PLEASE CLICK ON THE FOLLOWING LINK TO WATCH THE LECTURE ONLINE:-

https://www.youtube.com/watch?v=BRhUG2H9UR4&list=PLuBRb5B7fa_eyzMA0u7jajzWugcmiRi5s&index=7

Biopsy Principles In Orthopedics

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Introduction

- Initial Evaluation:

.Carried out in 4 phases>>

1st phase - involves

High index of suspicion for tumors

Routine X-ray

Routine Lab facilities

Meticulous history

Physical examination

2nd phase - is prebiopsy regional evaluation, to determine size,location and type of tissue involved.

3rd phase - is the actual biopsy.

4th phase - is undertaken if presumptive clinical & pathology evidence sugestive malignancy, search for mets is done using CT scan & Tc-99 bone scan, etc..

PRESENTING SYMPTOMS

- Pain.
- Mass.
- Neurological symptoms.
- Unexplained swelling of the lower extremity.
- An abnormal radiographic finding detected during evaluation of unrelated problem.

HISTORY OF THE PATIENT

- Age.
- Sex.
- Race.
- History any exposure to radiation Tx or Carcinogens.
- Various chemical Carcinogens.

PHYSICAL EXAMINATION

- Evaluation of pt’s general health.
- Tumor mass analysis
- Skin & subcutaneous tissue evaluation.
- Regional lymph nodes.
- Atrophy of surrounding musculature should be recorded.
- Neurological deficits & adequacy of circulation.

LABORATORY TEST

- Routine test.
- ESR.
- CRP.
- Alkaline phosphatse test.
- PTH.
- Serum phosphorus.
- Ionized calcium and serum calcium.
- Other tests like glucose tolerance test,PSA,PAP, electrophoresis & urinary bence jones protein

INVESTIGATIONS

- X-RAYS.
- CT SCAN.
- MRI.
- TECHNETIUM BONE SCAN.
- PET SCAN.

QUESTIONS TO ASK WHEN STUDYING AN X-RAY

Is the lesion solitary or are there multiple lesions?

What type of bone is involved?

Where is the lesion in the bone?

Are the margins of the lesion well- or ill-defined?

Are there flecks of calcification in the lesion?

Is the cortex eroded or destroyed?

Is there any periosteal new-bone formation?

Does the tumour extend into the soft tissues?

BOX 24-1 Differential Diagnosis for Epiphyseal Lesions

- Chondroblastoma (ages 10-25)
- Giant cell tumor (ages 20-40)
- Clear chondrosarcoma (rare)

BOX 24-2 Differential Diagnosis for Diaphyseal Lesions

- Ewing sarcoma (ages 5-25)
- Lymphoma (adult)
- Fibrous dysplasia (ages 5-30)
- Adamantinoma (consider in the tibia)
- Histiocytosis (ages 5-30)

BOX 24-3 Differential Diagnosis for Lesions of the Spine

Older than 40 Years

- Metastases
- Multiple myeloma
- Hemiangioma
- Chordoma (in sacrum)

Younger than 30 Years

- Vertebral body
  - Histiocytosis
  - Hemangioma
- Posterior elements
  - Osteoid osteoma
  - Osteoblastoma
  - Aneurysmal bone cyst

BOX 24-4 Differential Diagnosis for Multiple Lesions

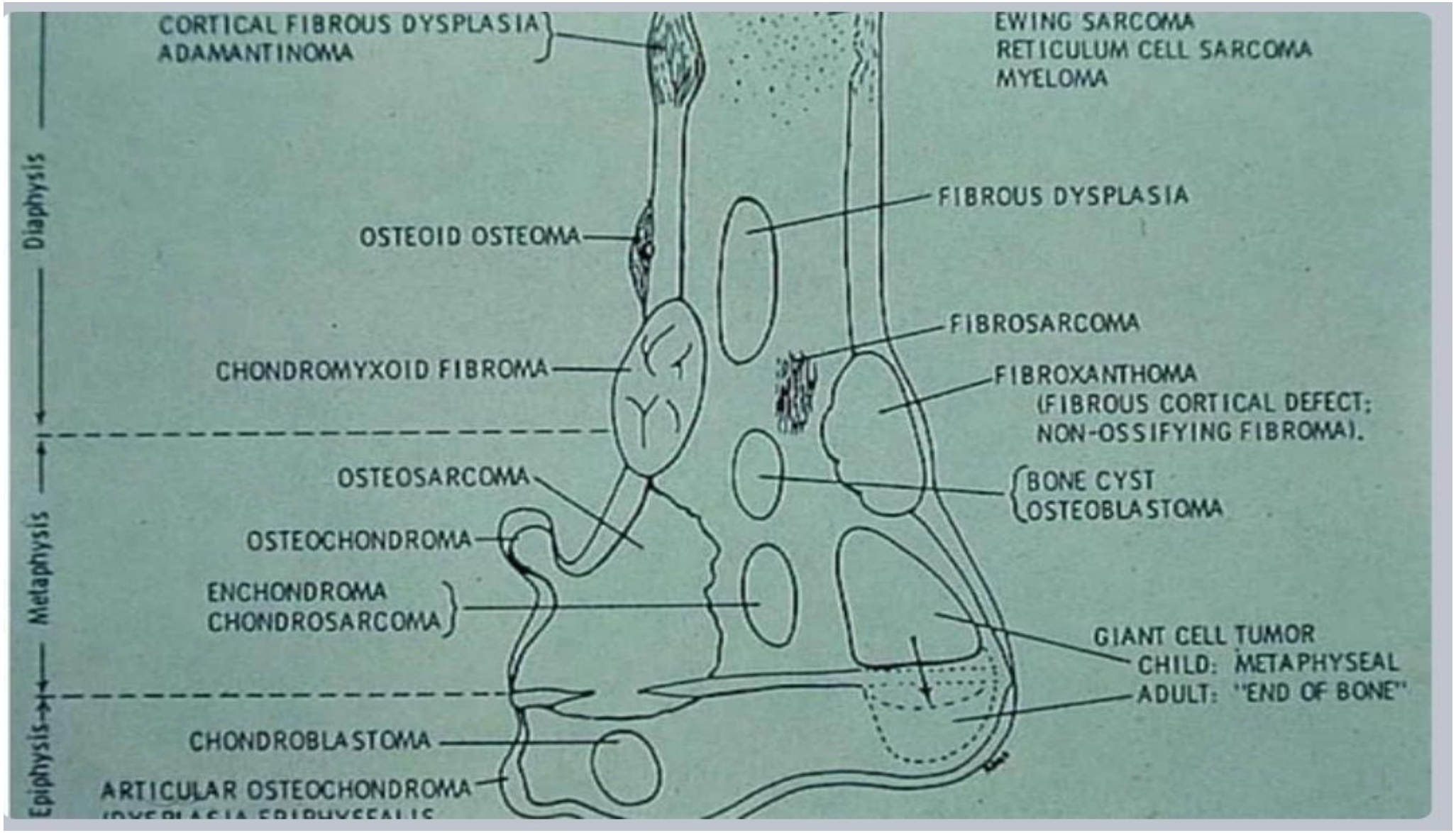
- Histiocytosis
- Enchondroma
- Osteochondroma
- Fibrous dysplasia
- Multiple myeloma
- Metastases
- Hemangioma
- Infection
- Hyperparathyroidism

TABLE 2-1 Differential Criteria for Benign Lytic Bone Lesions

Mnemonic: FEGNOMASHIC

- **F** — *Fibrous dysplasia* = No pain or periosteal reaction; if in tibia, mention adamantinoma
- **E** — *Enchondroma* = Must have calcification, except in phalanges; must be no pain or periostitis
- **G** — *Eosinophilic granuloma (EG)* = Patient must be younger than age 30
  Giant cell tumor (GCT) = (1) Epiphyses must be closed; (2) must be epiphyseal *and* abut the articular surface; (3) must be well defined with a nonsclerotic border; (4) must be eccentric
- **N** — *Nonossifying fibroma (NOF)* = Patient must be younger than 30; periostitis and pain must be absent
- **O** — # *Osteoblastoma* = Mentioned whenever ABC is mentioned, even if patient is older than age 30
- **M** — *Mets and myeloma* = Patient must be older than age 40
- **A** — *Aneurysmal bone cyst (ABC)* = Lesion must be expansile; patient must be younger than age 30
- **S** — *Solitary bone cyst* = Cyst be centrally located; patient must be younger than age 30; no pain or periostitis
- **H** — *Hyperparathyroidism (brown tumor)* = Must be other evidence of hyperparathyroidism
  Hemangiomas
- **I** — *Infection* = If adjacent to a joint, must involve the joint (weak)
- **C** — *Chondroblastoma* = Patient must be younger than 30; lesion must be epiphyseal
  # *Chondromyxoid fibroma* = Mention when a nonossifying fibroma is mentioned

Younger Than 30	No Periostitis or Pain	Epiphyseal	Multiple
EG ABC NOF Chondroblastoma Solitary bone cyst	Fibrous dysplasia Enchondroma NOF Solitary bone cyst	Chondroblastoma Infection GCT Geode (EG and ABC are optional)	(Mnemonic: FEEMHI) Fibrous dysplasia EG Enchondroma Mets and myeloma Hyperparathyroidism Hemangiomas Infection


CORTICAL FIBROUS DYSPLASIA
ADAMANTINOMA
EWING SARCOMA
RETICULUM CELL SARCOMA
MYELOMA
FIBROUS DYSPLASIA
OSTEOID OSTEOMA
FIBROSARCOMA
CHONDROMYXOID FIBROMA
FIBROXANTHOMA
(FIBROUS CORTICAL DEFECT;
NON-OSSIFYING FIBROMA).
OSTEOSARCOMA
BONE CYST
OSTEOBLASTOMA
OSTEOCHONDROMA
ENCHONDROMA
CHONDROSARCOMA
GIANT CELL TUMOR
CHILD: METAPHYSEAL
ADULT: "END OF BONE"
CHONDROBLASTOMA
ARTICULAR OSTEOCHONDROMA
Diaphysis
Metaphysis
Epiphysis

BIOPSY

- Biopsy is the gold standard test for the diagnosis of bone and soft tissue tumors.

- The tumor is then staged based on Enneking system for benign and malignant bone tumors.

INDICATIONS

- Aggressive bone or soft tissue lesions.
- Soft tissue lesions more than 5 cms.
- Soft tissue lesions deep to fascia.
- Soft tissue lesions overlying bone or neurovascular structures.
- When diagnosis is unclear despite patient being symptomatic.
- Solitary bone lesions in a patient with history of carcinoma.

CONTRAINDICATIONS

- Asymptomatic latent bone lesions.
- Symptomatic benign active bone lesions confirmed on imaging studies.
- Asymptomatic soft tissue lesion which are completely benign on MRI such as lipoma and hemangioma.

PRErequisites and General Principles for a Biopsy

- CBC, platelets and coagulation studies should be done.
- Cross-sectional imaging to evaluate local anatomy such CT scan and MRI.
- Treatment center carrying out biopsy must be capable of proper diagnosis and treatment.
- The surgeon who performs biopsy should preferably be the one who is later going to do the final excision.
- Biopsy has to be evaluated by 2 general histopathologist or one musculoskeletal pathologist.

TECHNIQUE

- Closed Technique (Needle biopsy)

-Types:

*Fine Needle Aspiration (FNA).

*Core biopsy (Tru-cut Biopsy).

- Open Technique

-Types:

*Incisional biopsy

*Excisional biopsy

Needle biopsy (Closed Technique)

- A small hole is made in the affected bone and a tissue sample from the tumor is removed .
- **Types:**

1.Fine needle aspiration: during this procedure,the tissue sample is removed with thin needle attached to a syringe.

2.Core needle aspiration: a small cylinder of tissue sample is removed from the tumor with rotating knife like device.

Closed Technique

- ***Fine Needle Aspiration (FNA)***
- It provides cytologic specimen.
- It is the most commonly used for carcinoma.
- It is usually not preferred for sarcoma.
- ***Core biopsy (Tru-cut Biopsy)***
- It allows for tumor structural examination.
- It allows evaluation of both the cytologic and stromal elements of the tumor.
- It is frequently used for sarcomas.

Open Technique

- The tumor is surgically exposed and biopsy of the tumor is taken.
- ***Types:***
- **Incisional biopsy** :a small surgical incision carefully placed to access tumor without contamination of critical structures.

- **Excisional biopsy** :It is done for small, superficial soft tissue masses.

Incision

- **Longitudinal incision** in the extremities is taken **(<2cm)**.

- It should allow for extension of the incision for definitive management.

Approach

- Never expose neurovascular structures during the procedure (considered contaminated with tumor).
- During the biopsy, all tissue exposed is considered contaminated with tumor.
- Meticulous hemostasis must be carried out :

1-Preventing Post-surgery hematomas (considere contaminated with tumor).

2-Always deflate the tourniquet prior to wound closure.

3-Closure layer by layer.

- Perform biopsy through the involved compartment of the tumor (keep in intra muscular **not inter** muscular approach , biopsy through a **single compartment**).
- For bone lesions with a soft tissue mass, perform the biopsy using the soft tissue mass.
- Take biopsy from **Periphery** of the mass (center of mass is necrotic).
- Each biopsy has to be **cultured** and eash tissue culture has to be histopathological studied.
- Each biopsy should be taken by **different instruments**.

Closure

1.If drain is kept, remove the drain out of the skin in line with surgical incision (1cm distal to wound or from wound it self),This helps in excising the drain site with definitive surgical extensive incision.

2.Site of bone biopsy should be closed with bone cement or bone wax to prevent hematoma.

3.no wash should be done.

cont..

4.Subcuticular continuous closure is better than interrupted simple closure bcoz interrupted will increase contamination at site of interrupted sutures & to decrease stitch marks.

5.Biopsy have to be **labeled** for orientation & site of specimen.

TABLE 24-4 Types of Biopsy

BIOPSY TYPE	TISSUE OBTAINED	ADVANTAGES	DISADVANTAGES
Fine-needle aspiration	Cells	Cost effective Fewer complications Good for obese patient or tumor near neurovascular structure	Small sample size Need expert pathologist
Core needle	Small tissue core	Cost effective More tissue than fine-needle aspiration	More complications* than fine-needle aspiration
Incisional biopsy	Adequate sample of mass/lesion	Adequate tissue sample (gold standard)	Increased complications* May compromise definitive resection
Excisional biopsy	Entire lesion removed	Removes entire lesion Indicated for small lesion or expendable bone	Increased complications*

*Complications include infection, bleeding/hematoma, pathological fracture, tumor contamination/seeding.

Staging

- Enneking (MSTS) Staging System.

- The AJCC staging system for sarcomas.

- The Enneking surgical staging system (also known as the MSTS system) for **benign** musculoskeletal tumors based on radiographic characteristics of the tumor host margin.

- It is widely accepted and routinely used classification.

STAGING

- Staging of ***benign bone tumours*** as described by Enneking
- stages of benign tumors designated by Arabic numbers, and malignant tumors by Roman numerals
-

Latent	Well-defined margin. Grows slowly and then stops Remains static/heals spontaneously E.g. Osteoid osteoma
Active	Progressive growth limited by natural barriers Not self-limiting. Tendency to recur E.g. Aneurysmal bone cyst
Aggressive	Growth not limited by natural barriers (e.g. giant cell tumour)

- **Stage 1** -lesions are intracapsular,

  usually asymptomatic, and

  frequently incidental findings
- **Radiographic features** –

  well-defined margin with thick rim of reactive bone.

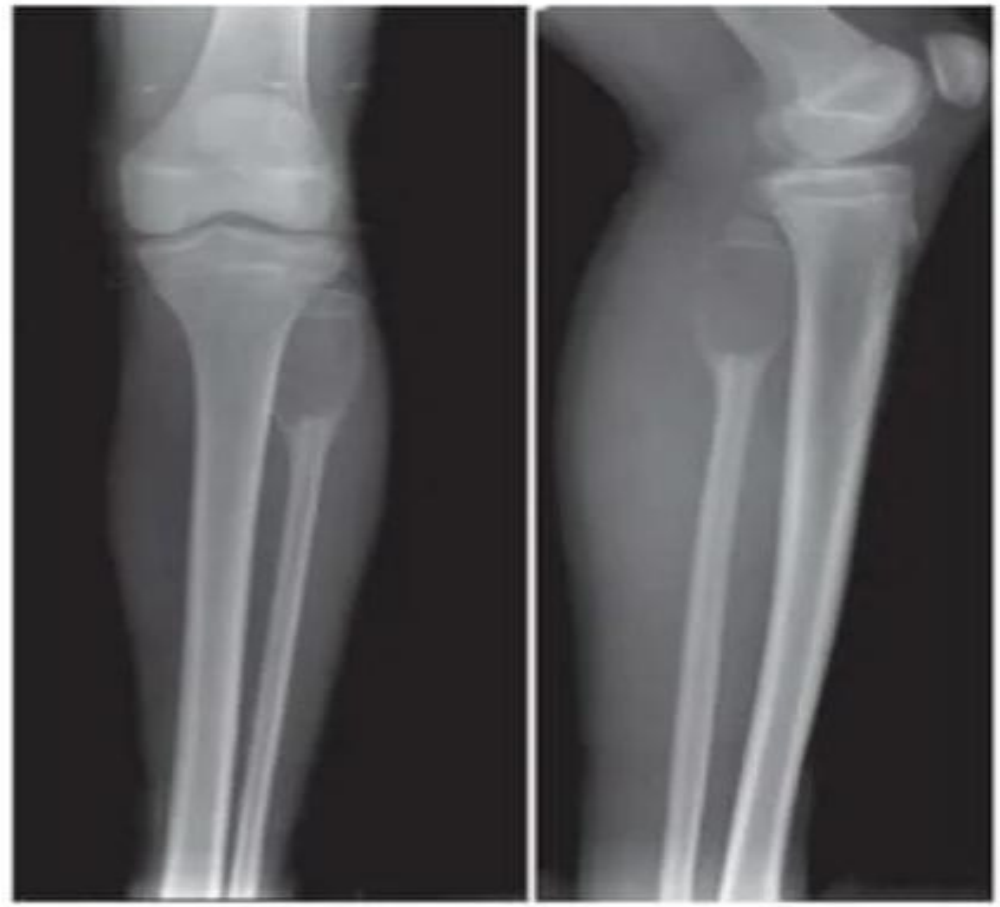
  no cortical destruction or expansion.
- **not require treatment** –

  not compromise the strength of the bone

  resolve spontaneously

URE 24-2 Stage 1 benign lesion: nonossifying fibroma
distal tibia.

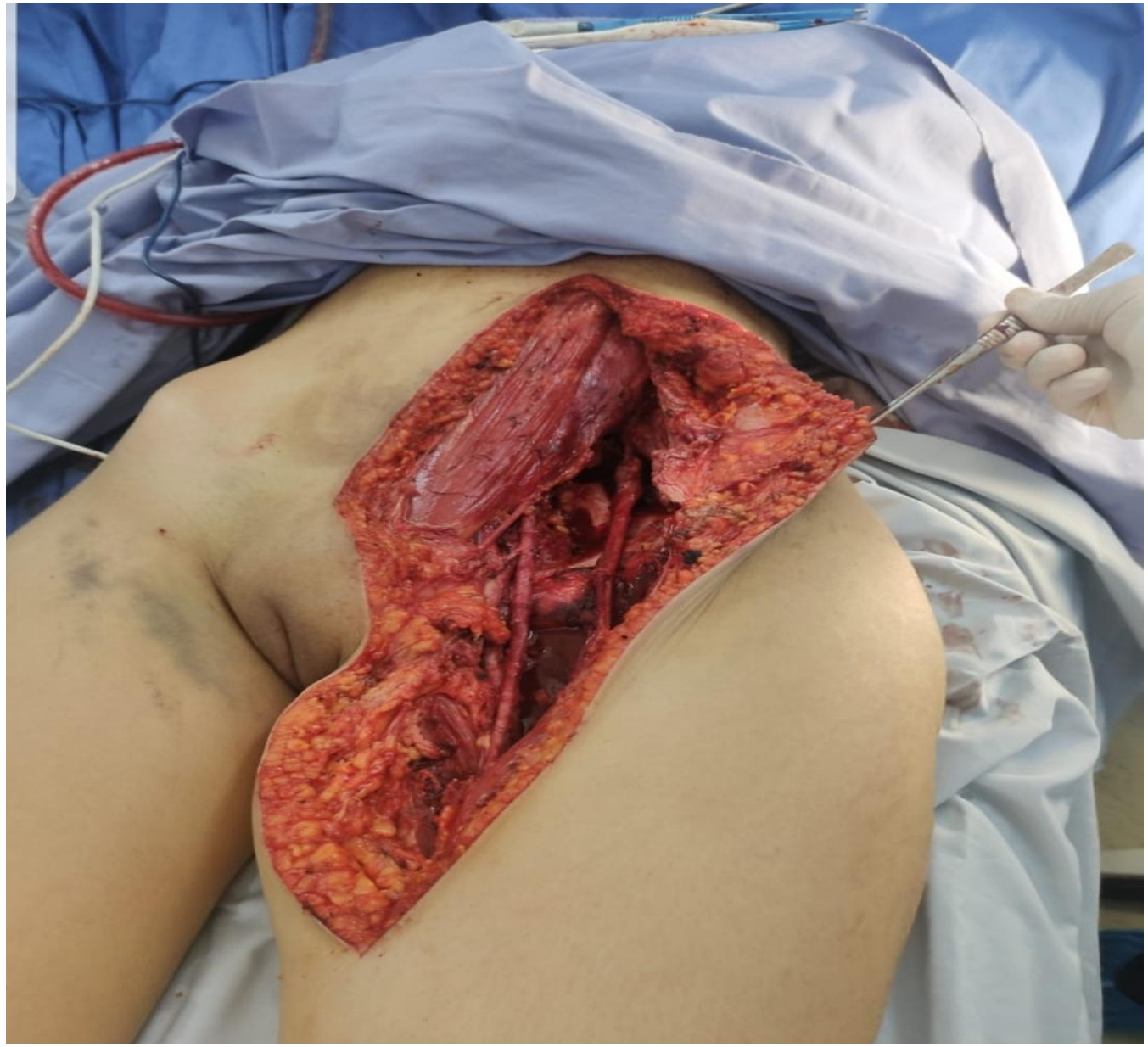
- **Stage 2-** intracapsular
  actively growing
  cause symptoms or pathological fracture
- **Radiographs**-well-defined margins
  expand and thin cortex.
  thin rim of reactive bone
- **Treatment** - extended curettage



URE 24-3 Stage 2 benign lesion: aneurysmal bone cyst proximal fibula.

- **Stage 3 –** extracapsular
  broken through reactive bone and cortex
- **MRI** shows soft tissue mass, and
  metastases may present in 5% of patients
- **Treatment** -extended curettage
  marginal or wide resection,
- local recurrences are common.

FIGURE 24-4 Stage 3 benign lesion: giant cell tumor of the distal femur.



- The Enneking surgical staging system (also known as the MSTS system) for **malignant** musculoskeletal tumors based on histological and radiographic characteristics of the tumor host margin.

Surgical stages as described by Enneking

Stage	Grade	Site	Metastases
IA	Low	Intracompartmental	No
IB	Low	Extracompartmental	No
IIA	High	Intracompartmental	No
IIB	High	Extracompartmental	No
IIIA	Low	Intra- or extracompartmental	Yes
IIIA	High	Intra- or extracompartmental	Yes

The AJCC staging system for soft tissue

- **The AJCC** staging soft tissue sarcomas based on
  - tumor grade (low or high),
  - size (≤5 cm or >5 cm in greatest dimension),
  - depth (superficial or deep to the fascia)

TABLE 24-2 American Joint Committee on Cancer System for Staging Soft Tissue Sarcomas

STAGE	GRADE	SIZE	DEPTH	METASTASES
I	Low	Any	Any	None
II	High	5 cm	Any	None
	High	>5 cm	Superficial	None
III	High	>5 cm	Deep	None
IV	Any	Any	Any	Regional or distant

The AJCC staging system for bone sarcomas

TABLE 24-3 American Joint Committee on Cancer System for Staging Bone Sarcomas

STAGE	GRADE	SIZE	METASTASES
I-A	Low	≤8 cm	None
I-B	Low	>8 cm	None
II-A	High	≤8 cm	None
II-B	High	>8 cm	None
III	Any	Any	Skip metastasis
IV-A	Any	Any	Pulmonary metastases
IV-B	Any	Any	Nonpulmonary metastases

Summary

- Intiatil evaluation and lab. test with investigations are very important steps before taking biopsy.
- Biopsy is the gold standard test for the diagnosis of bone and soft tissue tumors.
- The tumor is staged based on Enneking system for benign and malignant bone tumors.
- MDT with musculoskeletal radiologist ,medical oncologist ,histopathologist for diagnosis ,treatment and surgical planning.

Thank You