Objectives

- Discuss presenting history and physical examination features of bone tumours
- Discuss imaging characteristics of bone tumours
- Discuss biopsy principles and techniques for bone tumours

Clinical Presentation

- Pain
- Mass
- Pathologic Fracture
- Incidental finding on x-ray

Key History Questions

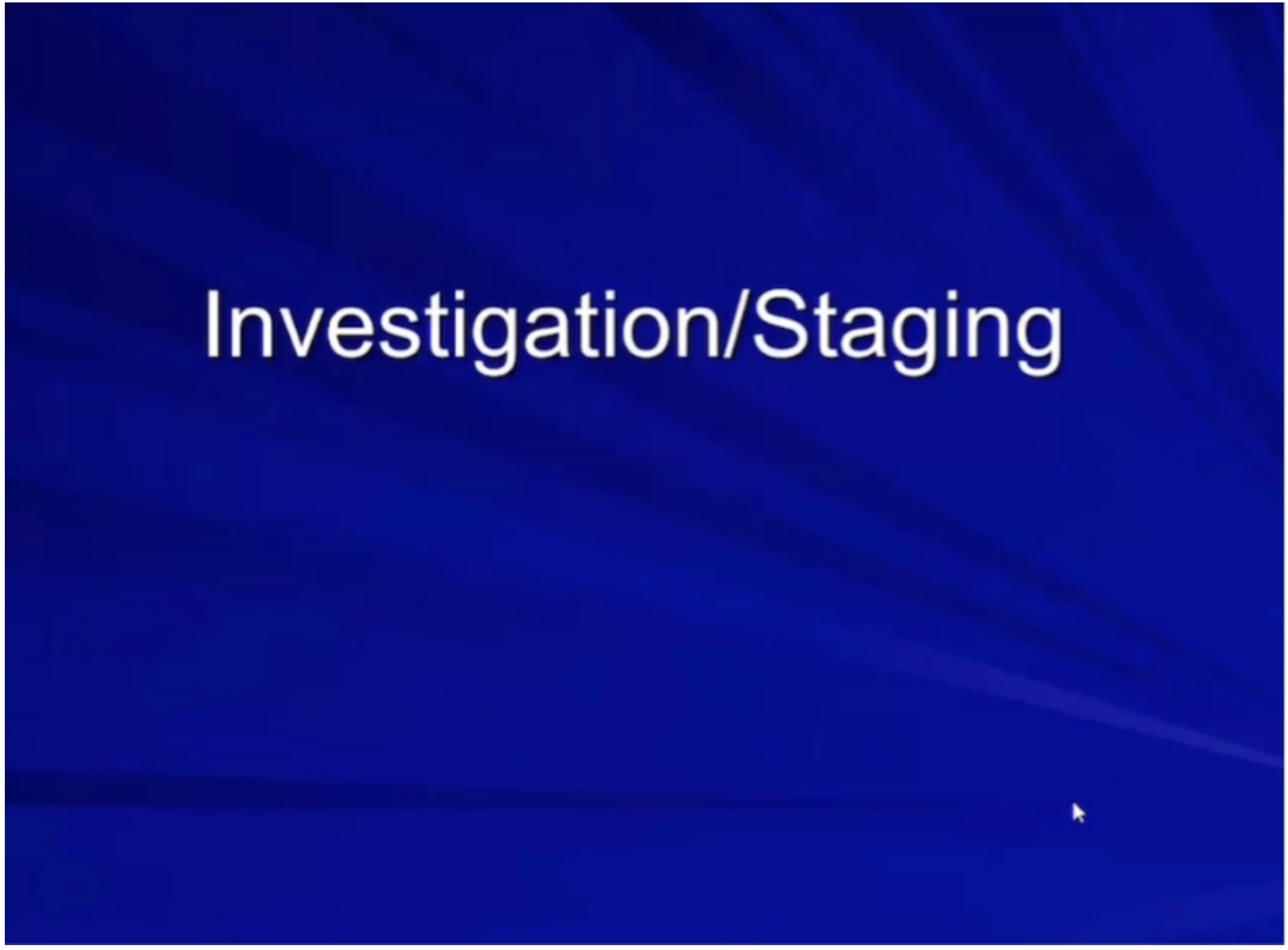
- Onset of pain – traumatic vs. atraumatic
- Progressive pain
- Night pain, rest pain
- Relieving factors (NSAIDs)
- Family history
- History of radiation, Paget's disease, other cancers

Physical Examination

- Mass – fixed vs. mobile
- Deep to fascia or superficial (contract muscle group underneath – if deep to fascia then it becomes more fixed)
- Estimate size of mass
- Lymphadenopathy
- Neurovascular examination

Nine Questions

1. Where is the lesion?
2. How big is it?
3. Is it solitary or multifocal?
4. What is the interface between the bone and the lesion?
5. Is there periosteal reaction?
6. Is there bony remodeling?
7. Is the cortex eroded?
8. Is there a soft tissue mass?
9. Is there any matrix?


Investigation/Staging

Nine Questions

1. Where is the lesion?
2. How big is it?
3. Is it solitary or multifocal?
4. What is the interface between the bone and the lesion?
5. Is there periosteal reaction?
6. Is there bony remodeling?
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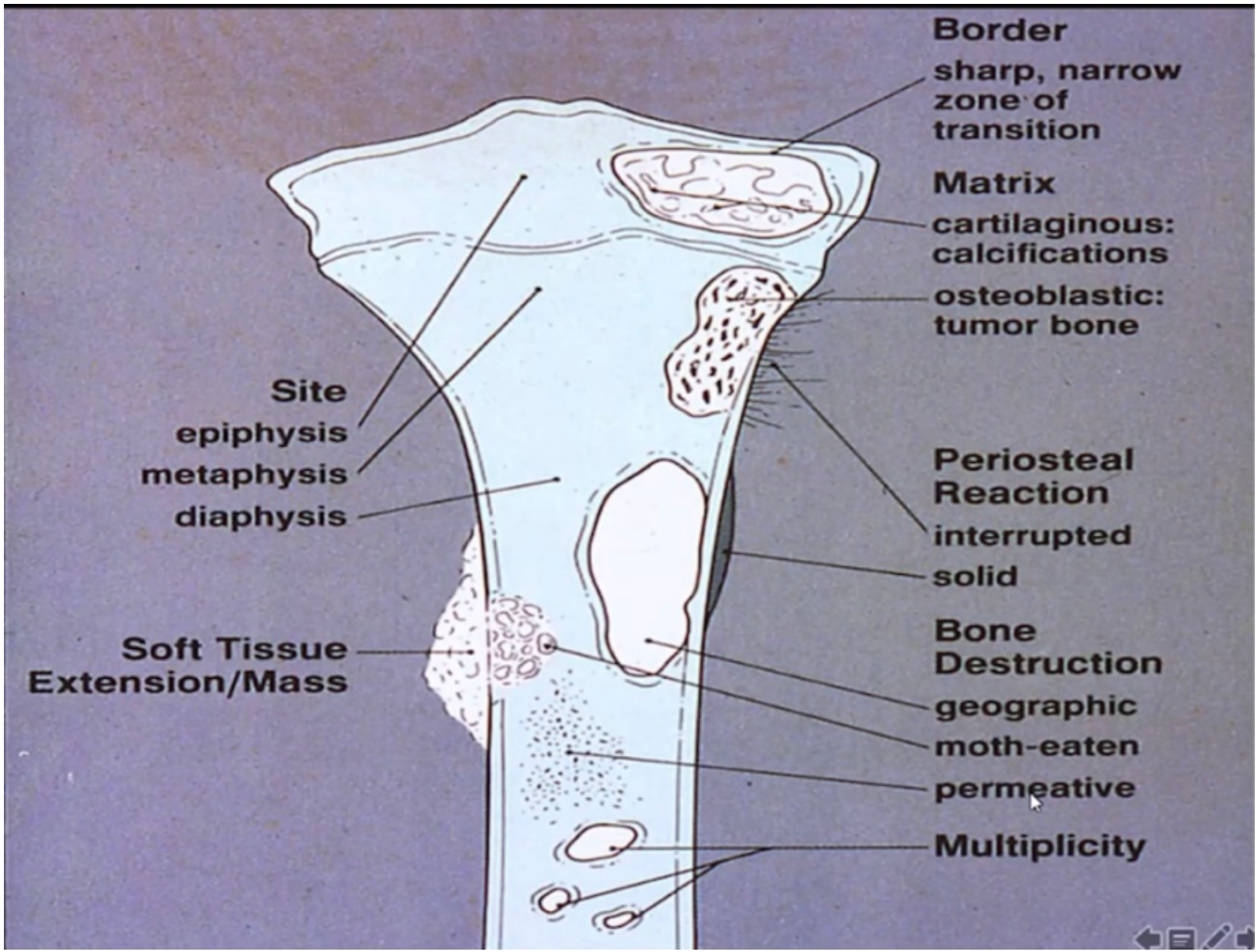
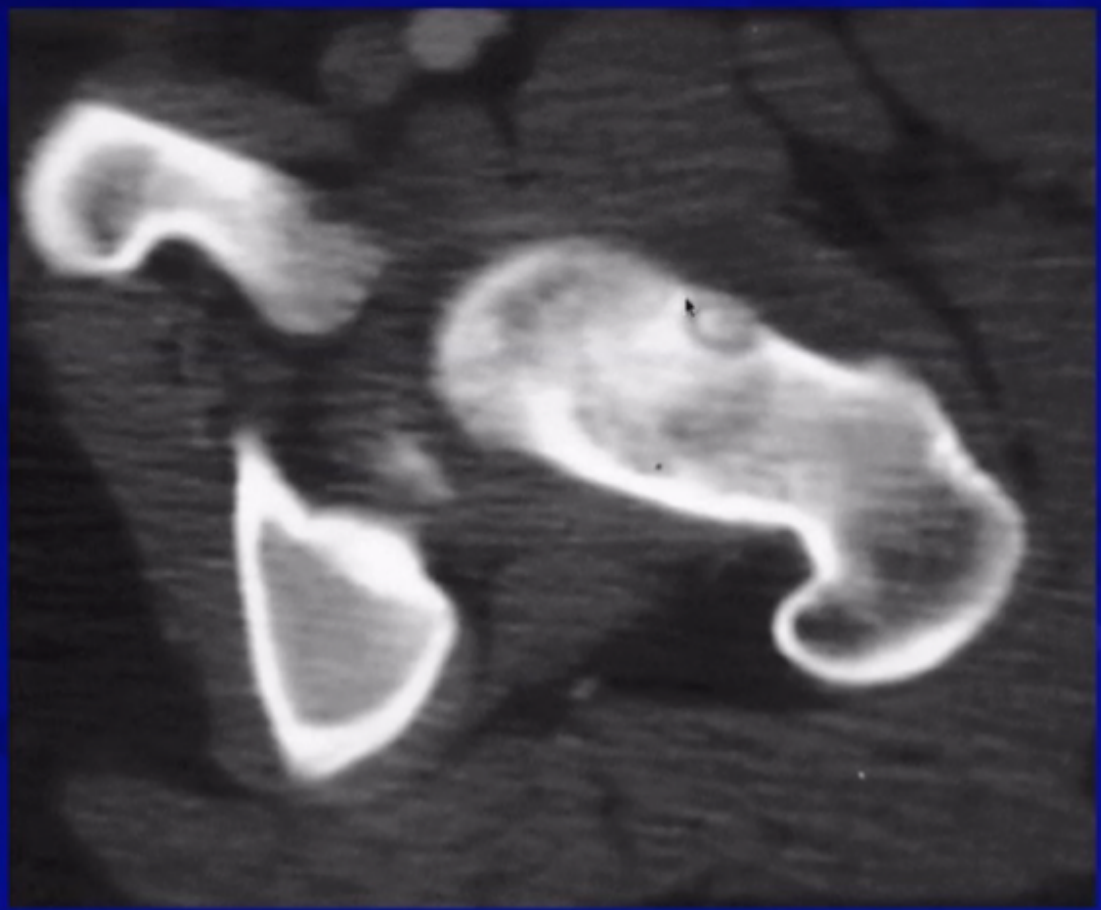
8. Is there a soft tissue mass?
9. Is there any matrix?


Border
sharp, narrow zone of transition
Matrix
cartilaginous: calcifications
osteoblastic: tumor bone
Site
epiphysis
metaphysis
diaphysis
Periosteal Reaction
interrupted
solid
Soft Tissue Extension/Mass
Bone Destruction
geographic
moth-eaten
permeative
Multiplicity

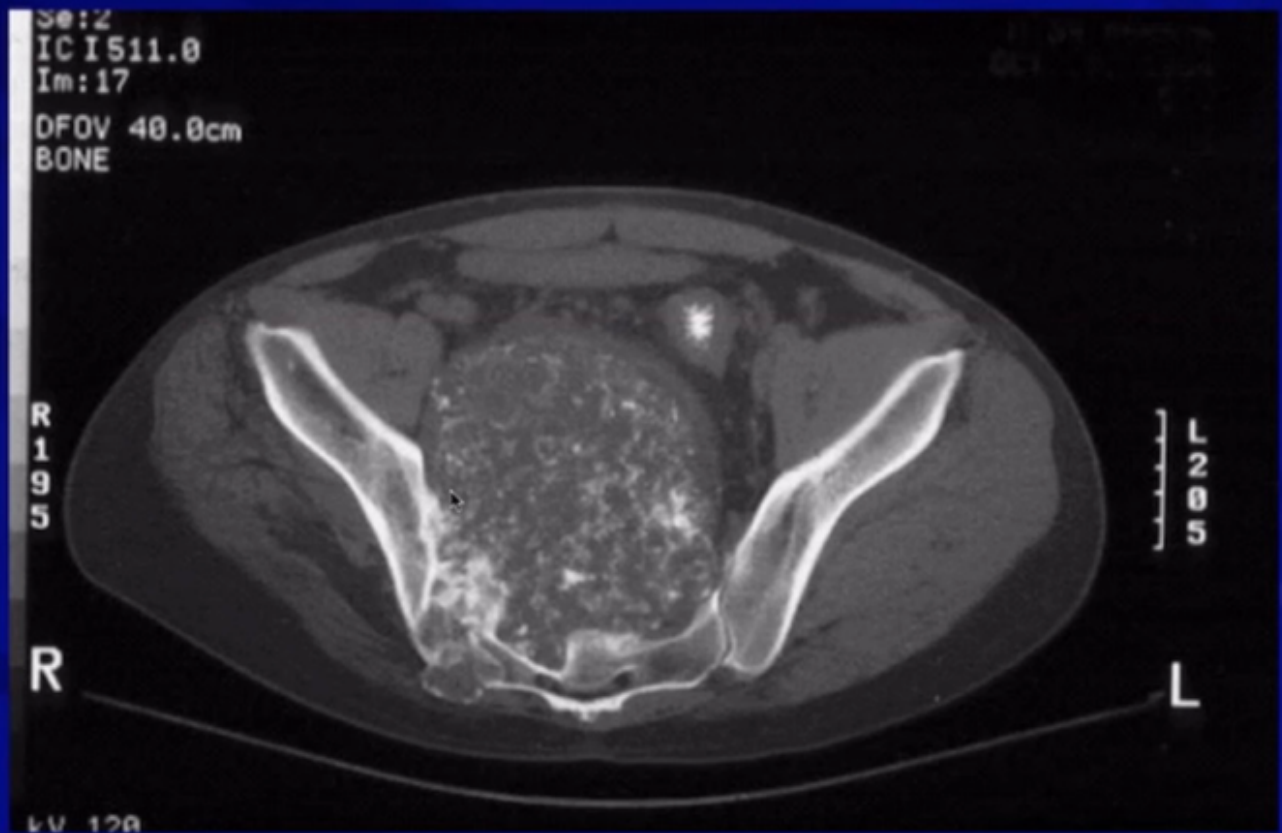
Where is the Lesion?

- Epiphyseal, metaphyseal, diaphyseal
- Surface
- Peri-articular
- Central or eccentric

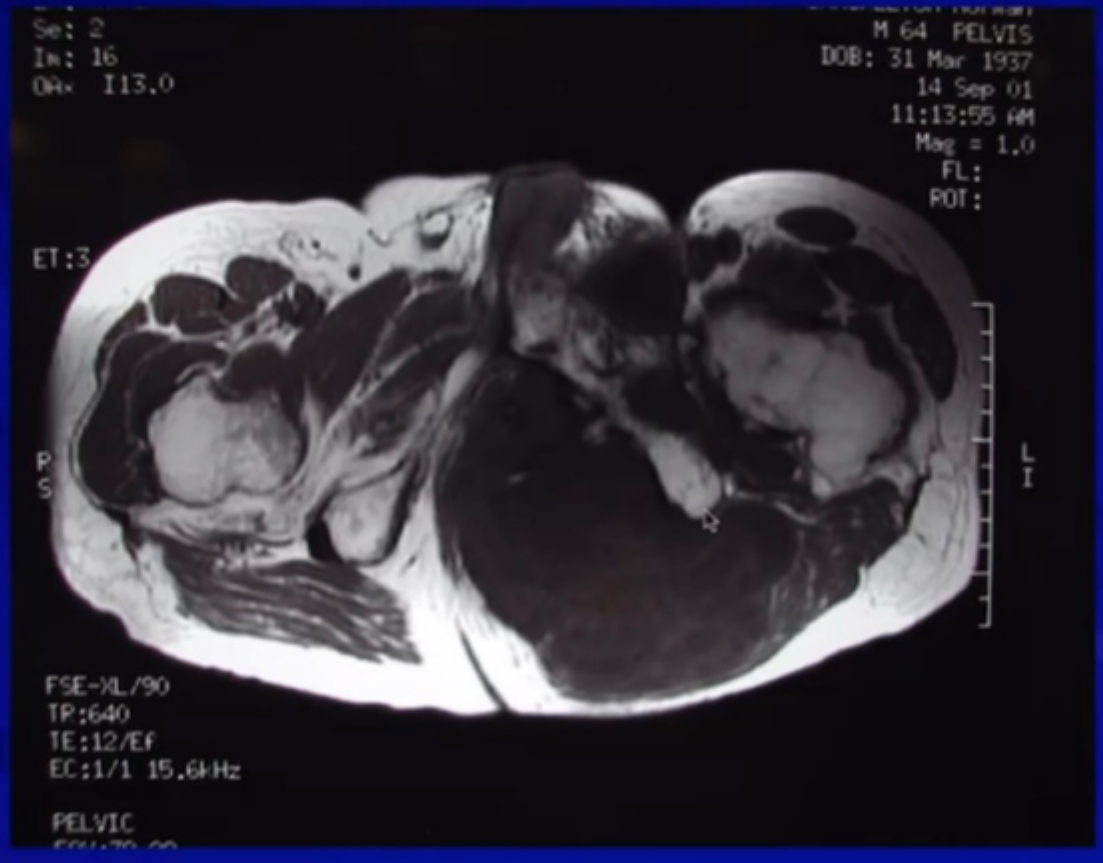
How big is the lesion?



How big is the lesion?



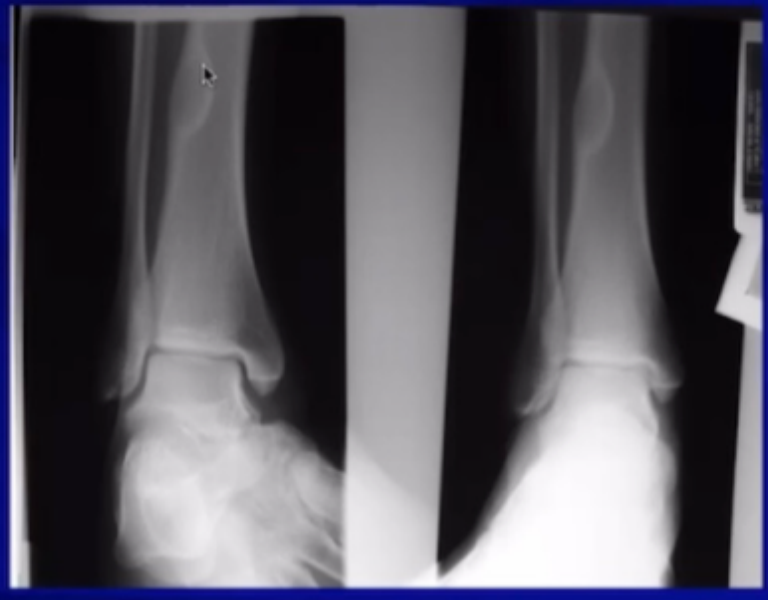
Solitary or multifocal?



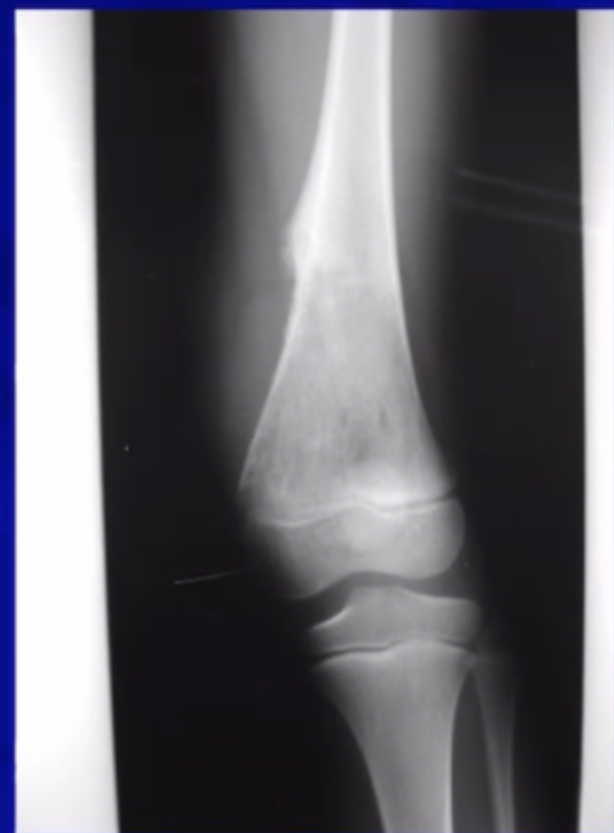
Solitary or multifocal?

Solitary or multifocal?

What is the interface between the bone and the lesion?



What is the interface between the bone and the lesion?



What kind of periosteal reaction?

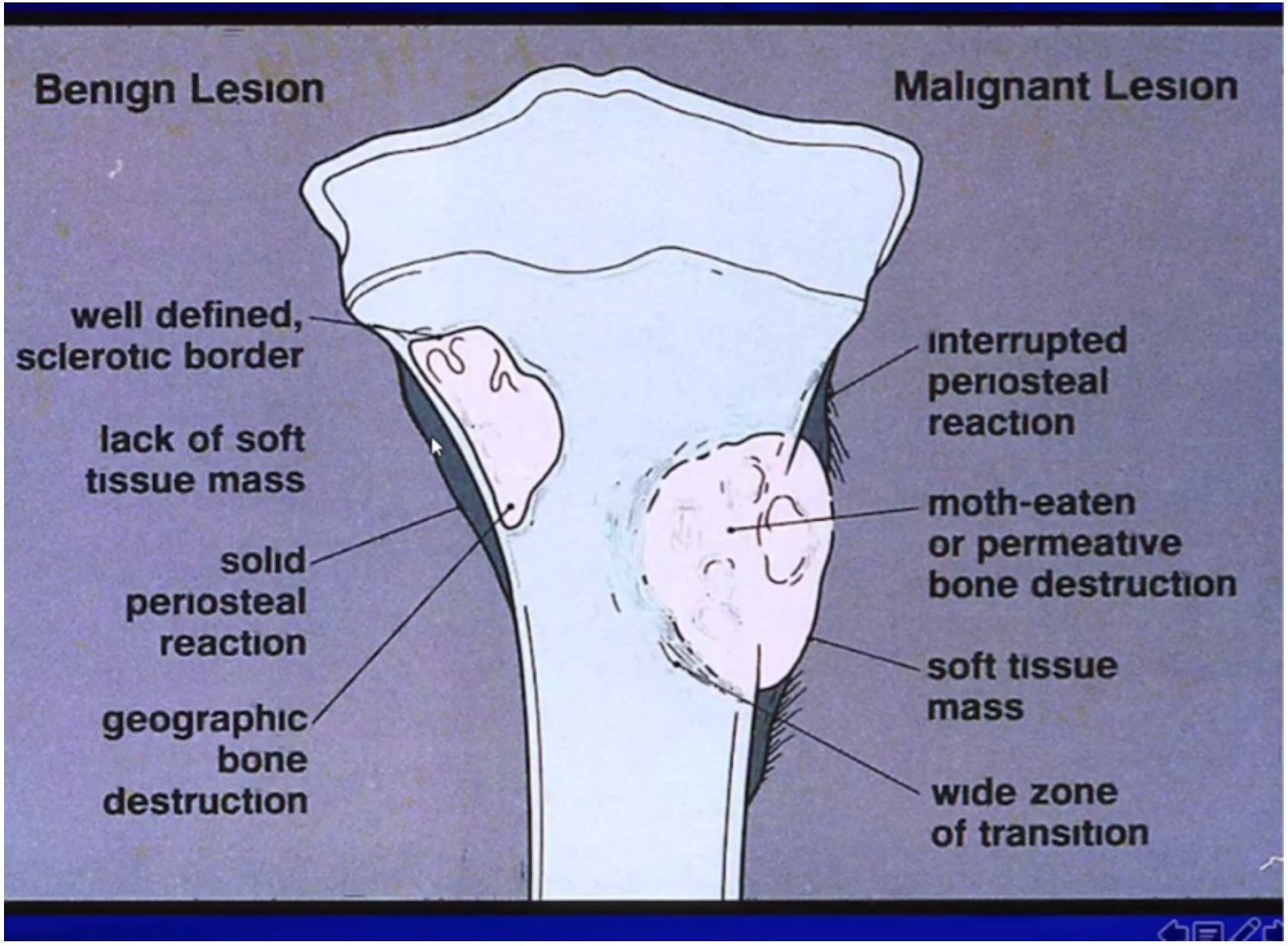
Is there cortical erosion?

Soft Tissue Mass?

Matrix?

The Spectrum

- Benign Latent
- Benign Active
- Aggressive
- Lo-grade Malignant
- Hi-grade Malignant


Benign Lesion
Malignant Lesion
well defined, sclerotic border
lack of soft tissue mass
solid periosteal reaction
geographic bone destruction
interrupted periosteal reaction
moth-eaten or permeative bone destruction
soft tissue mass
wide zone of transition

Benign latent

- Asymptomatic
- Narrow zone of transition (geographic)
- No soft tissue mass
- No periosteal reaction
- May or may not have matrix
- eg's – enchondroma, non-ossifying fibroma

Benign Active

- Symptomatic
- Geographic
- Well-ordered periosteal reaction
- No soft tissue mass
- May or may not have matrix
- eg's – osteoid osteoma, UBC, eosinophilic granuloma, fibrous dysplasia, osteochondroma

Benign Aggressive

- Symptomatic
- Geographic or permeative
- Usually lytic, cortical erosion
- May have soft tissue mass
- Periosteal neocorticalization
- eg's – GCT, ABC, osteoblastoma, chondroblastoma, chondromyxoid fibroma, periosteal chondroma

Low Grade Malignant

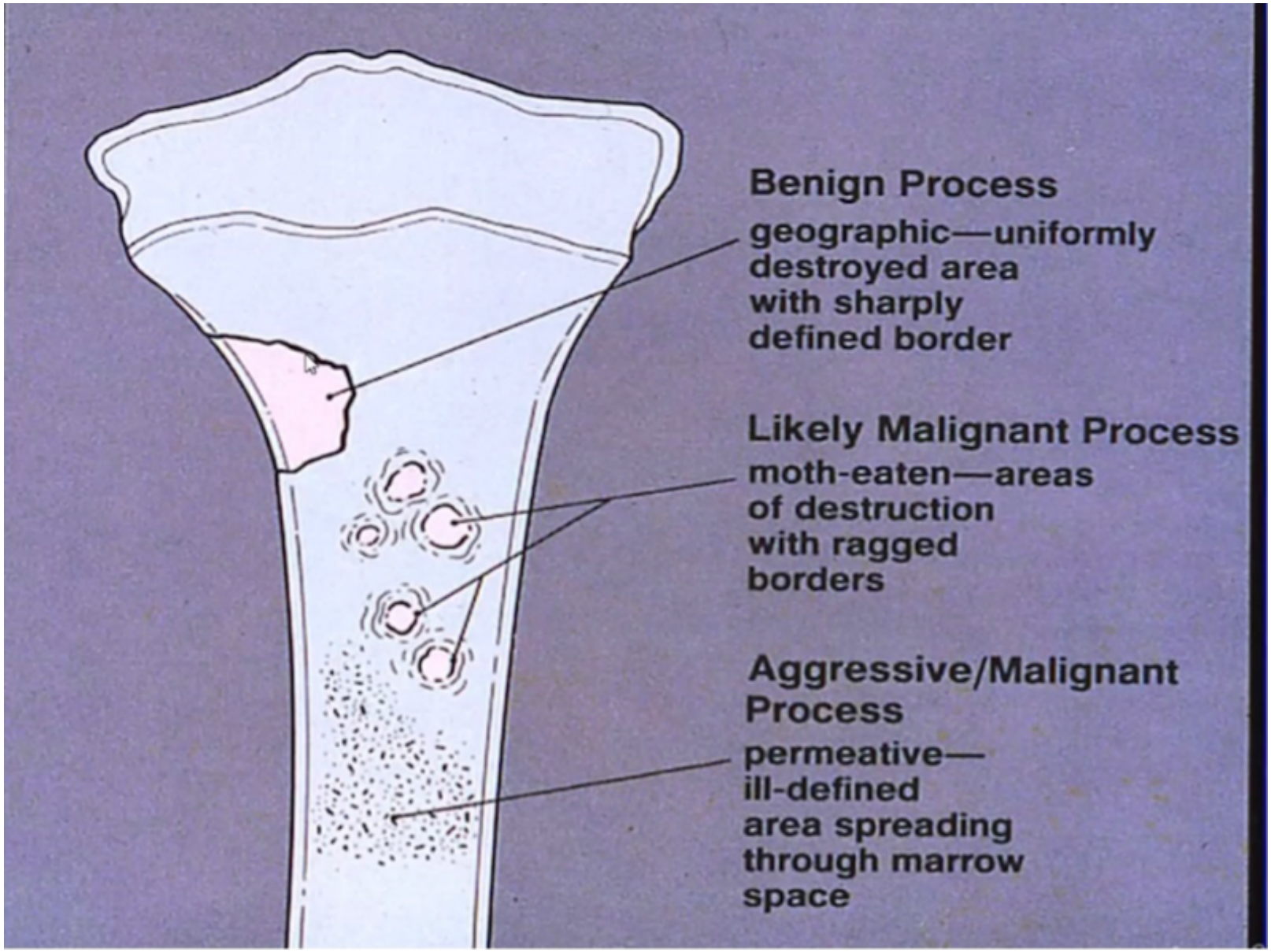
- Usually permeative
- May have matrix
- Cortical erosion
- May have soft tissue mass in continuity with cortical erosion

Low Grade Malignant

- Low-grade CSA
- Adamantinoma
- Parosteal OSA
- Chordoma

High Grade Malignant

- Permeative
- Usually has soft tissue mass
- Cortex usually intact
- Malignant periosteal reaction (onion skinning, sunburst, codman's triangle)
- May or may not have matrix
- Osteosarcoma, Ewing's sarcoma, high grade chondrosarcoma, non-osteogenic spindle cell sarcoma (eg. MFH)


Benign Process
geographic—uniformly destroyed area with sharply defined border
Likely Malignant Process
moth-eaten—areas of destruction with ragged borders
Aggressive/Malignant Process
permeative—ill-defined area spreading through marrow space

What next?

- If lesion is benign latent, no further investigation is usually necessary
- If benign active or aggressive, requires further local imaging, perhaps systemic staging
- If malignant, requires further investigation including local and systemic staging

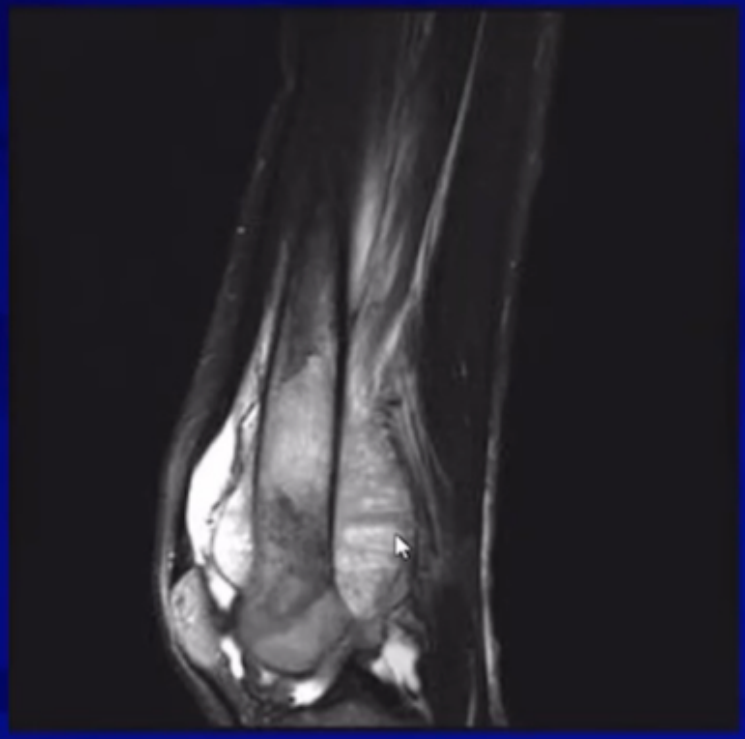
Local and Systemic Staging

- Bloodwork – CBC, ESR, CRP, serum calcium, Alkaline phosphatase, LDH (latter 2 are prognostic in sarcomas)
- Local x-ray (done), chest x-ray
- MRI of local site (occasionally CT)
- CT chest
- Total body bone scan
- For Ewing's sarcoma – gallium scan, bone marrow aspirate

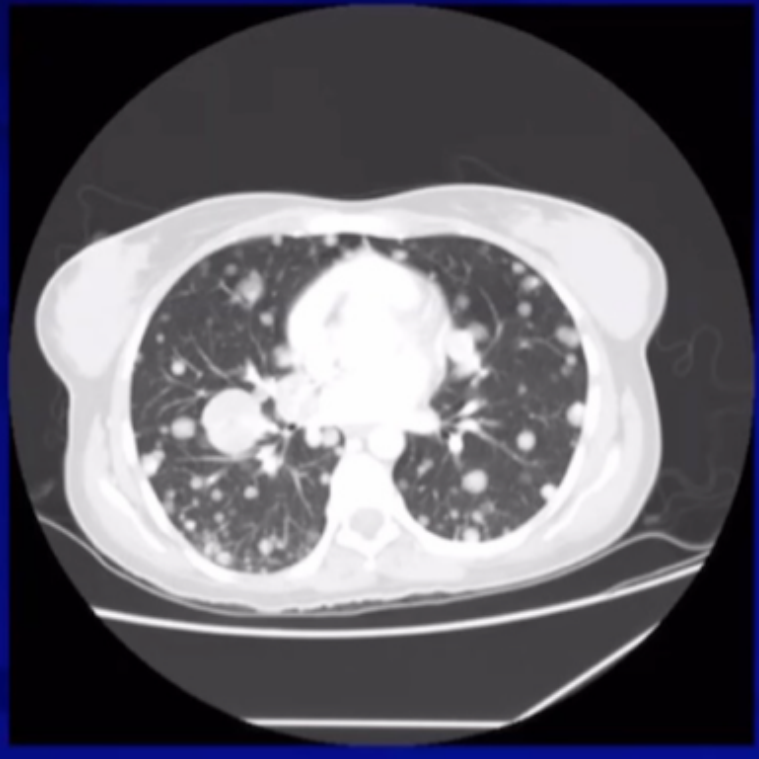
What if you think it's metastatic disease?

- Bloodwork – same bloodwork plus PSA, serum immunoelectrophoresis
- CT chest and abdomen
- Mammogram
- Bone scan

Local staging – must MRI entire bone



Systemic staging

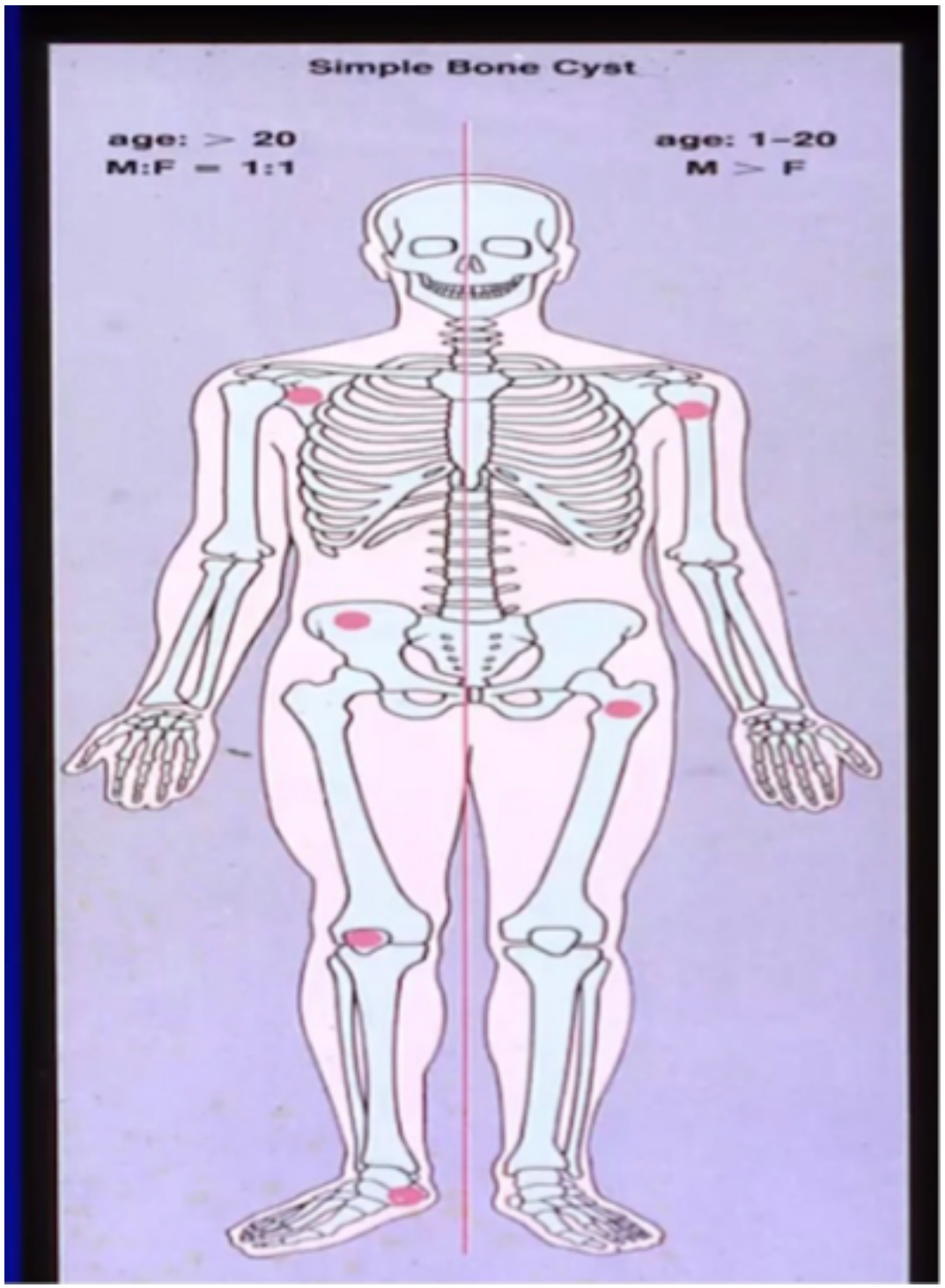


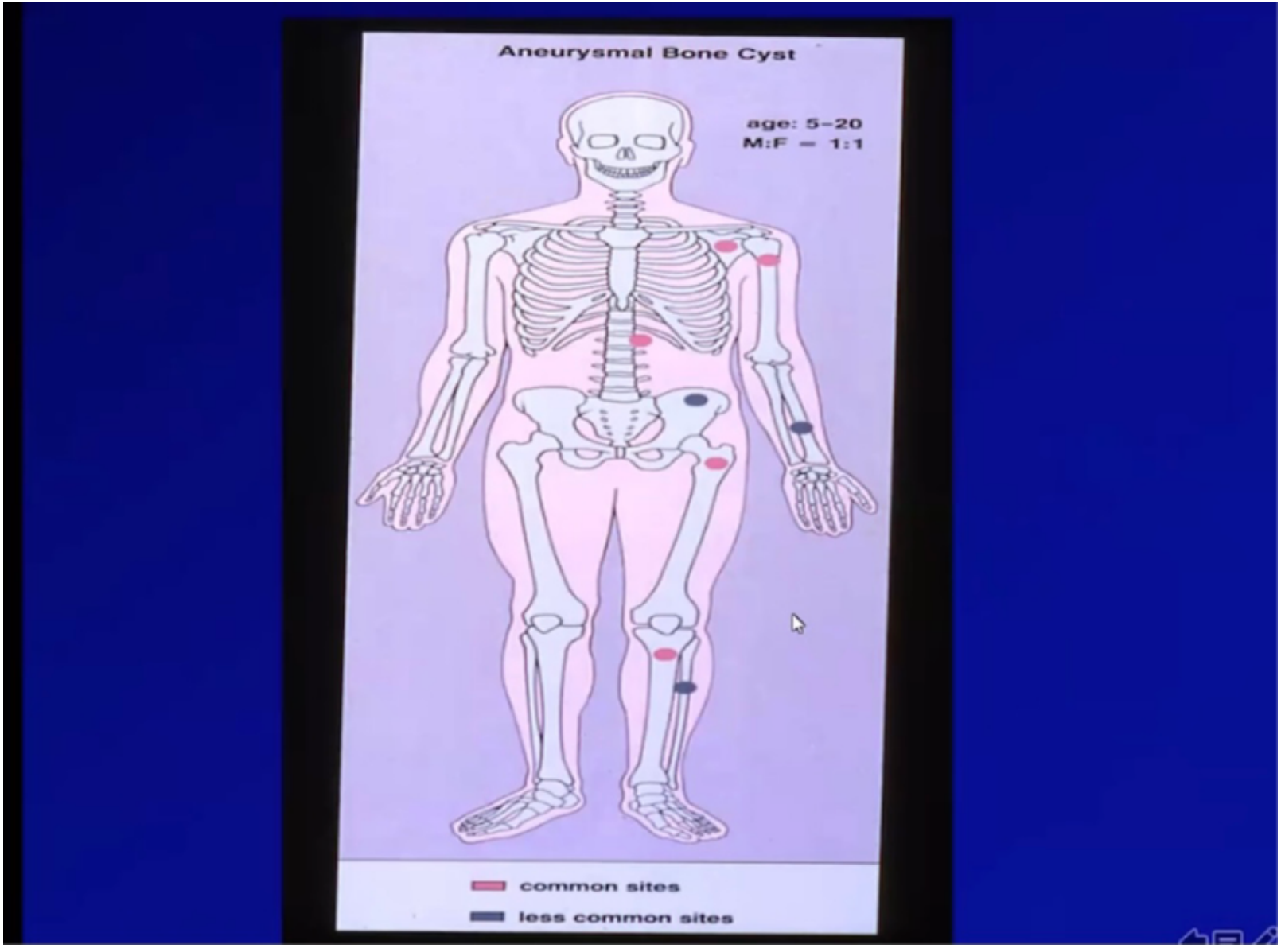
How To Stage Bone Tumours

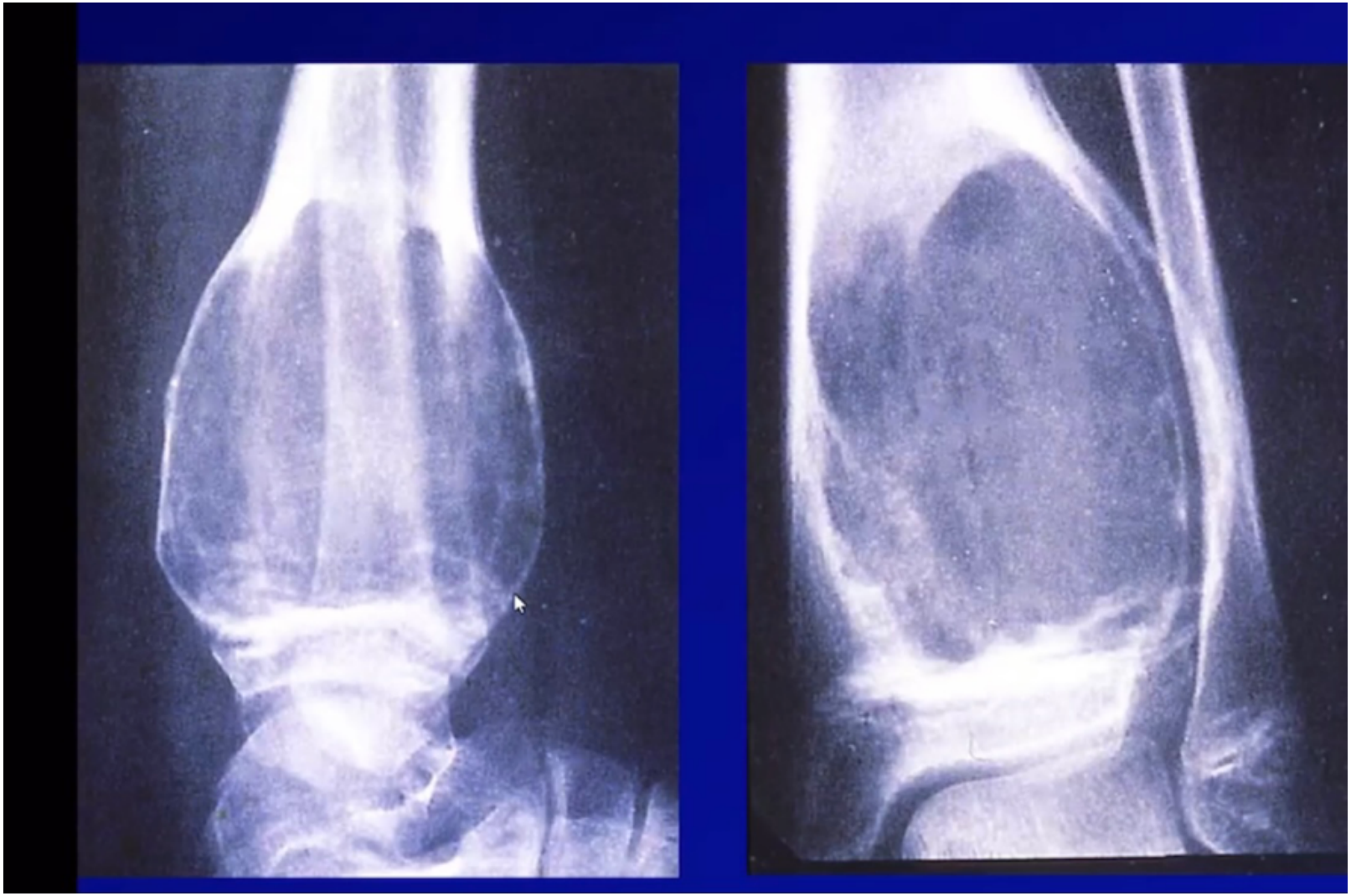
- Benign Latent/Active: Local - xray +/- CT/MRI
  +/- TBBS
- Benign Aggressive: Local - xray/CT/MRI
  Systemic - TBBS, CXR
- Malignant: Systemic - CT Chest, TBBS
- Special: Gallium scan, CT Abd + Pelvis,
  Bone marrow biopsy

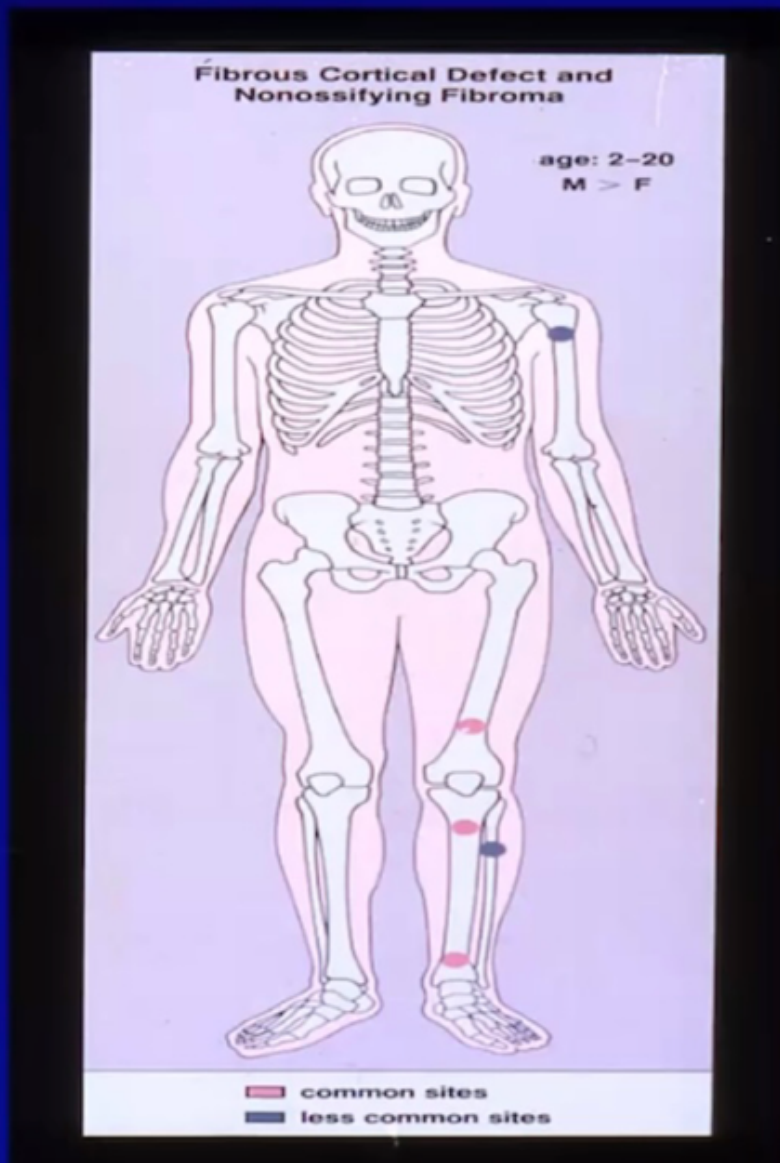
FIG. 13.2 CLASSIFICATION OF TUMORS AND TUMORLIKE LESIONS BY TISSUE OF ORIGIN

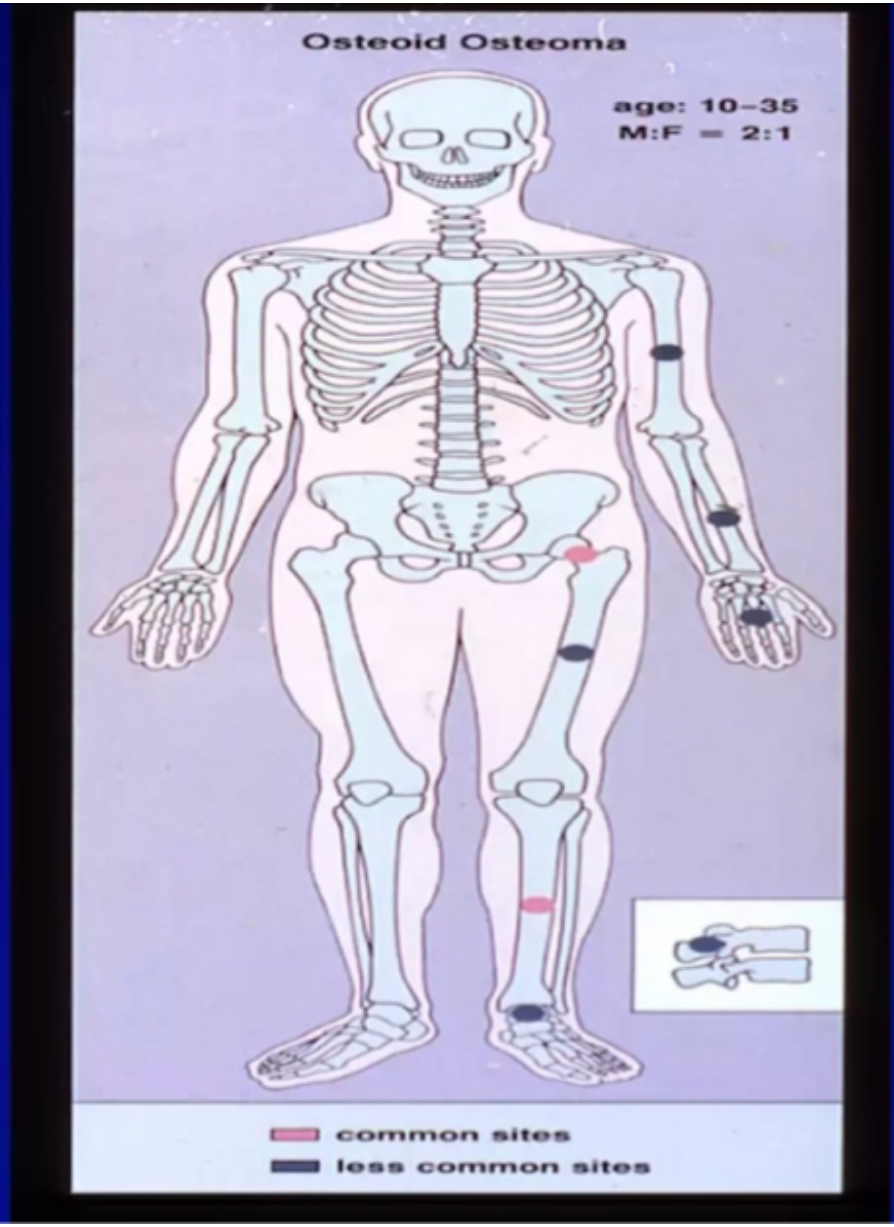
Tissue of Origin	Benign Lesion	Malignant Lesion
Bone-forming (osteogenic)	Osteoma Osteoid osteoma Osteoblastoma	Osteosarcoma (and variants) Juxtacortical osteosarcoma (and variants)
Cartilage-forming (chondrogenic)	Enchondroma (chondroma) Periosteal (juxtacortical) chondroma Enchondromatosis (Ollier's disease) Osteochondroma (osteocartilaginous exostosis, single or multiple) Chondroblastoma Chondromyxoid fibroma	Chondrosarcoma (central) Conventional Mesenchymal Clear cell Dedifferentiated Chondrosarcoma (peripheral) Periosteal (juxtacortical)
Fibrous and fibrohistiocytic (fibrogenic)	Fibrous cortical defect (metaphyseal fibrous defect) Nonossifying fibroma Benign fibrous histiocytoma Fibrous dysplasia (mono- and polyostotic) Periosteal desmoid Desmoplastic fibroma Osteofibrous dysplasia (Kempson–Campanacci lesion) Ossifying fibroma (Sissons' lesion)	Fibrosarcoma Malignant fibrous histiocytoma
Vascular	Hemangioma Glomus tumor Cystic angiomatosis	Angiosarcoma Hemangioendothelioma Hemangiopericytoma
Bone-marrow (hematopoietic) and lymphatic	Giant cell tumor (osteoclastoma) Eosinophilic granuloma Lymphangioma	Malignant giant cell tumor Histiocytic lymphoma Hodgkin's disease Leukemia Myeloma (plasmacytoma) Ewing's sarcoma
Neural (neurogenic)	Neurofibroma Neurilemoma	Malignant schwannoma
Notochordal		Chordoma
Fat (lipogenic)	Lipoma	Liposarcoma
Unknown	Simple bone cyst Aneurysmal bone cyst Intraosseous ganglion	Adamantinoma

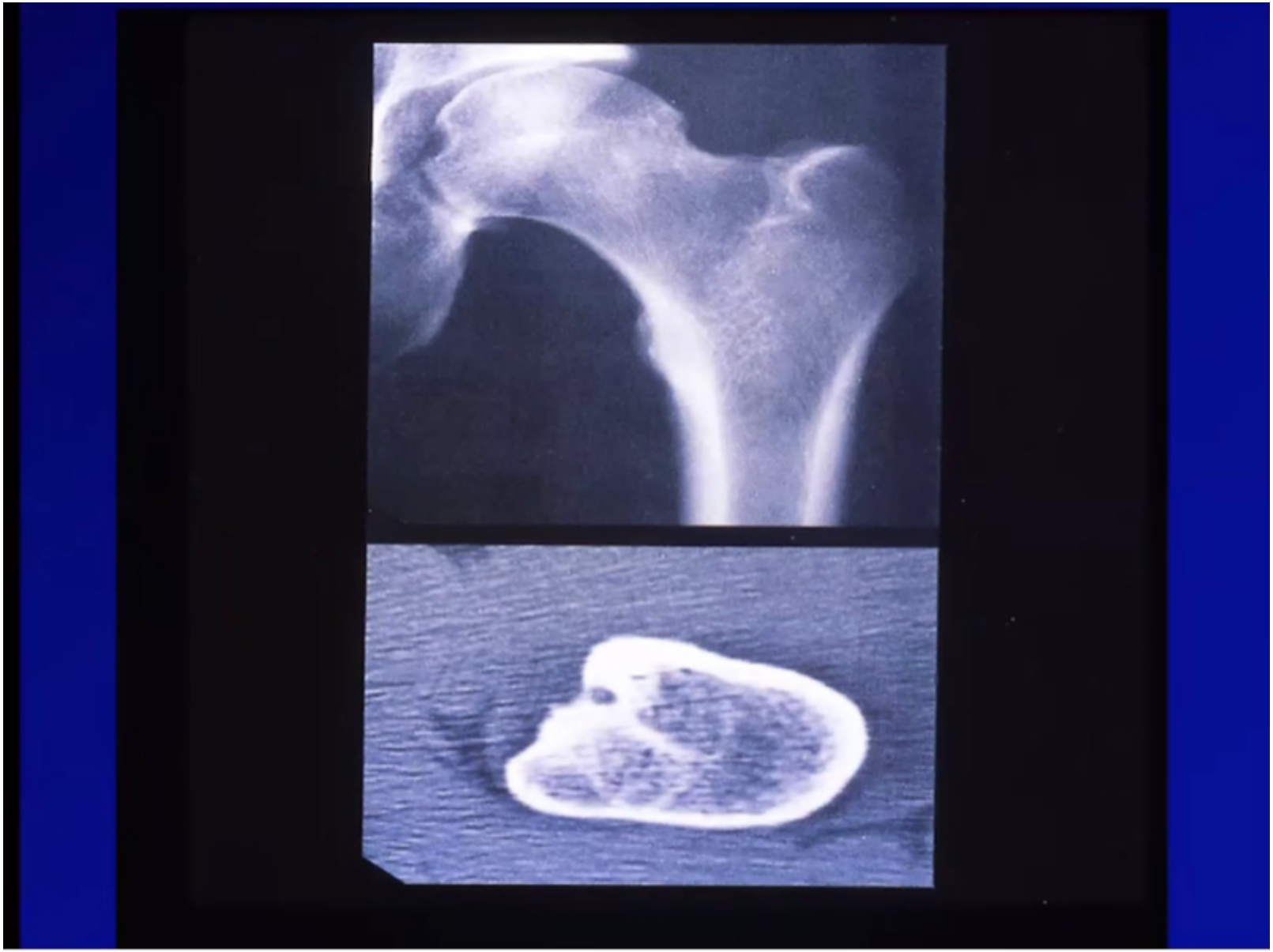

Simple Bone Cyst
age: > 20
M:F = 1:1
age: 1–20
M > F

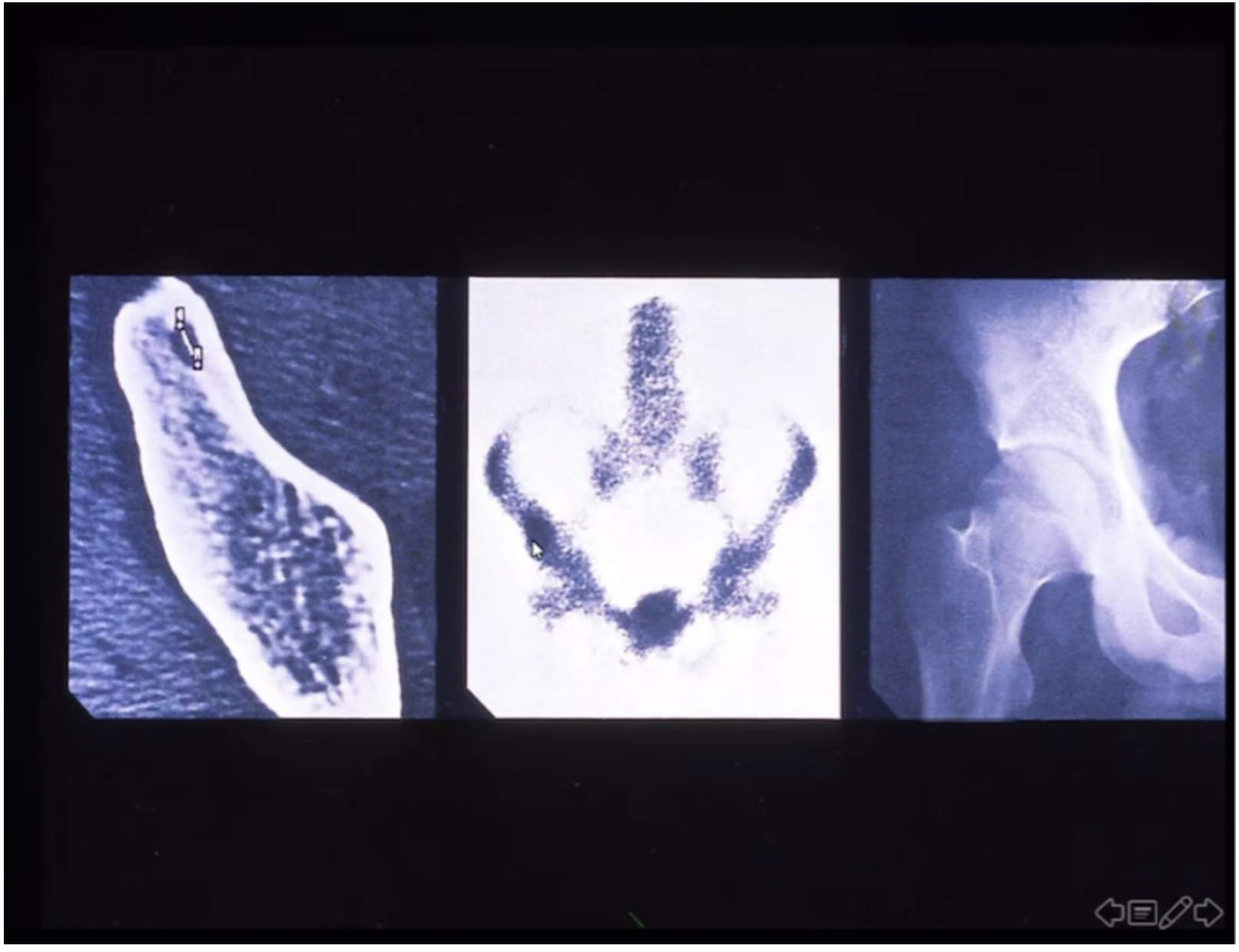

Aneurysmal Bone Cyst
age: 5–20
M:F = 1:1
common sites
less common sites

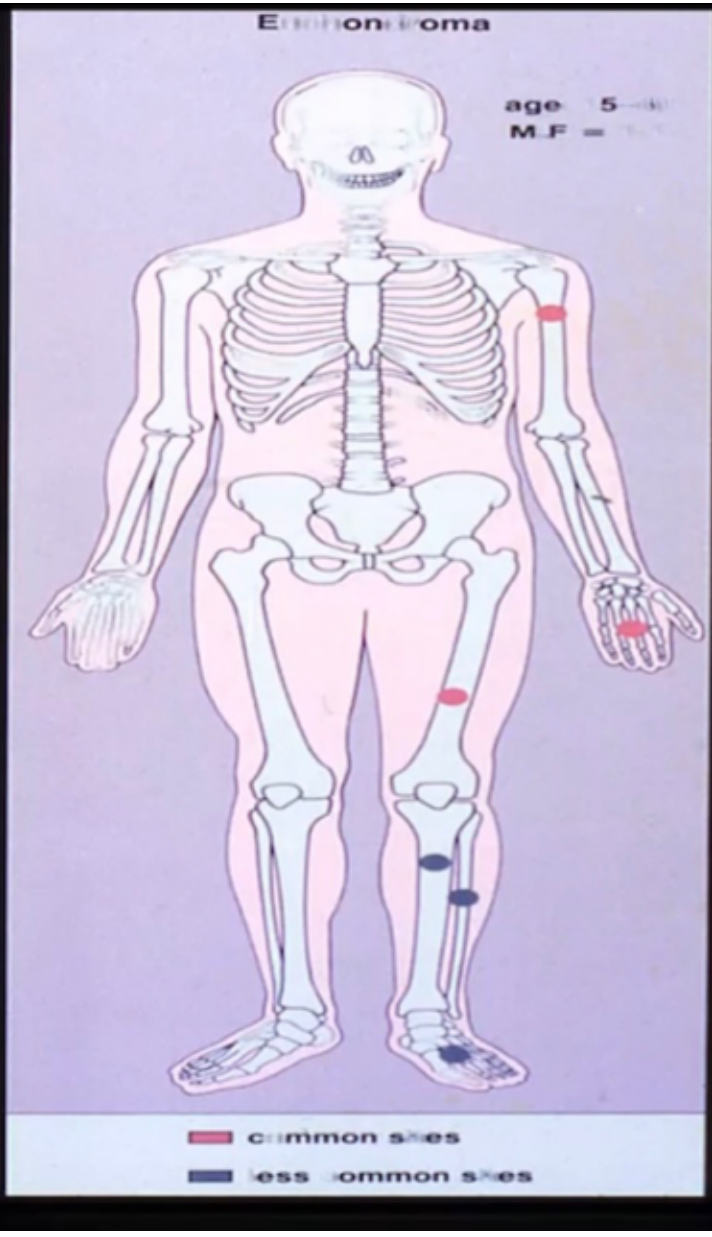


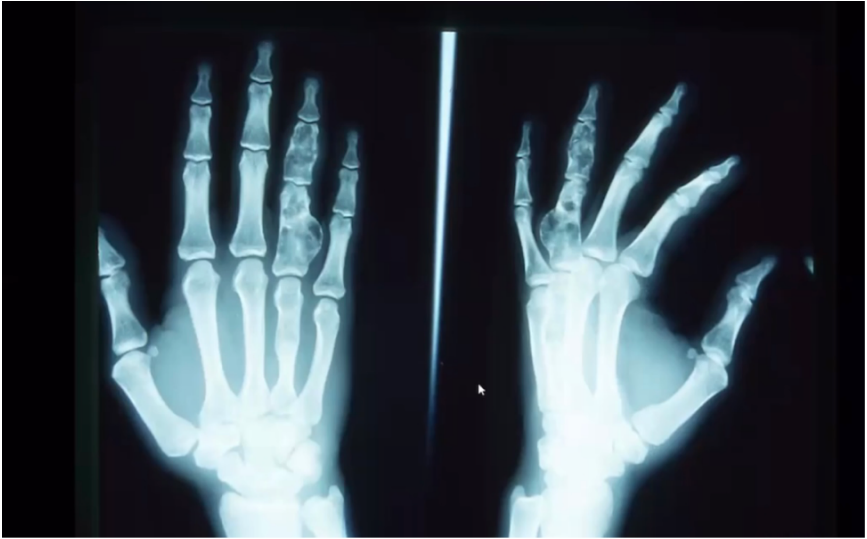

Fibrous Cortical Defect and
Nonossifying Fibroma
age: 2–20
M > F
common sites
less common sites

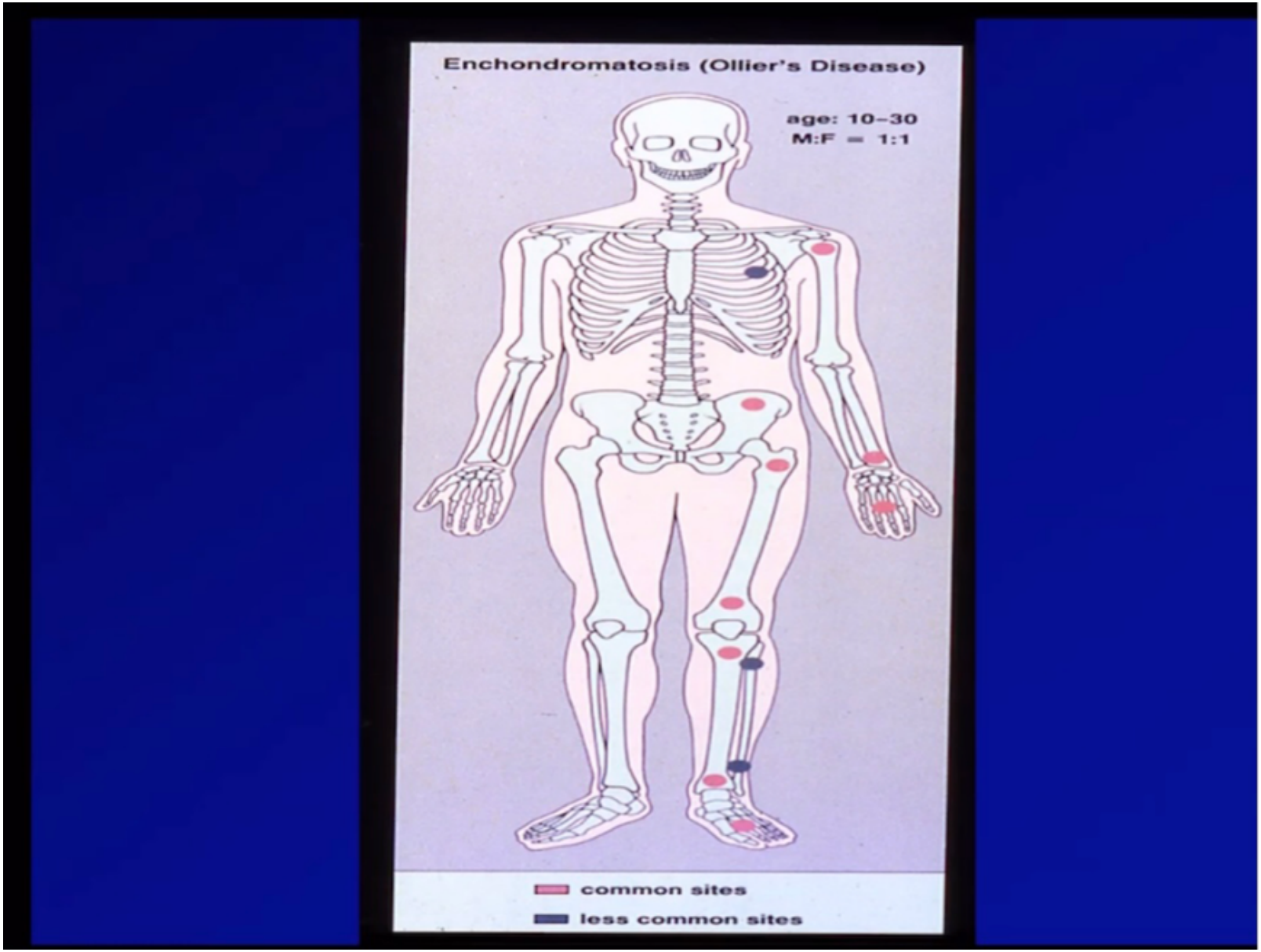

Osteoid Osteoma
age: 10–35
M:F = 2:1
common sites
less common sites

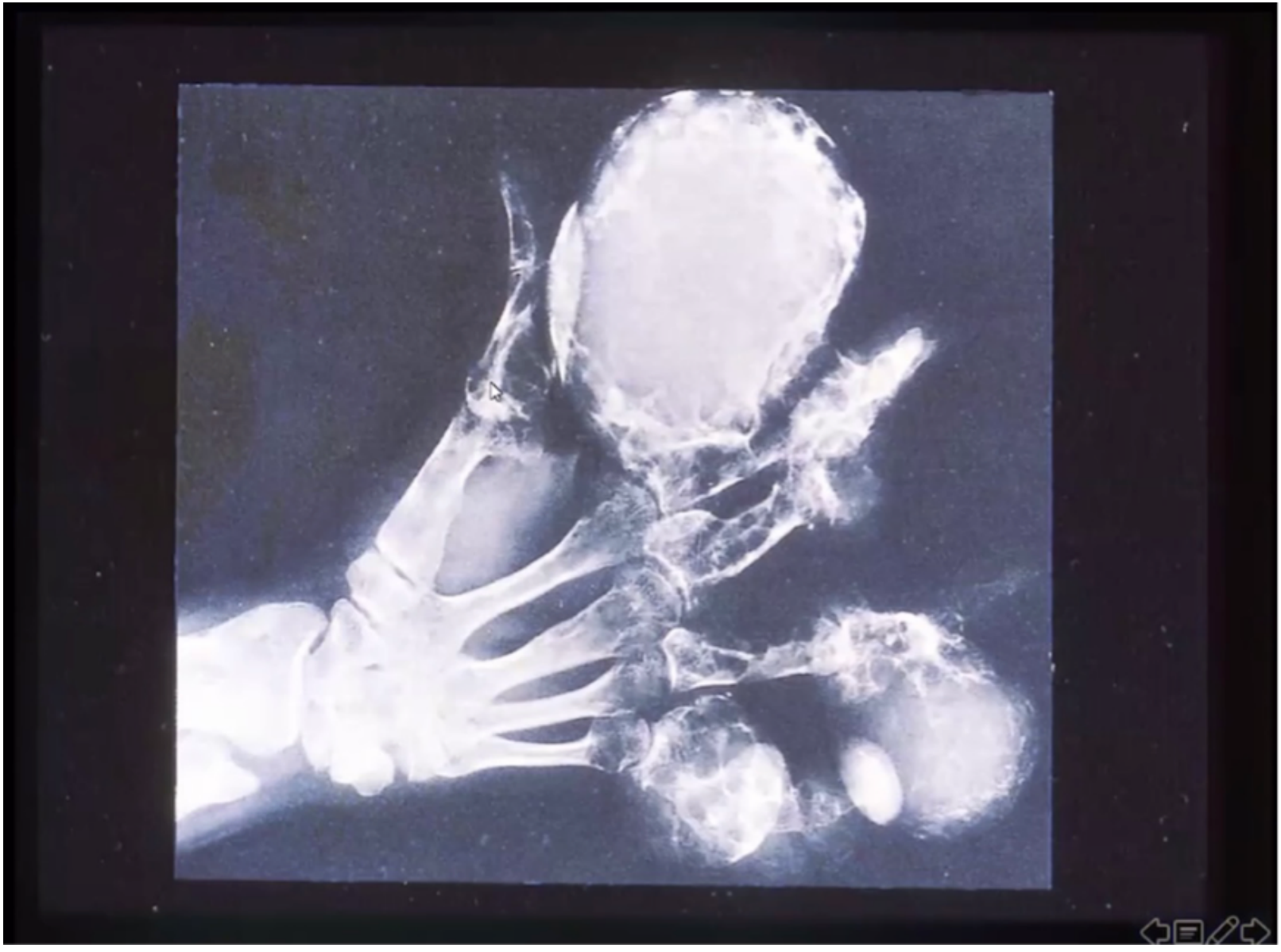


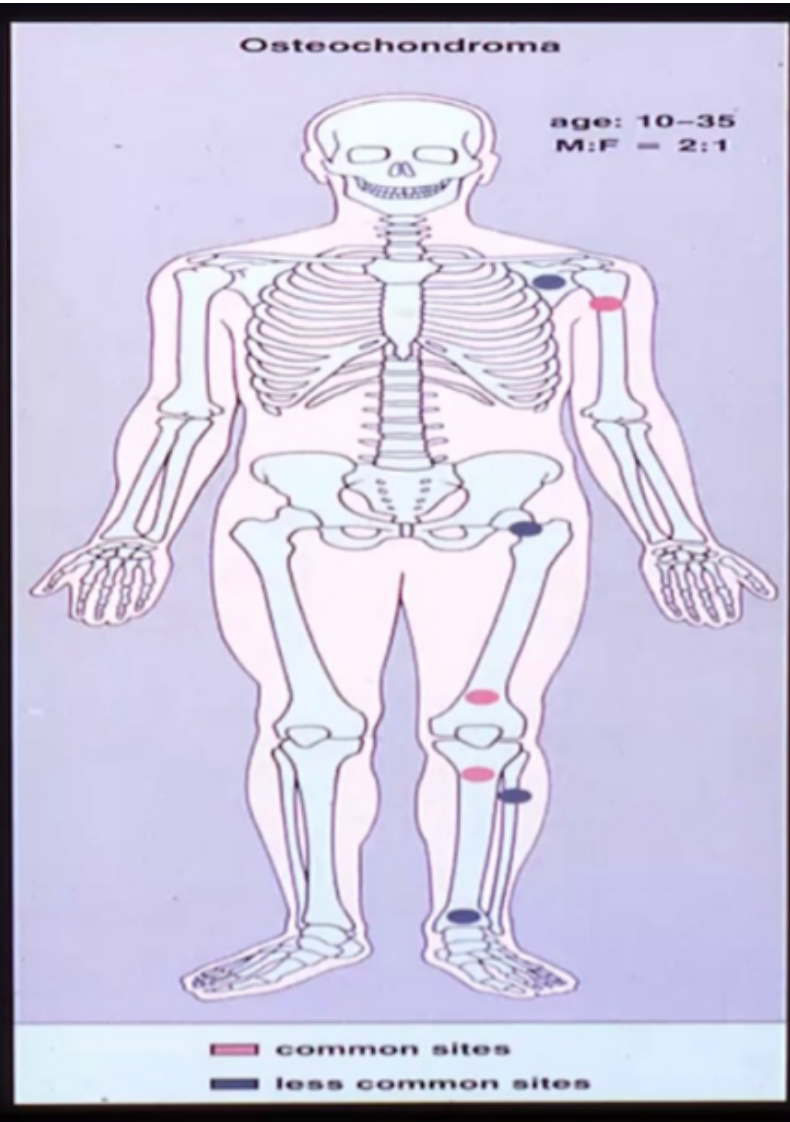


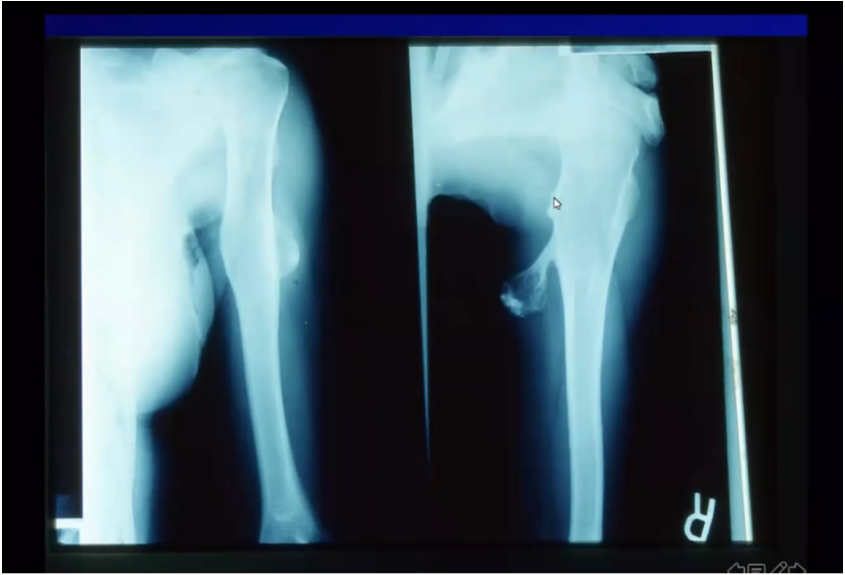

age 5
M:F =
common sites
less common sites

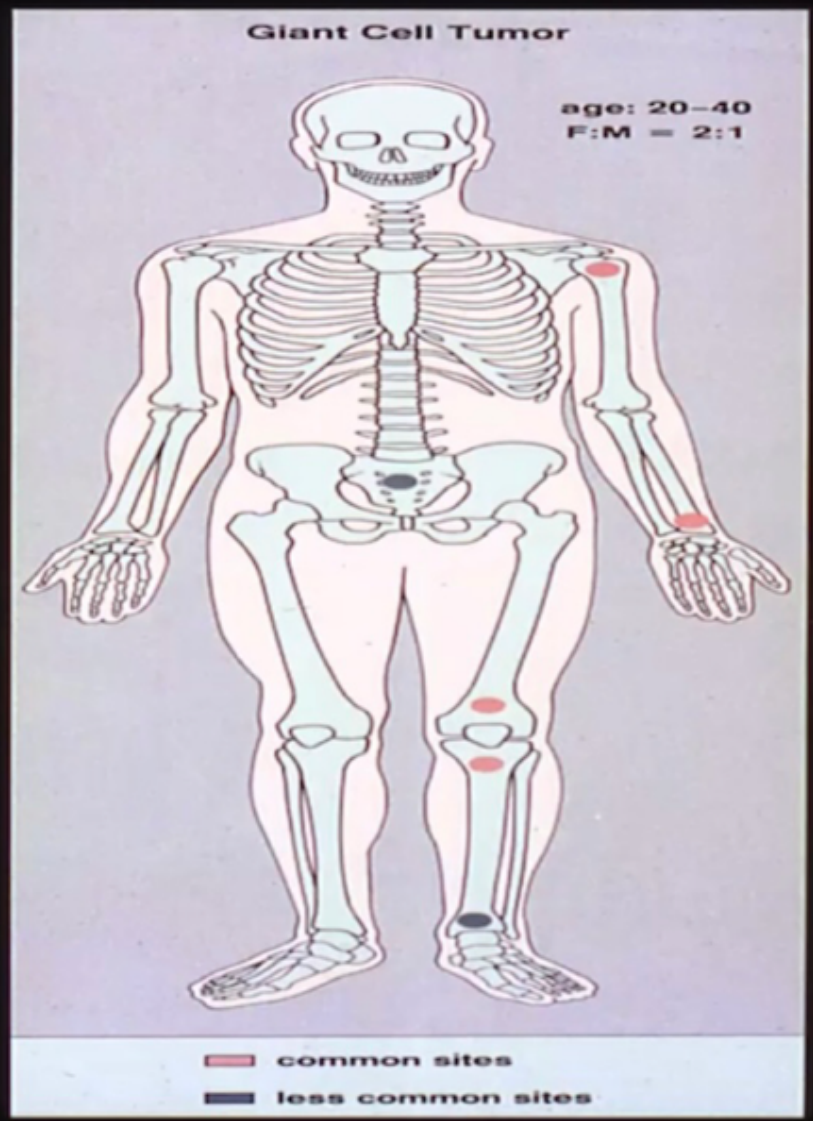


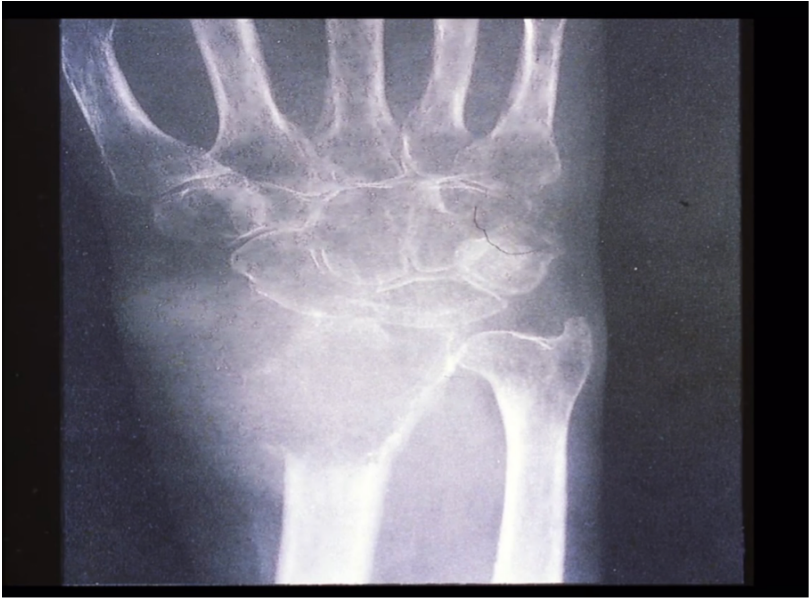

Enchondromatosis (Ollier's Disease)
age: 10–30
M:F = 1:1
common sites
less common sites

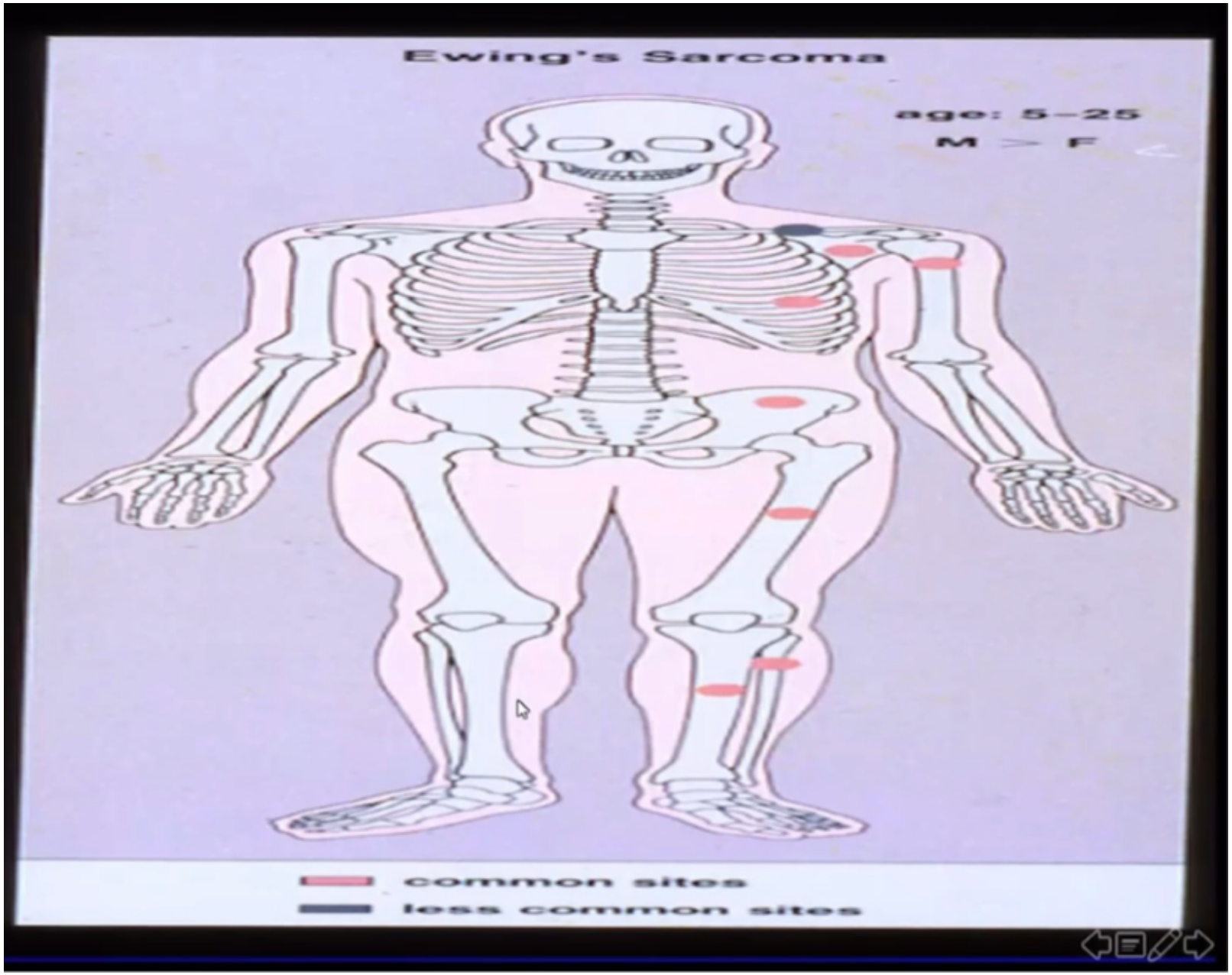


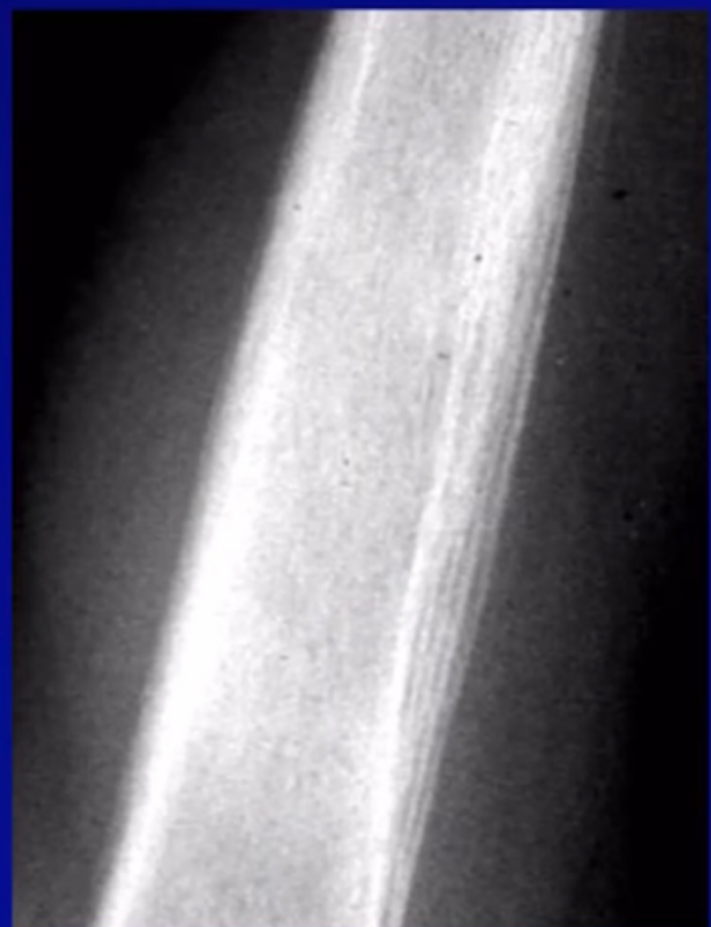

Osteochondroma
age: 10–35
M:F = 2:1
common sites
less common sites

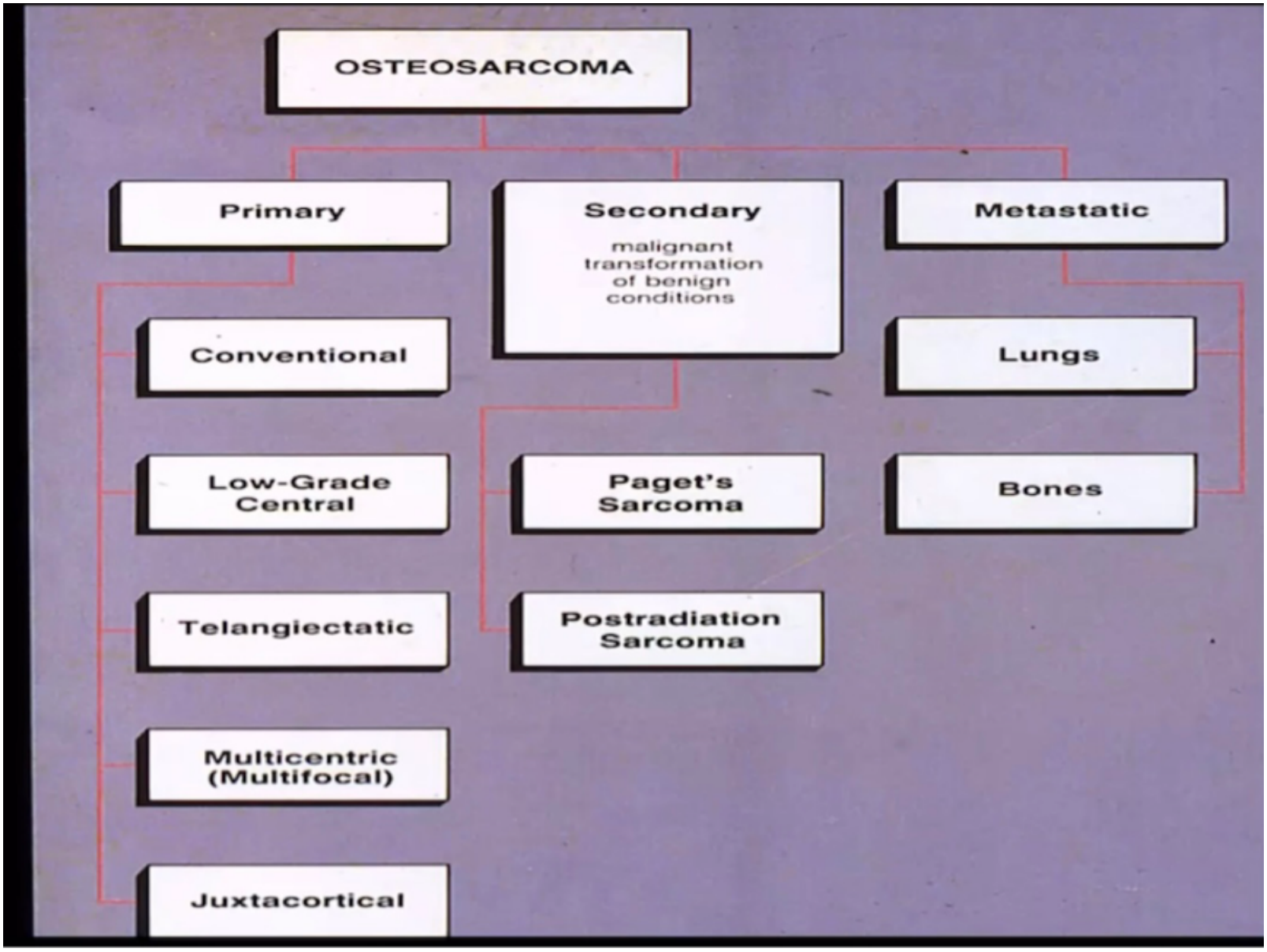

R

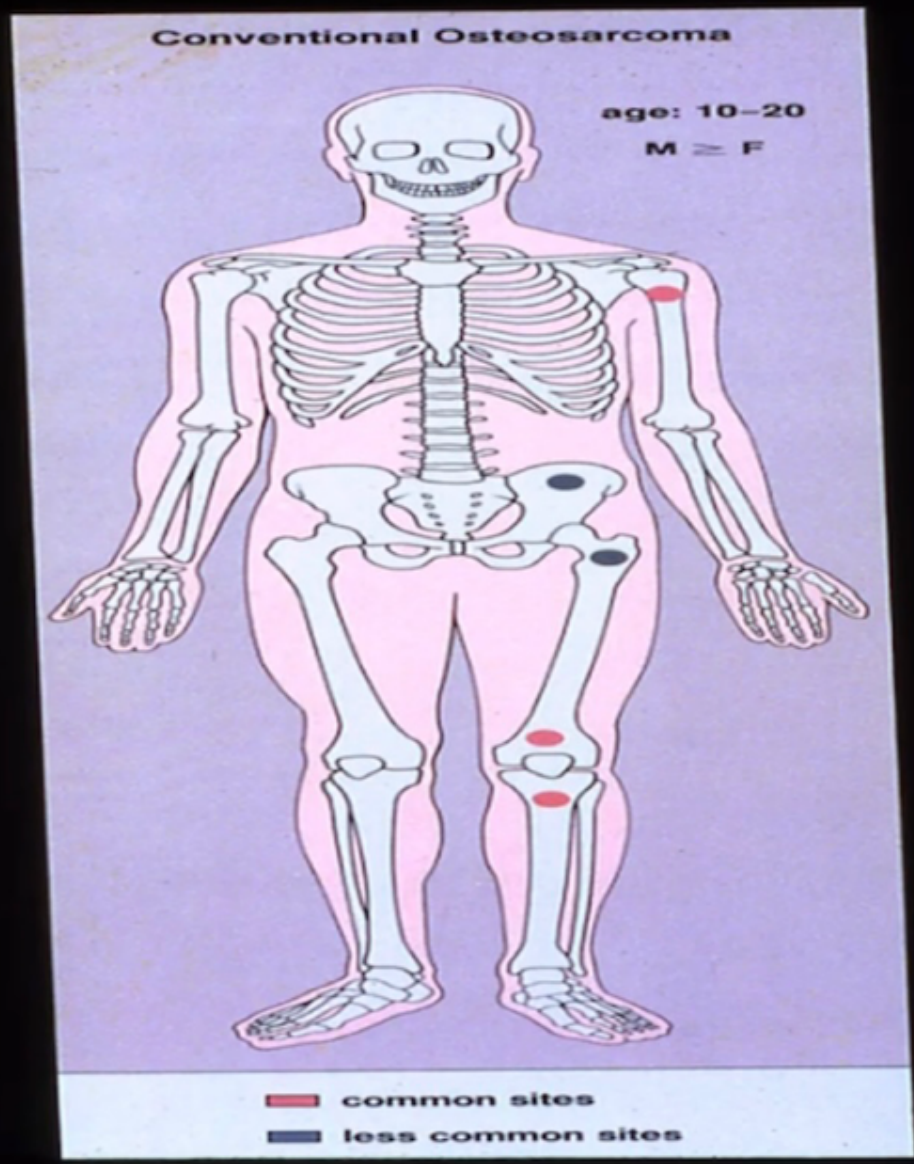

Giant Cell Tumor
age: 20–40
F:M = 2:1
common sites
less common sites

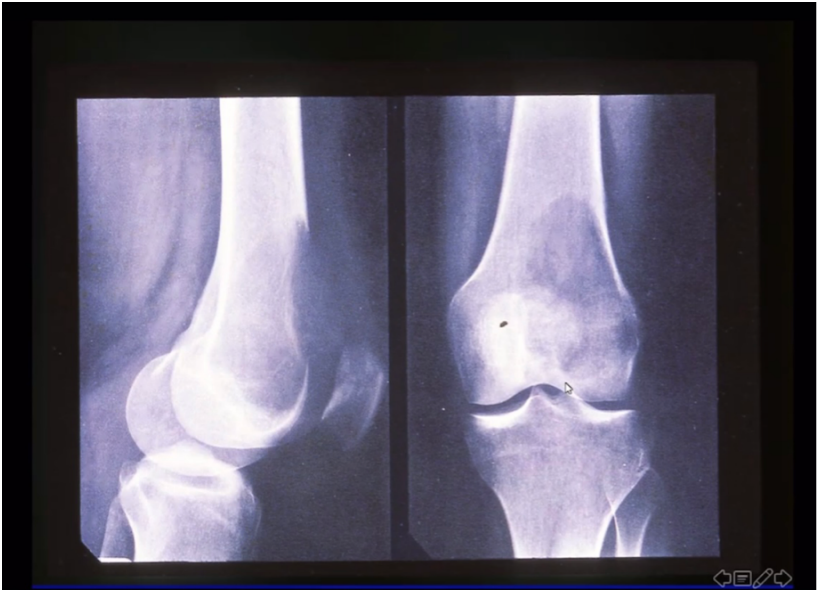


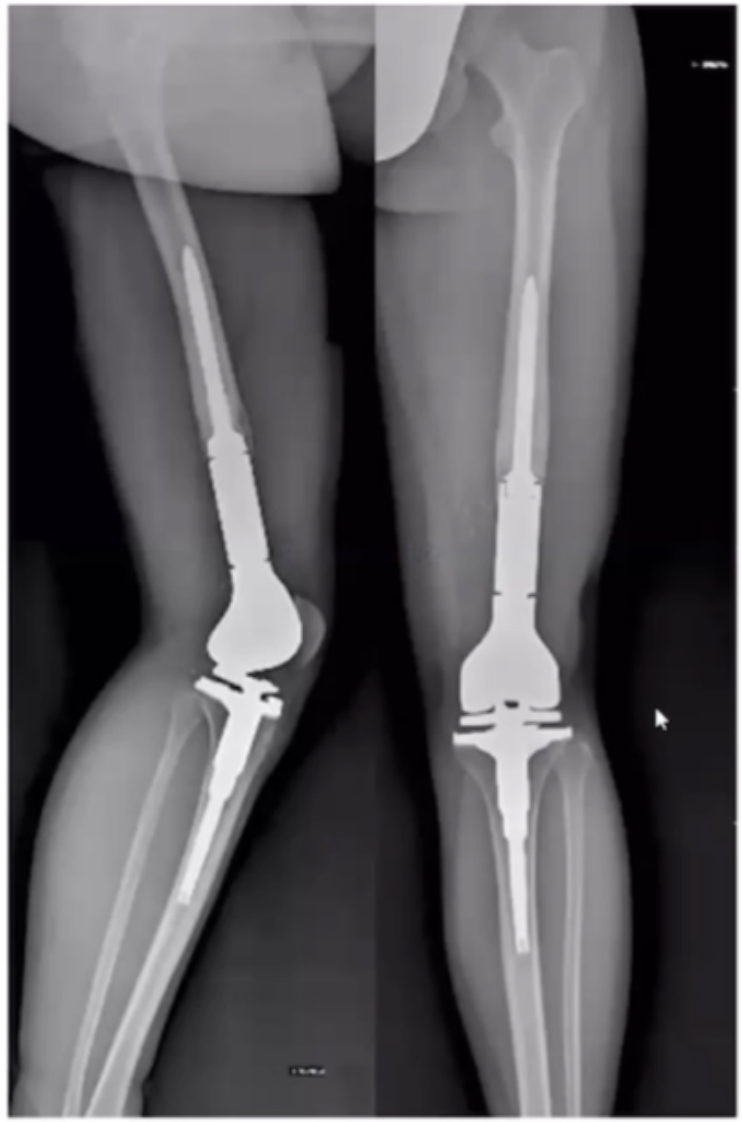

Ewing's Sarcoma
age: 5–25
M > F
common sites
less common sites

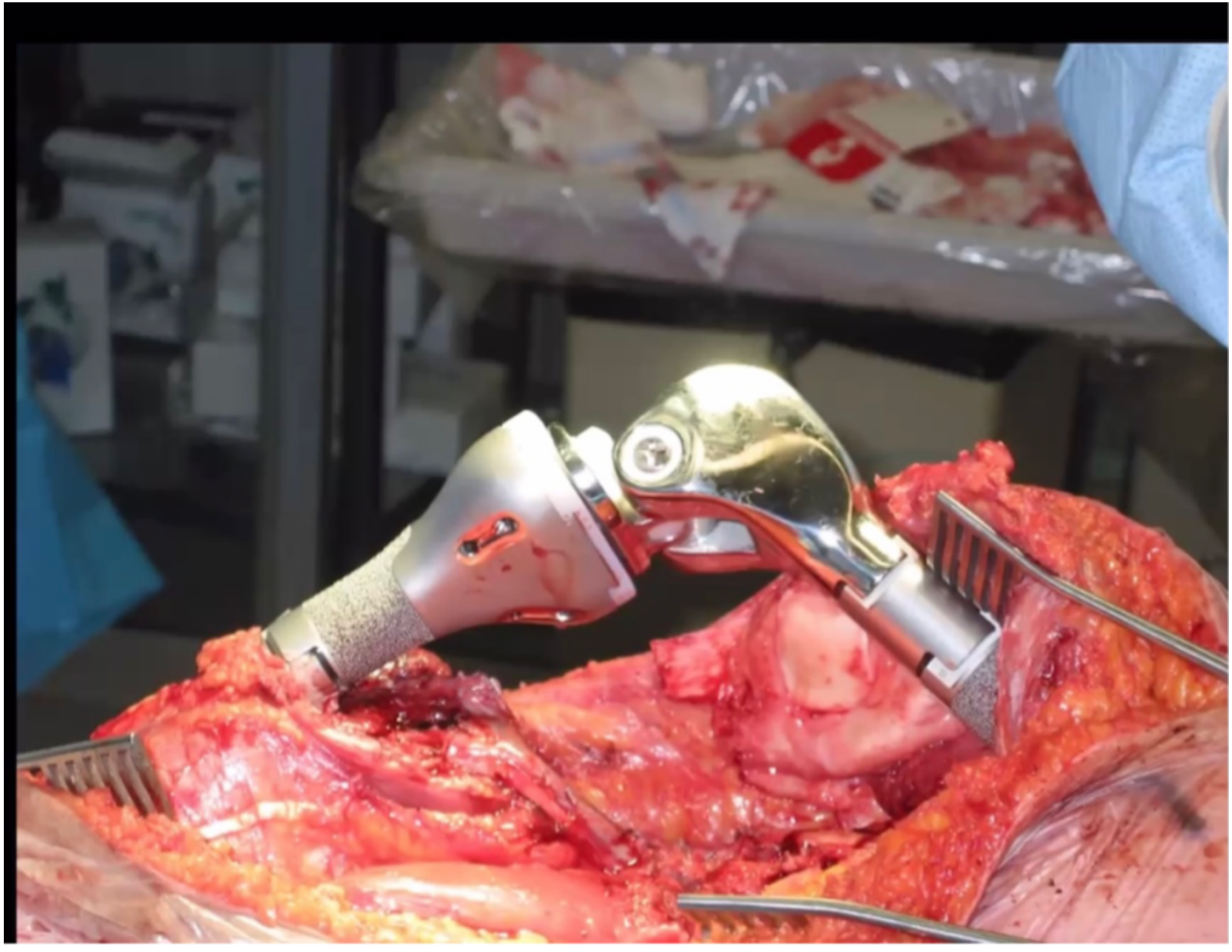


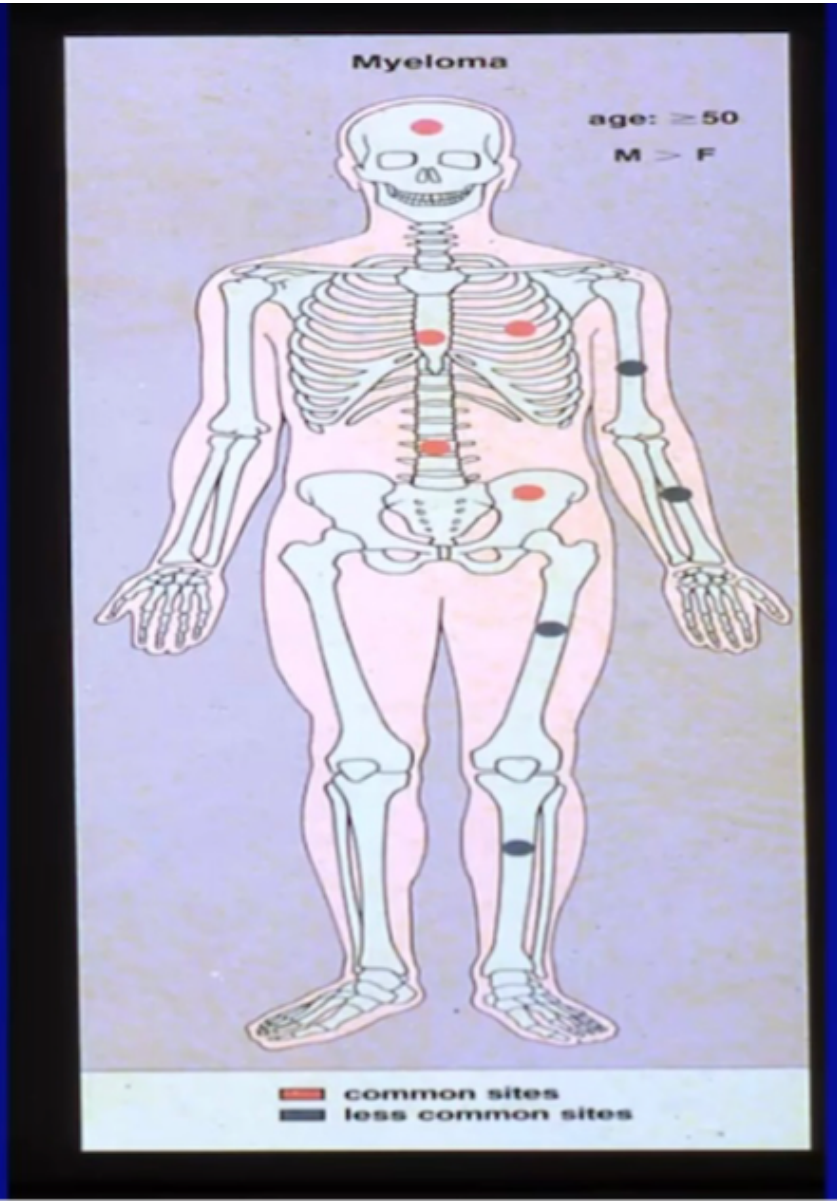

OSTEOSARCOMA
Primary
Secondary
malignant transformation of benign conditions
Metastatic
Conventional
Low-Grade Central
Telangiectatic
Multicentric (Multifocal)
Juxtacortical
Paget's Sarcoma
Postradiation Sarcoma
Lungs
Bones

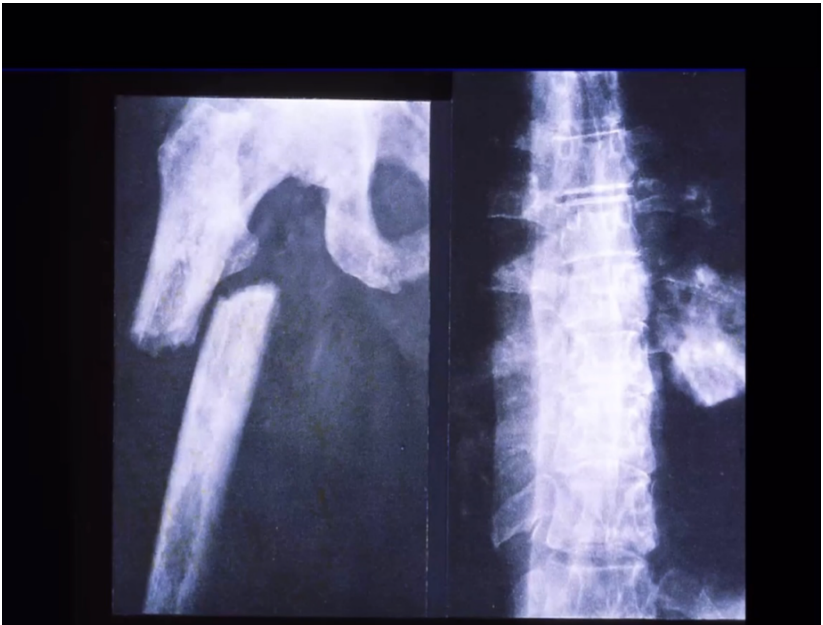

Conventional Osteosarcoma
age: 10–20
M ≥ F
common sites
less common sites

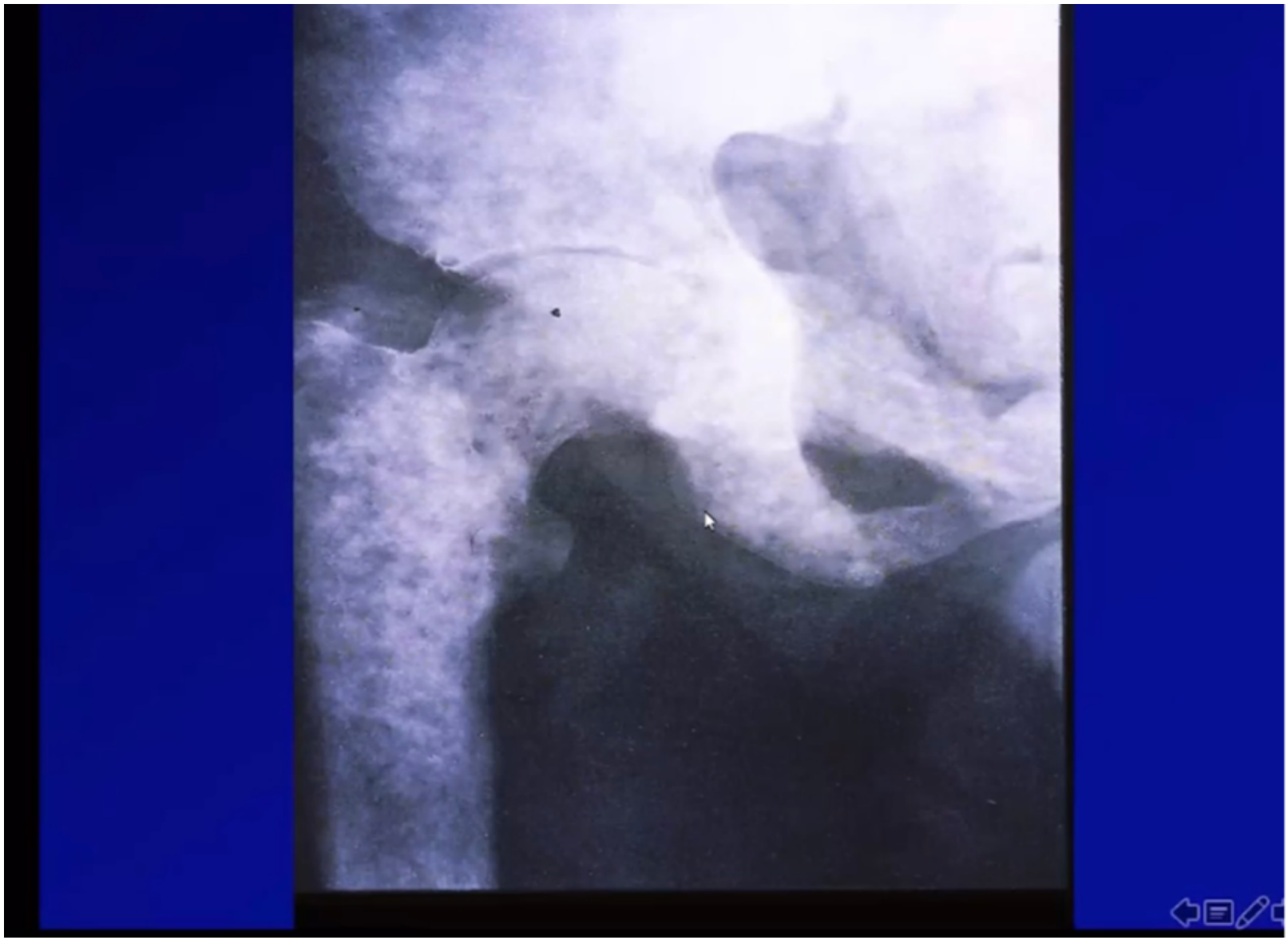


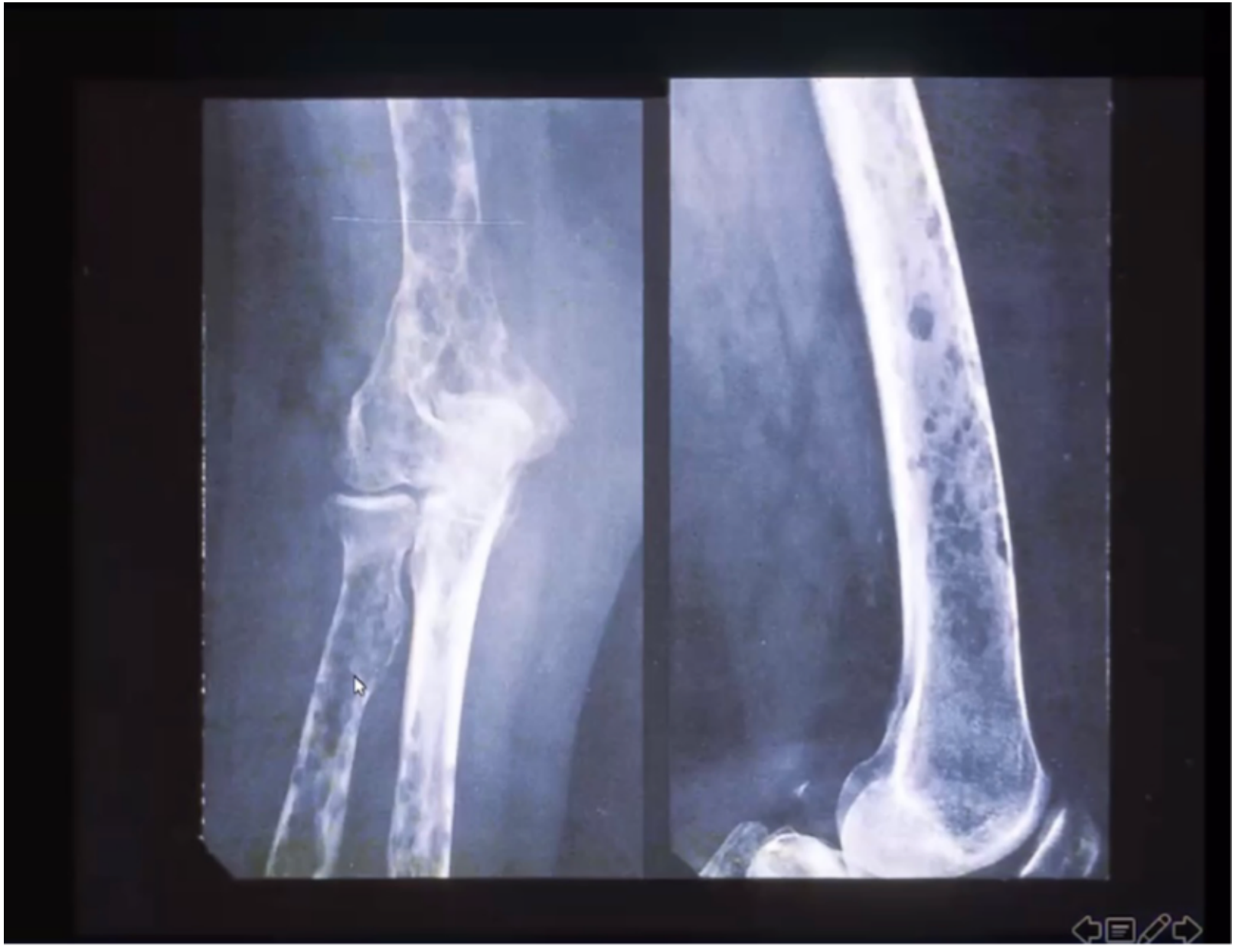


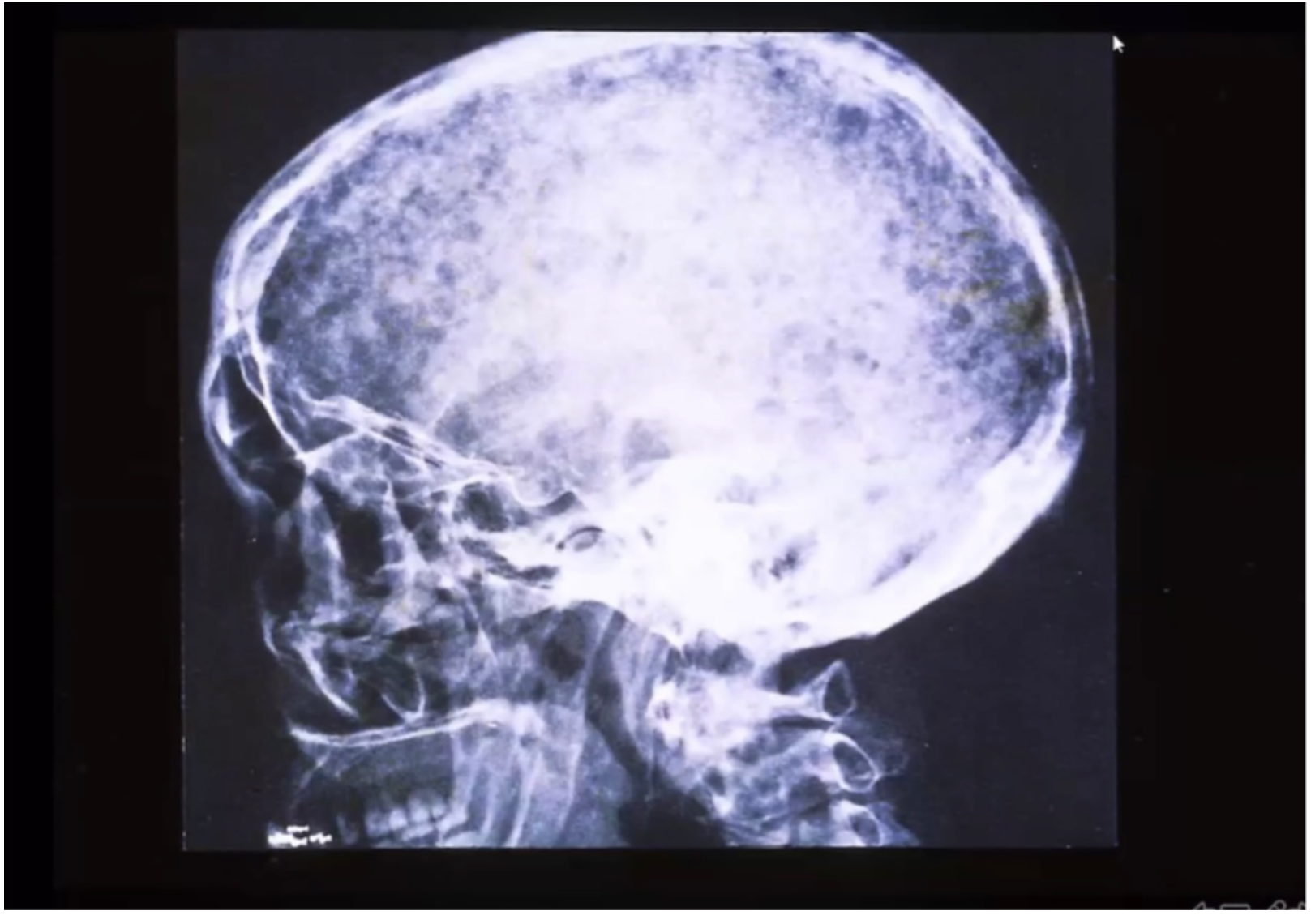


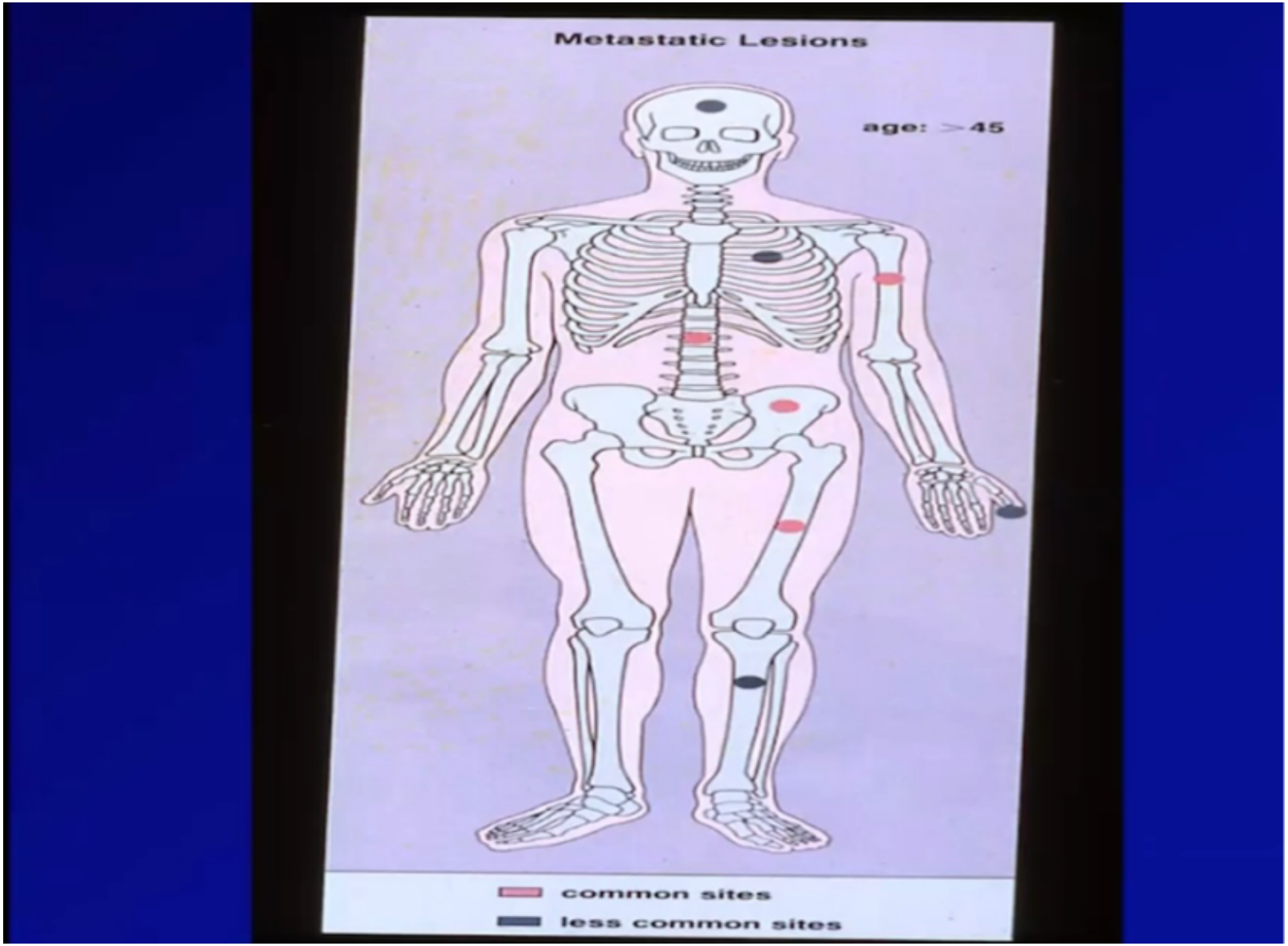

Myeloma
age: ≥ 50
M > F
common sites
less common sites

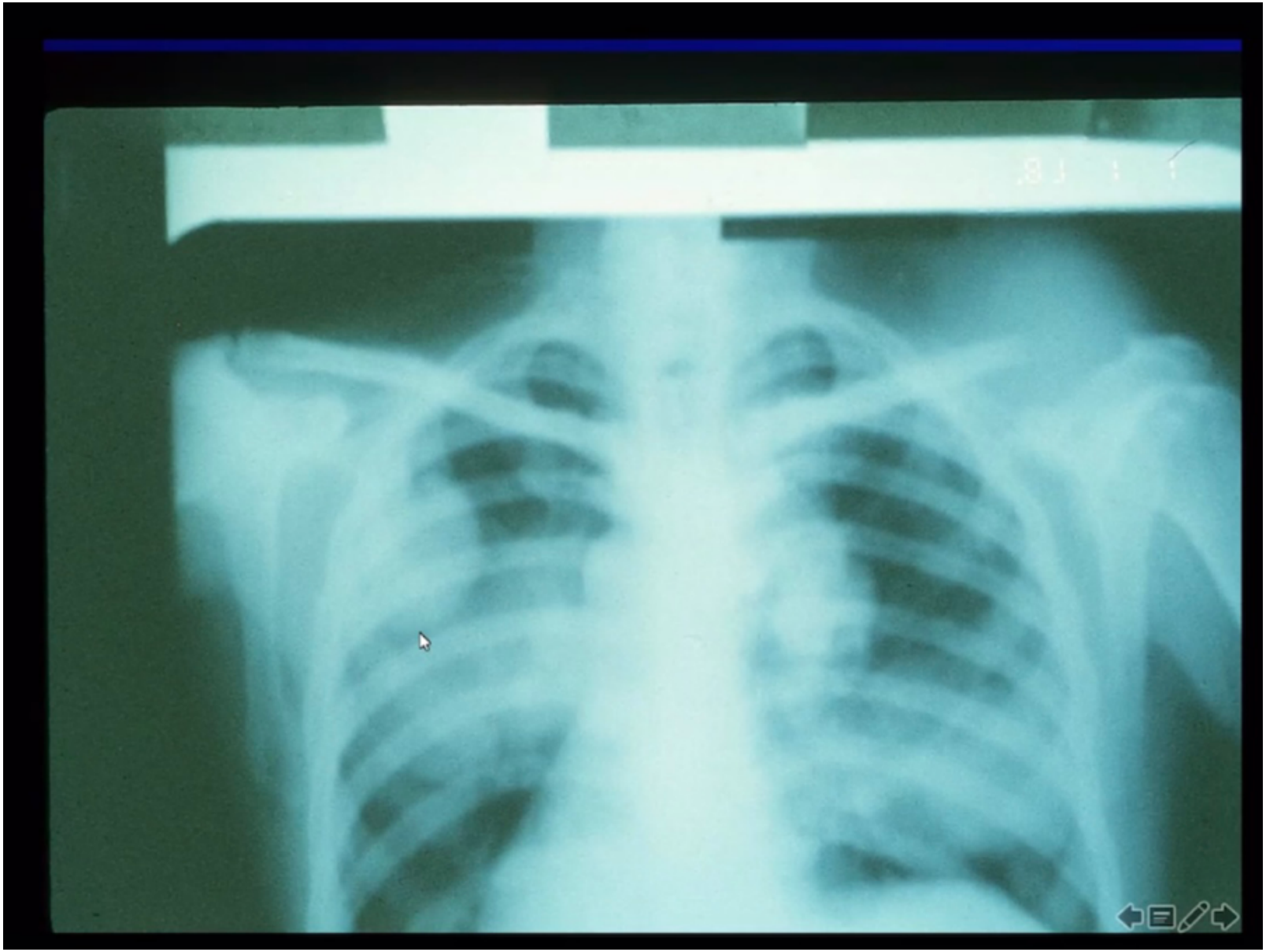


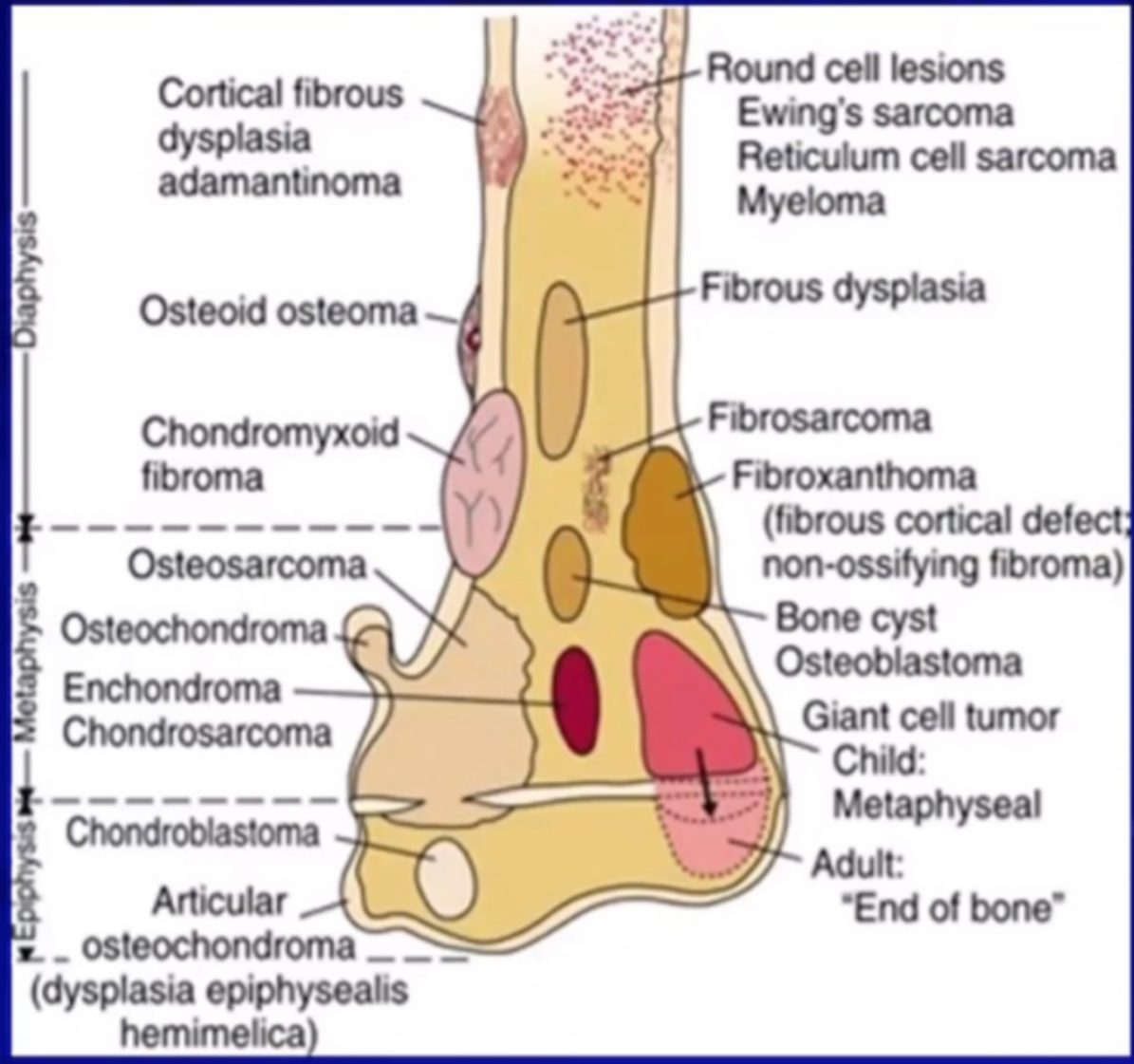


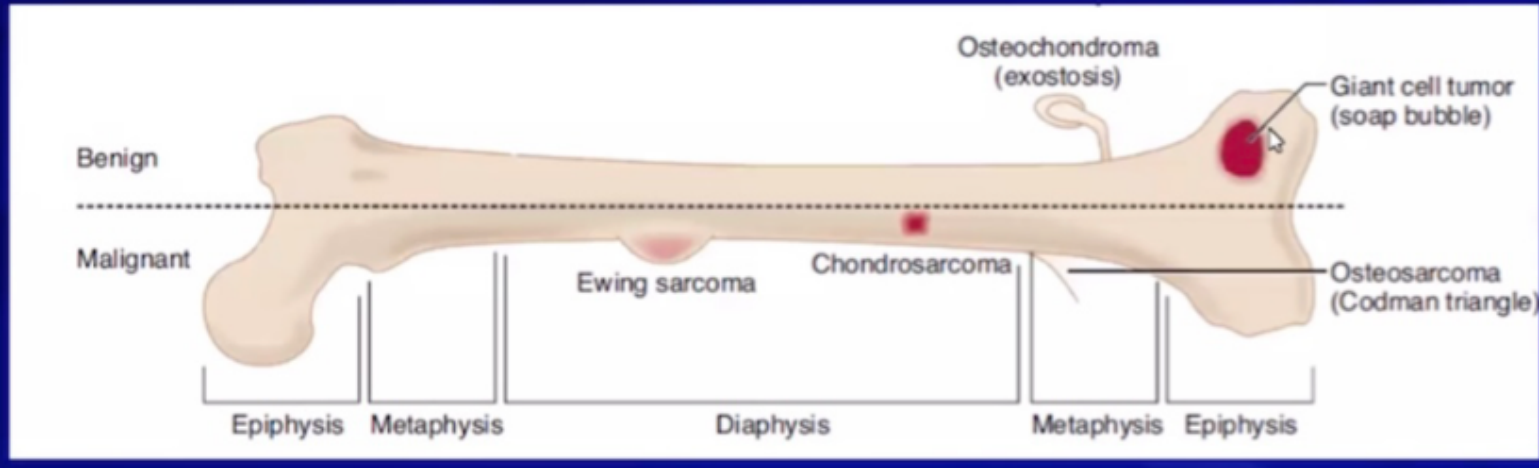





Metastatic Lesions
age: >45
common sites
less common sites




Cortical fibrous dysplasia adamantinoma
Round cell lesions
Ewing's sarcoma
Reticulum cell sarcoma
Myeloma
Osteoid osteoma
Fibrous dysplasia
Chondromyxoid fibroma
Fibrosarcoma
Fibroxanthoma
(fibrous cortical defect; non-ossifying fibroma)
Osteosarcoma
Bone cyst
Osteoblastoma
Osteochondroma
Enchondroma
Chondrosarcoma
Giant cell tumor
Child: Metaphyseal
Chondroblastoma
Adult: "End of bone"
Articular osteochondroma
(dysplasia epiphysealis hemimelica)
Diaphysis
Metaphysis
Epiphysis


Osteochondroma
(exostosis)
Giant cell tumor
(soap bubble)
Benign
Malignant
Ewing sarcoma
Chondrosarcoma
Osteosarcoma
(Codman triangle)
Epiphysis
Metaphysis
Diaphysis
Metaphysis
Epiphysis

What's next?

The biopsy

The Biopsy

- Is not a substitute for thorough history, physical examination and investigation
- Serves to confirm diagnosis suspected from above
- “If you don’t know what it is before the biopsy, you won’t know what it is after”

Every lesion does not need a biopsy!

- An asymptomatic (latent) or symptomatic bone lesion (active) that appears entirely benign on imaging does not need a biopsy
- A soft tissue lesion that appears entirely benign on MRI (lipoma, hemangioma) does not need a biopsy
- When in doubt, it is safer to do a biopsy

Indications for Biopsy

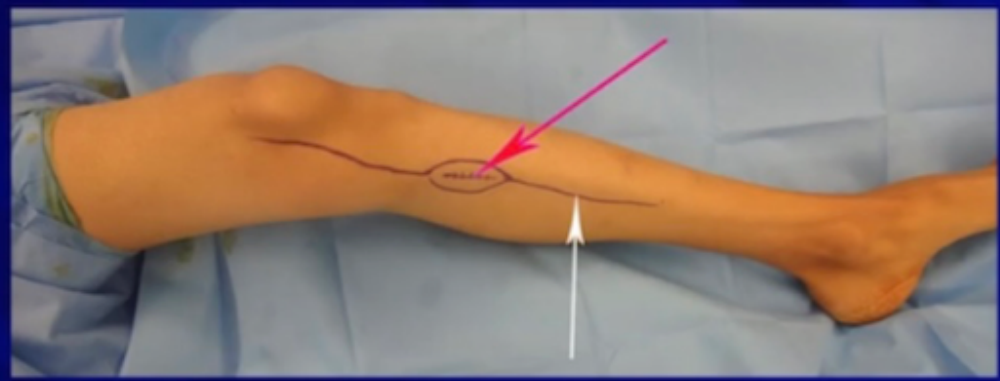
- Aggressive or malignant appearing bone or soft tissue lesions
- For soft tissue lesions - >5cm, deep to fascia or overlying bone or neurovascular structures
- Unclear diagnosis in symptomatic patient
- Special situation - solitary bone lesion in a patient with a history of carcinoma

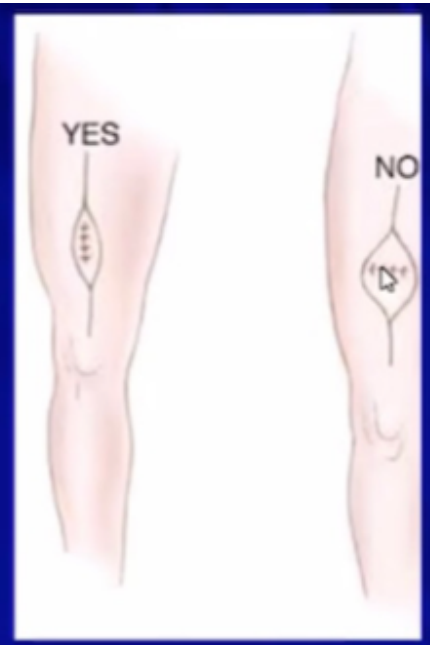
Prerequisites for Biopsy

- CBC, platelets, coagulation screen
- Cross-sectional imaging – depicts local anatomy, solid areas of tumour
- Experienced musculoskeletal pathologist available

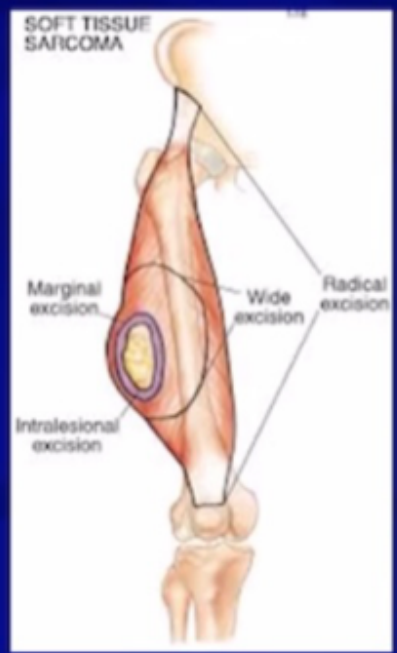
Techniques of Biopsy

- Fine needle aspirate – gives cytologic specimen (adequate for some pathologists experienced with this technique)
- Core biopsy (tru-cut) – allows for ultrastructural examination
- Incisional biopsy
- Excisional biopsy – selected indications (small, superficial soft tissue masses)




YES
NO


Radical excision
Wide excision
Marginal excision
Intralesional excision

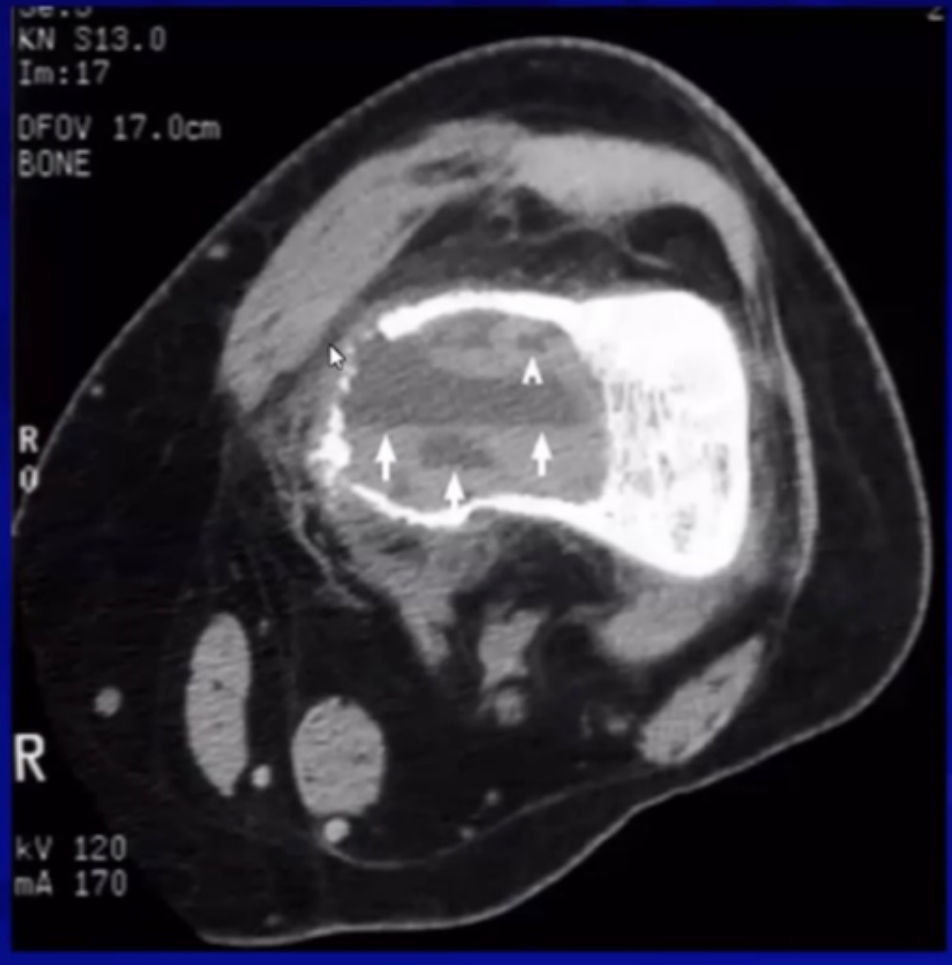

SOFT TISSUE SARCOMA
Marginal excision
Wide excision
Radical excision
Intralesional excision

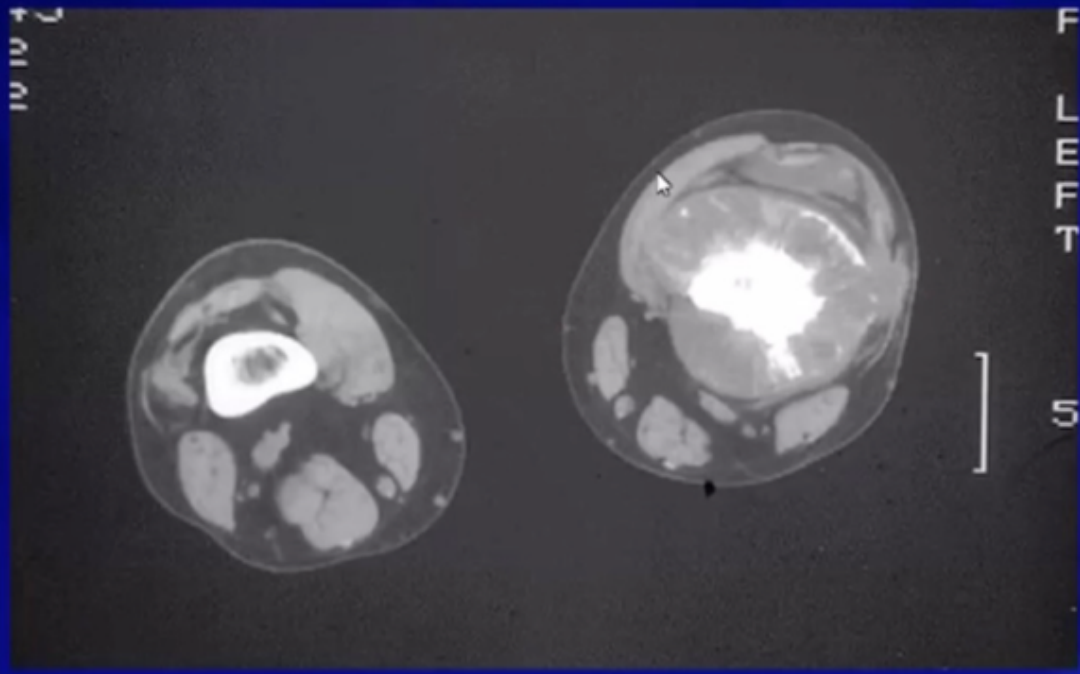
Principles of Open Biopsy

- Extensile incision – longitudinal in extremities
- Avoid developing planes
- Use involved compartment
- Do not expose neurovascular structures
- Meticulous hemostasis
- Release tourniquet prior to wound closure
- If using drain, bring out in line with incision

General Recommendations

- For benign aggressive tumours without soft tissue mass, plan biopsy through area of maximal cortical weakening based on CT or MRI
- For malignant tumours or benign aggressive with soft tissue mass, biopsy soft tissue rather than creating hole in bone


KN S13.0
Im:17
DFOV 17.0cm
BONE
R
R
kV 120
mA 170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