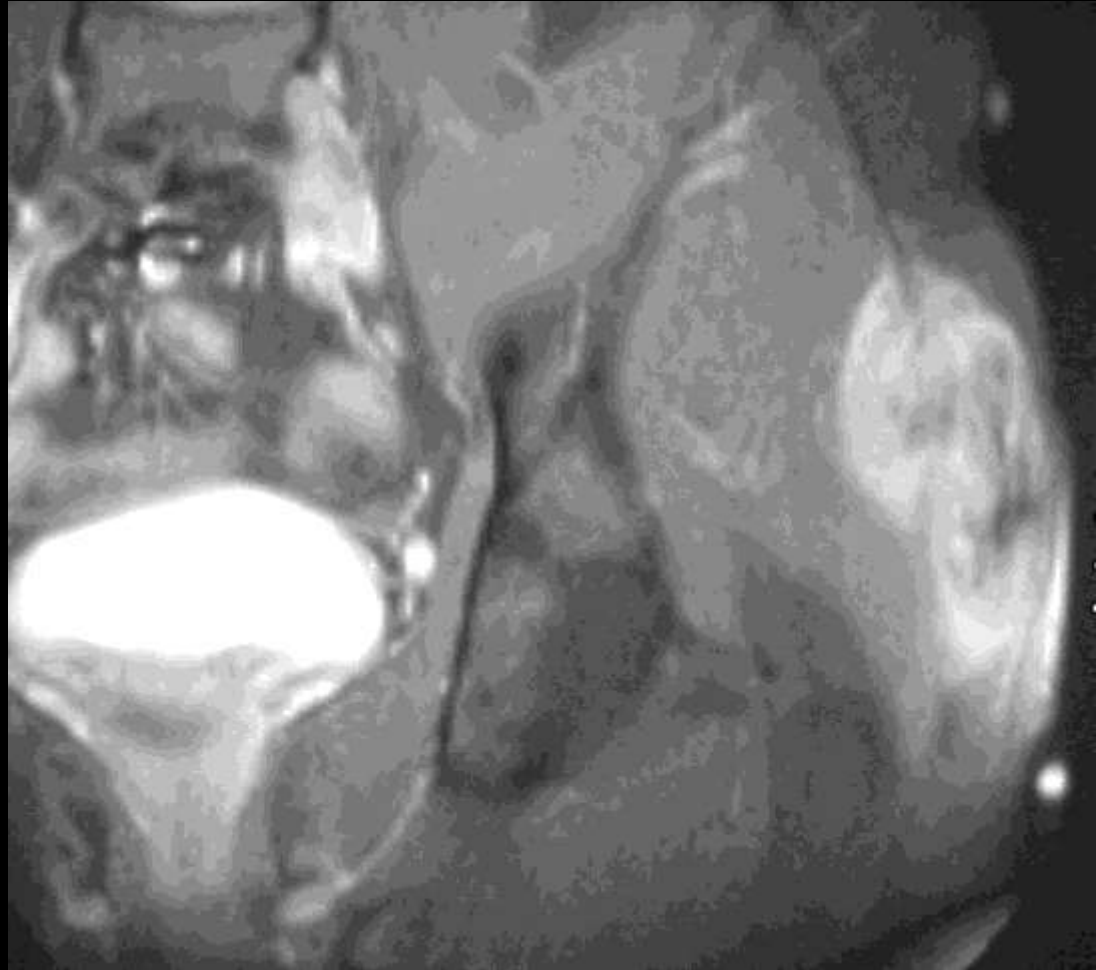
Stage - T1

- Extracapsular but intracompartmental
 - Skin and subcutaneous tissues
 - One muscle compartment
 - Intracortical
 - Paraosseous without muscle or bone invasion
 - Single ray of hand or foot



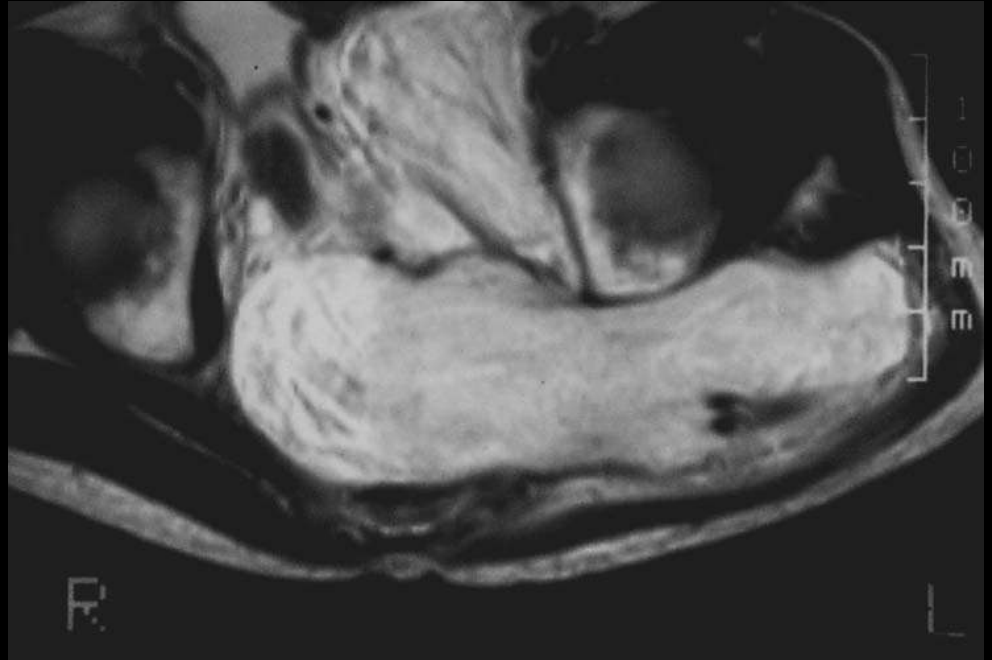
Stage - T2

- Extracapsular extracompartmental
- Lesion no longer confined by periosteum or fascia
- Increases risk of metastasis and recurrence



Stage - T2

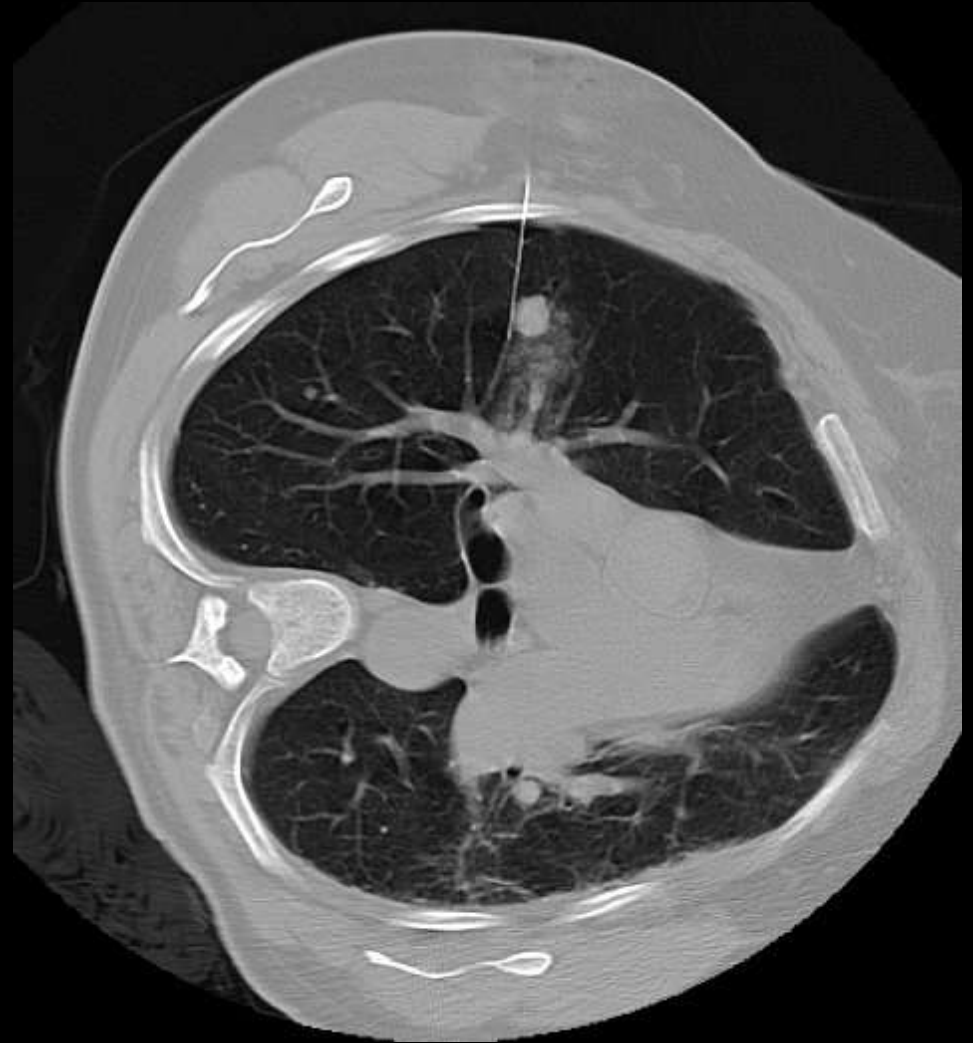
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Sciatic invasion by liposarcoma- Stage T2

Sarcoma metastasis

- Most common site of sarcoma metastasis is lung
- Lung staging part of initial tumor workup for sarcoma
- CT scanning more sensitive than radiography
- CT used for staging, biopsy, and follow-up

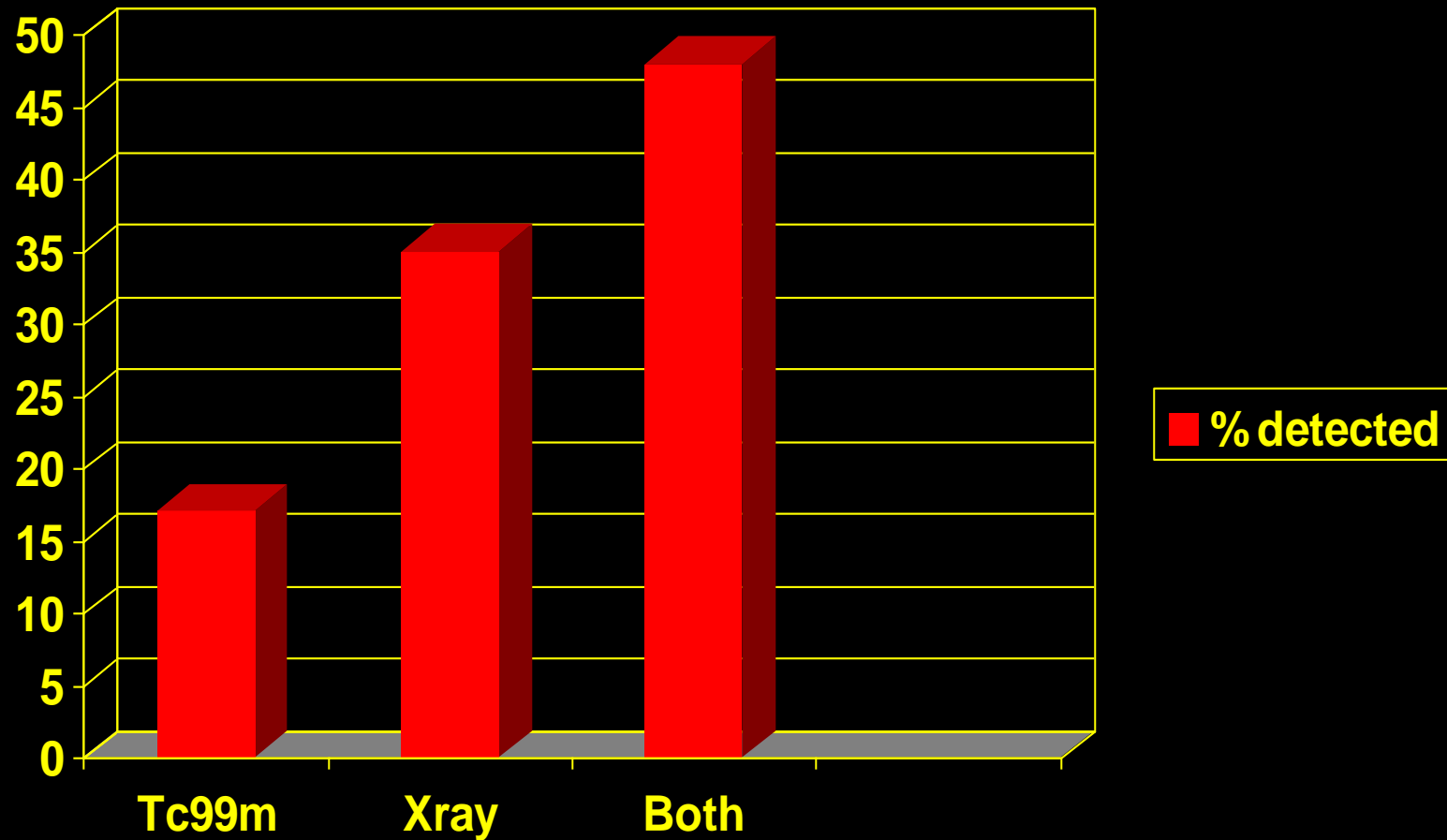


Sarcoma metastasis

- Next most common site is bone
- Axial and diaphyseal predominance
- Osteolytic in 88%, majority show moth-eaten pattern
- Cortical violation in 51%, high risk of pathologic fracture
- Bone scan has high false negative rate!

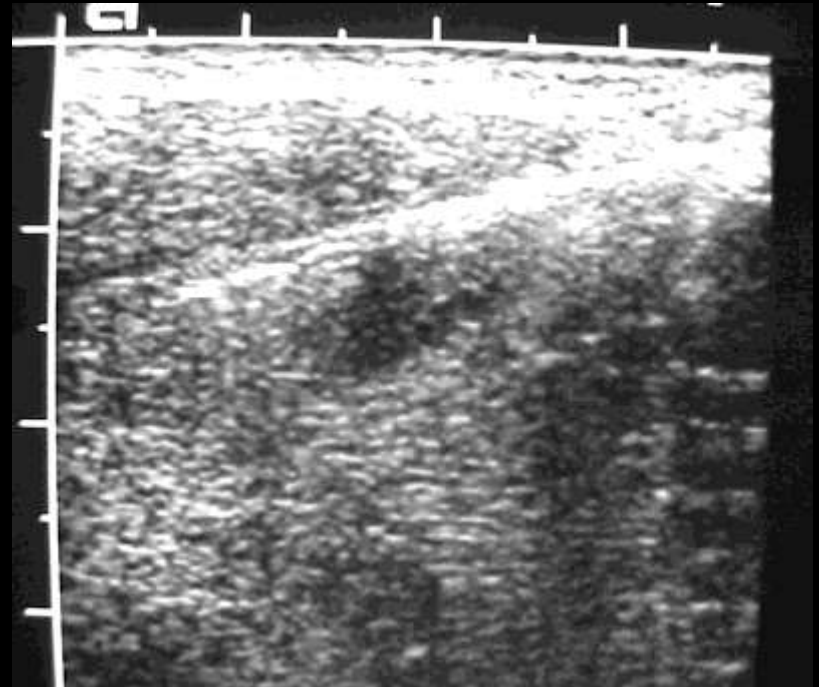


Bone mets from sarcoma



Biopsy

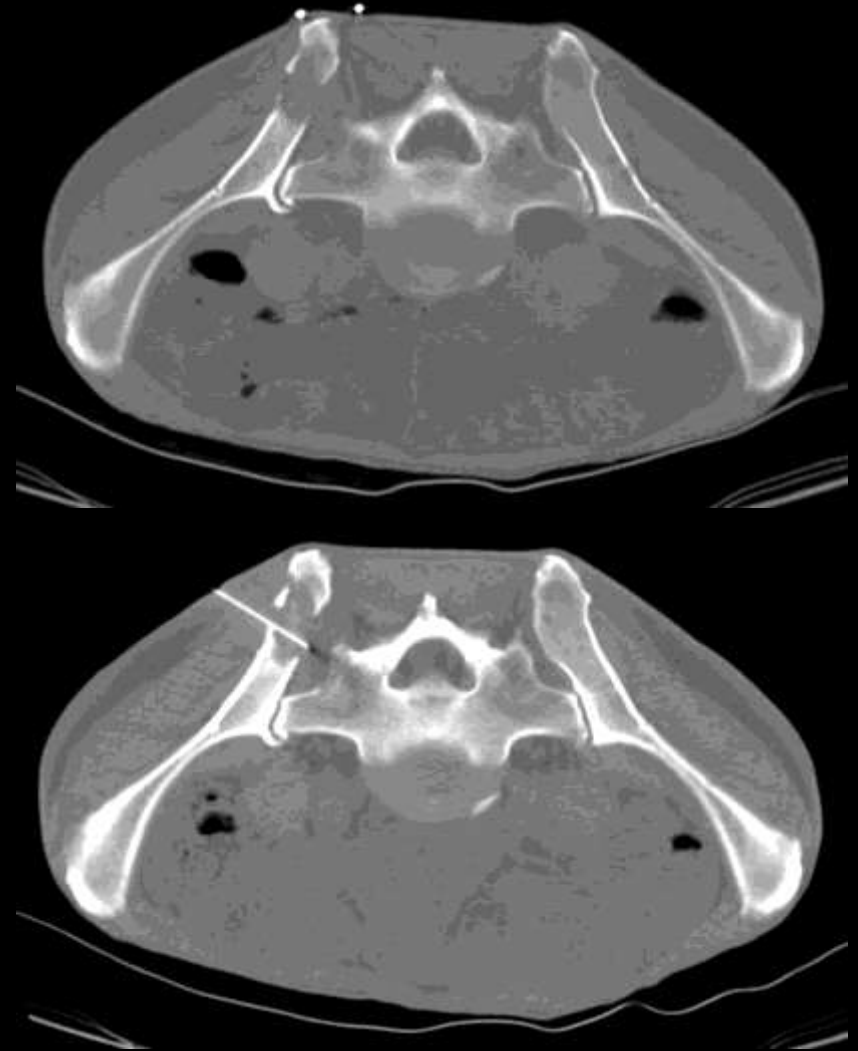
- Metastatic disease
- Round cell tumor
- Primary bone or soft tissue neoplasm only after consultation with orthopedic surgeon
- Local staging should be completed prior to biopsy



Fibrous tumor of soft tissue parts

Biopsy

- Fluoroscopic
- US for soft tissue
- CT guidance for axial and deep lesions
- Fine needle aspiration
- Core biopsy with cutting needle or trephine



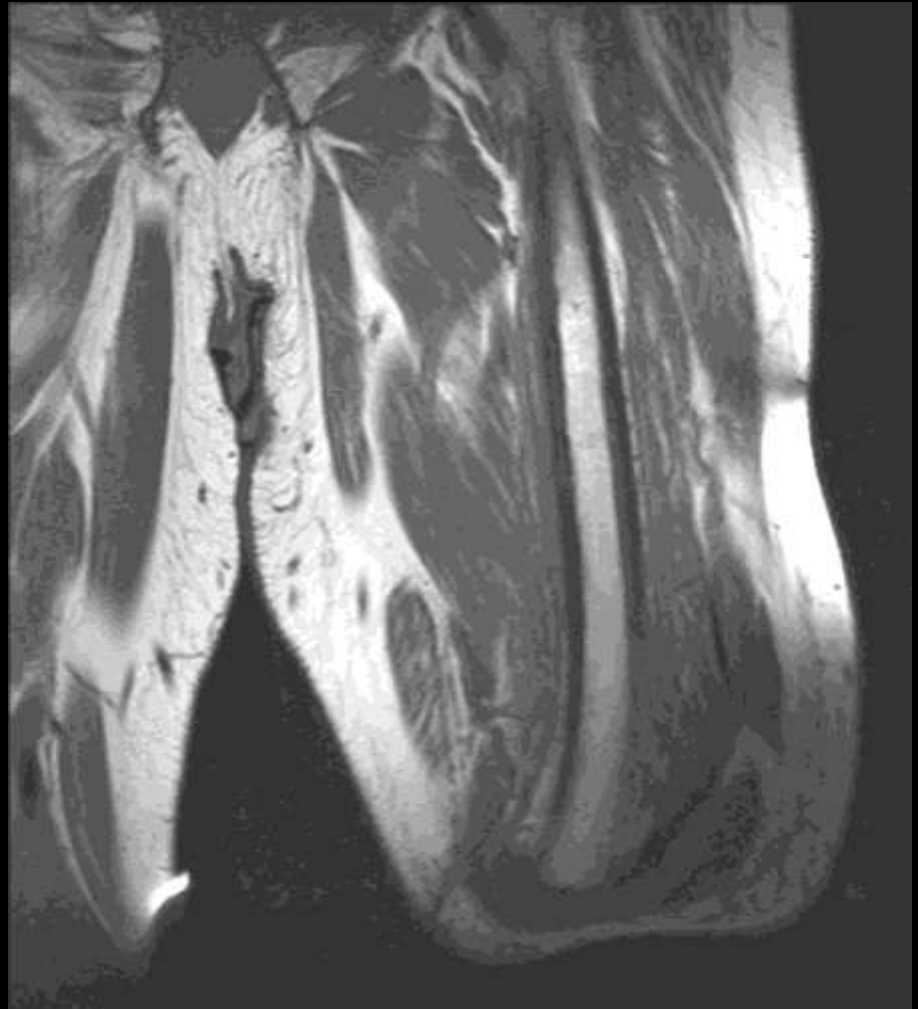
Diagnostic imaging

- Technique
- Detection
- Histologic characterization
- Anatomic staging
- Biopsy
- Follow-up



Follow-up

- Monitor therapy
- Identify complications
- Detect recurrence
- Detect metastases



Follow-up

- Clinical assessment limited
- Laboratory indicators limited
- Diagnostic imaging
- Histology and pathology



MRI Follow Up

- Be cost effective
- Have baseline 12 week post op
- Often and Limited rather than Infrequent and Extensive
- Limit scans to useful plane
- Limit scans to those previously shown to be Sensitive for the tumor
- Mainstay of follow up for low grade tumour

Improved prognosis

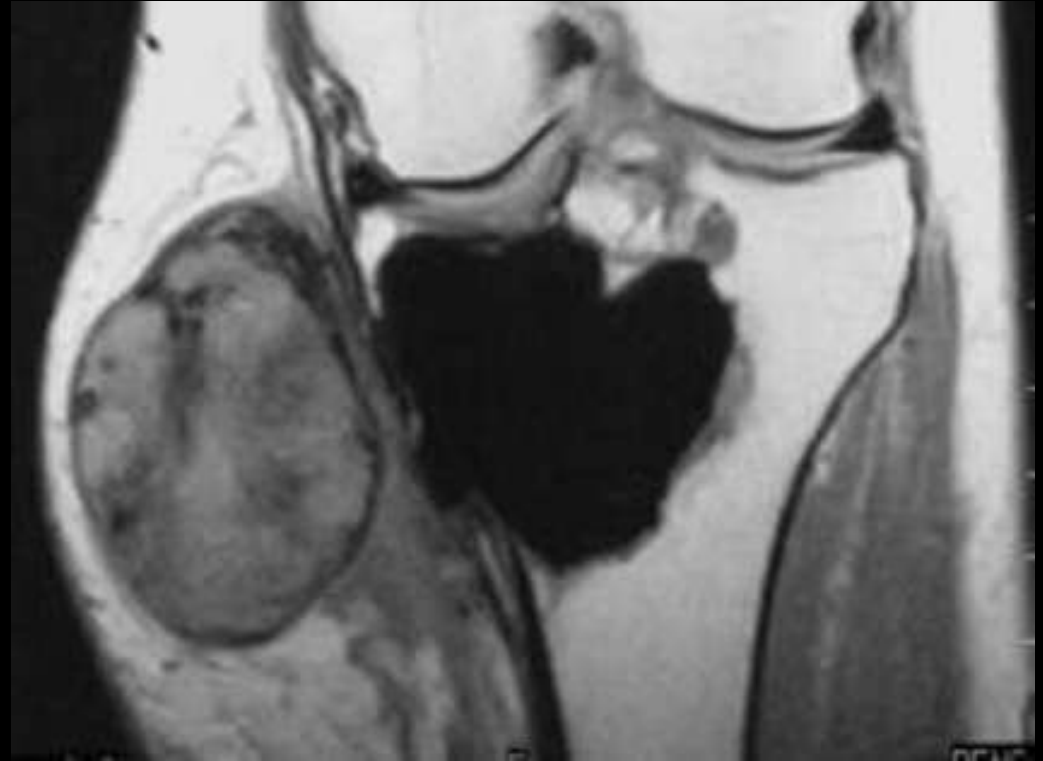
- Earlier detection
- More accurate staging
- Adequate surgical resection
- Adjuvant radiation and/or chemotherapy

Treatment

- Observation
- Intralesional injection
- Intralesional curettage
- Marginal excision
- Wide resection
- Radical amputation
- Chemotherapy
- Radiation therapy

Recurrence of Musculoskeletal tumors

- Low grade
 - Rarely recur
- Moderate grade
 - Local recurrence common
- High grade
 - Local recurrence and distant metastasis common

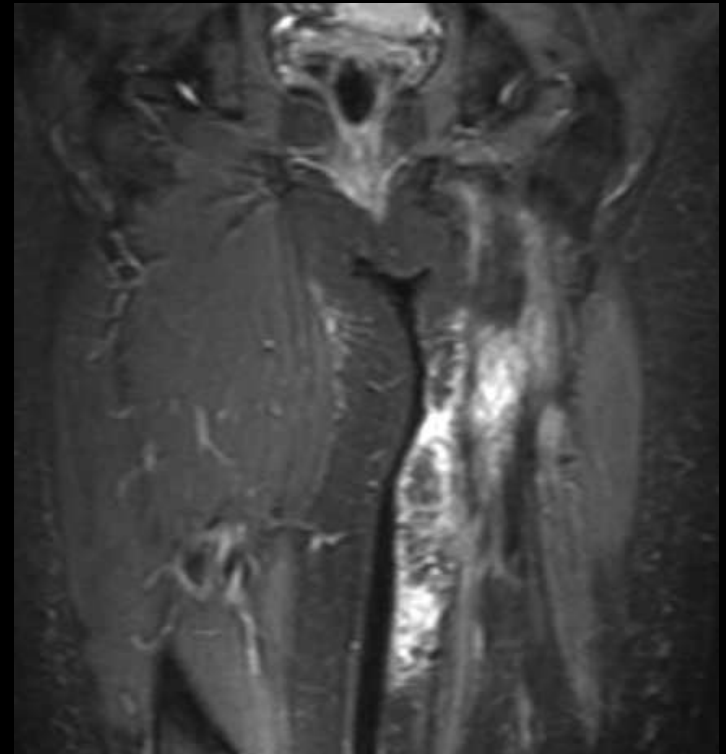


Local recurrence

- Increased size of lesion
- Development of new areas of osteolysis
- Cortical thinning and destruction
- Resorption of graft
- Arrest or failure of healing

Increased signal post therapy

- Residual or recurrent tumor
- Necrosis
- Lymphocele
- Hemorrhage
- Edema
- Granulation tissue



Cor T1FSGd