

Pediatric Bone Tumor: Lumps, Bumps & Holes in Bone

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Disclosure



I have no relevant financial or nonfinancial relationships to disclose.



Question 1

What are the 3 characteristics used to evaluate a bony lesion on x-ray?

- a. Location, soft-tissue envelope, cortices
- b. Location, presence of pathologic fracture, fallen leaf sign
- c. Location, Margin, Density
- d. Location, Density, soft-tissue envelope



Question 2

What are two of the most common musculoskeletal tumors in children?

- a. Osteosarcoma, Ewing's sarcoma
- b. Hemangiomas, lymphangiomas
- c. Osteosarcoma, Unicameral bone cyst
- d. Osteochondroma, Fibrocorticle Defect (FCD)/Nonossifying fibroma (NOF)



Question 3

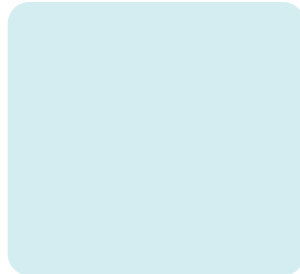
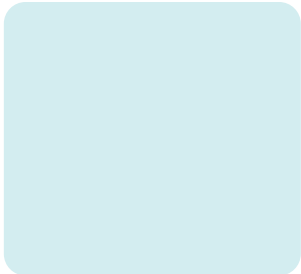
What is the most appropriate description of this lesion?

- a. Diaphyseal, lucent, scalloped sclerotic margins.
- b. Metadiaphyseal, eccentric, scalloped sclerotic margins.
- c. Metadiaphyseal, eccentric, expansile, cystic
- d. Metaphyseal, osteogenic, destructive.





Pediatric Bone Tumor: Stats



Incidence

“Unusual, Not Rare”

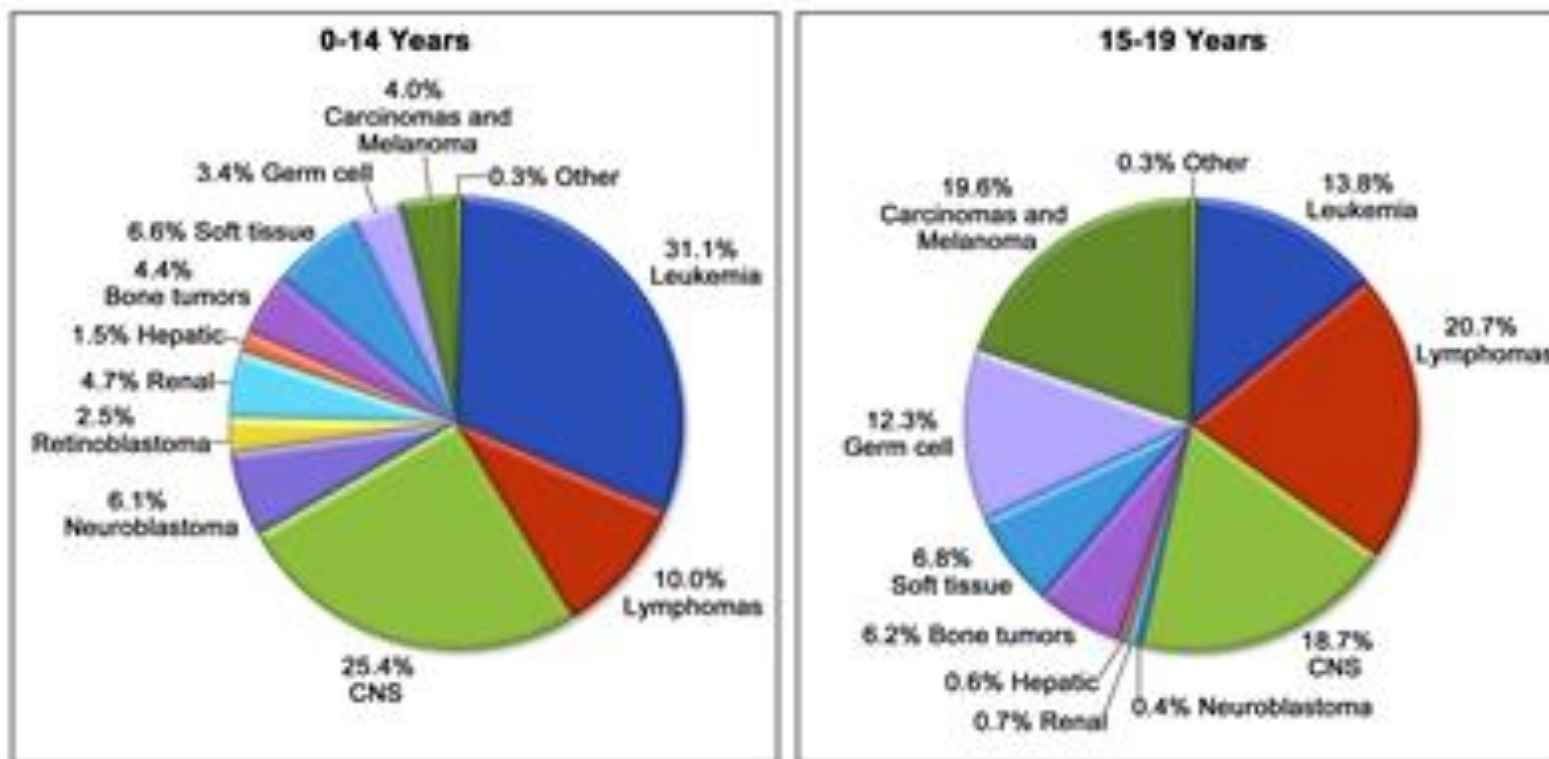
-Dr. Chappie Conrad

- Malignancies/year = 2000-3000
- Benign = est. 20,000-30,000



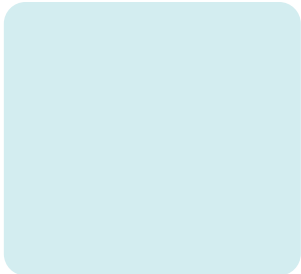
Distribution of Pediatric Malignancies

Age-Adjusted and Age-Specific Cancer Incidence Rates for Patients 0-19 Years of Age (SEER 2005-2009)





Evaluation



Evaluation

Age



History



Exam



Imaging



Age

Less than 10yo:

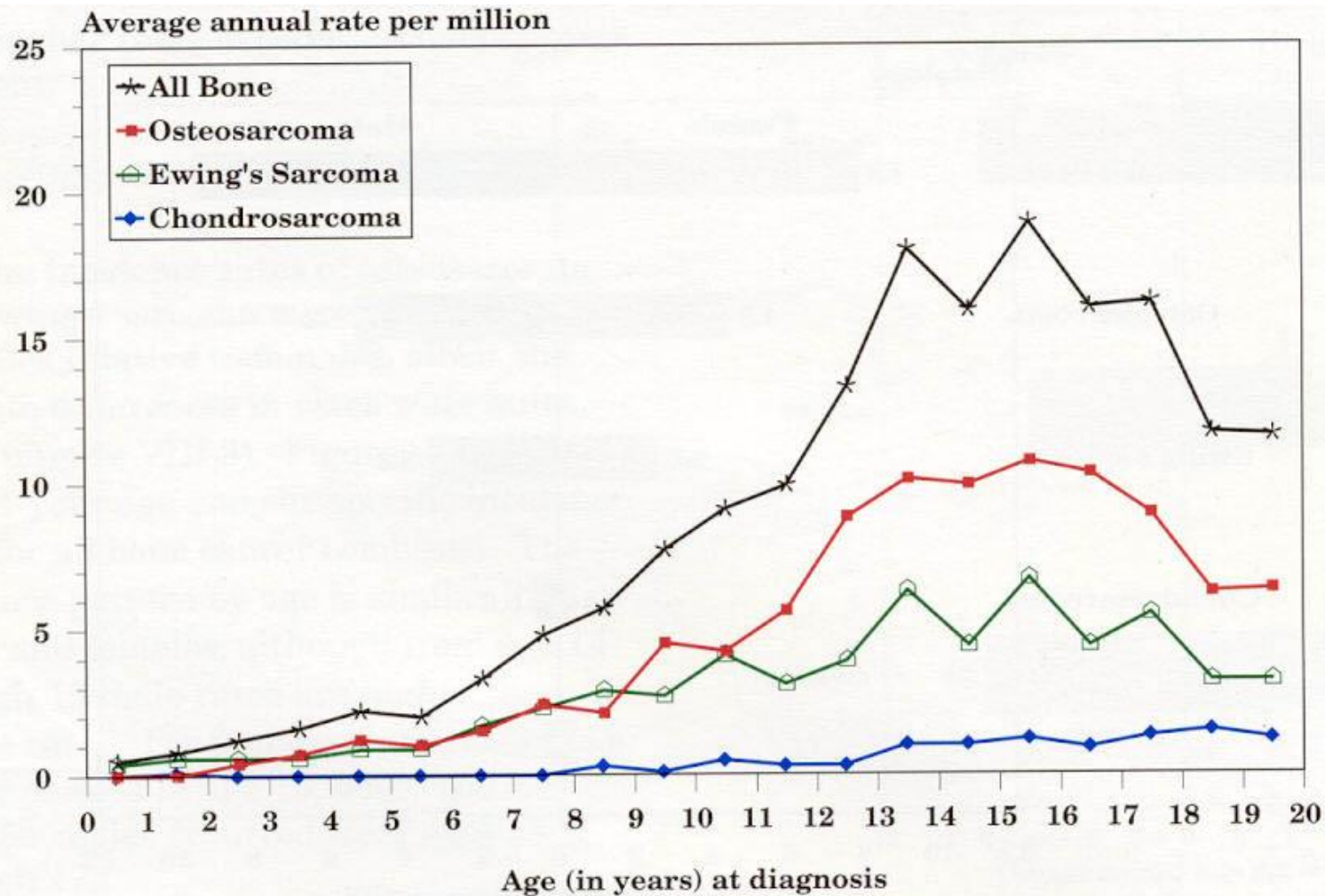
- greater risk for benign tumor or infection (still at risk for malignancy)
- < 5 likely infection or eosinophilic granuloma (aka Langerhans Cell Histiocytosis)

Greater than 10yo:

- Osteosarcoma peak age of 14yo
- Ewing's sarcoma peak age of 12yo



Age cont...



History

Mass?

- How long a mass has been present is difficult to determine

Pain?

- More reliable indicator for onset of tumor
- Night pain:
 - Both malignant and benign tumor
 - Be **VERY** worried about night pain in adolescents



Exam

- **Asymmetry?**
- **Deformity?**
- **Swelling?**
- **Masses?**

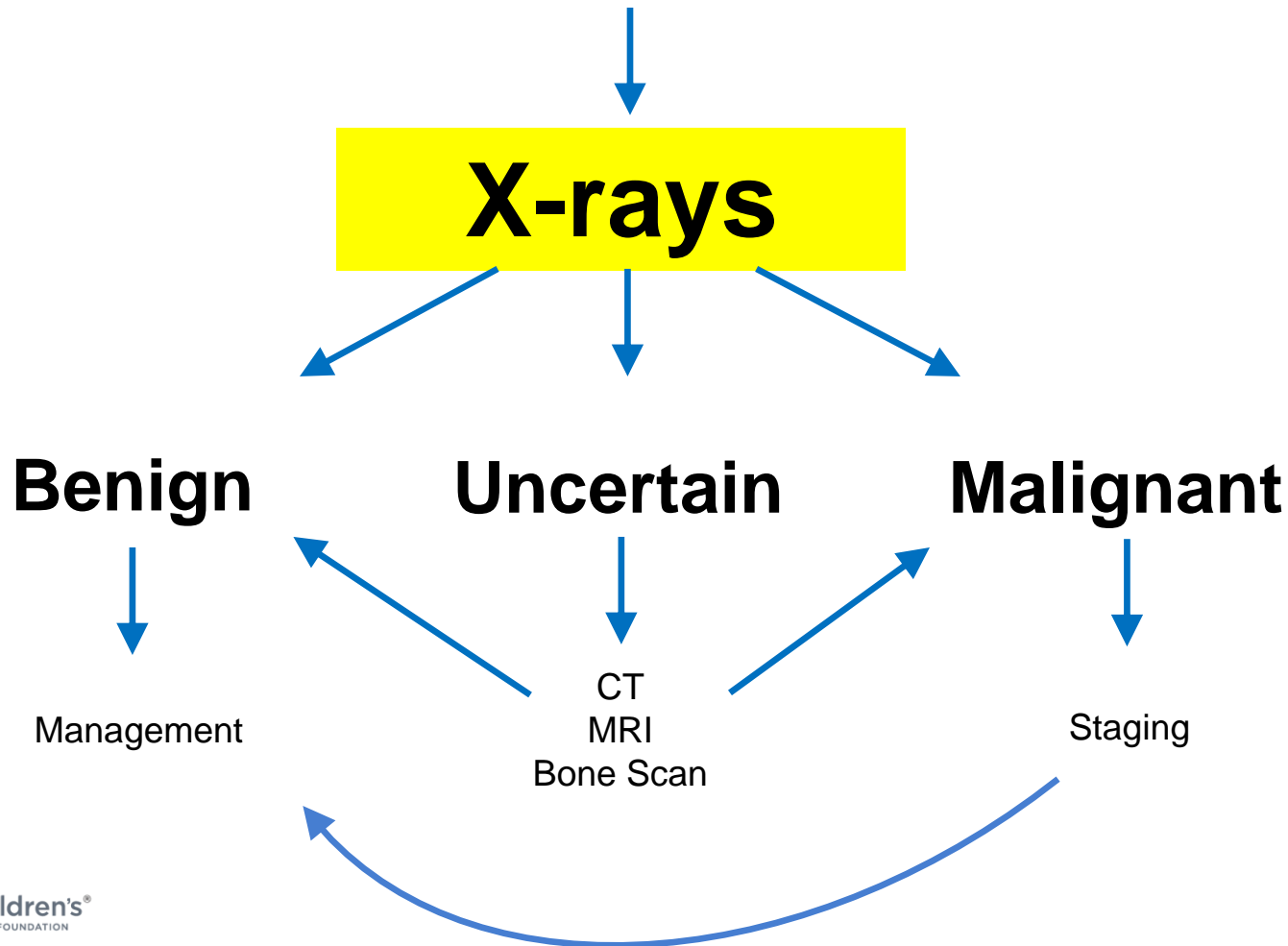
Malignant tumors:

- Usually firm
- Nontender
- Inflammation?



Primary Bone Tumor

(If it hurts and is unilateral, for Gods sake get an x-ray)

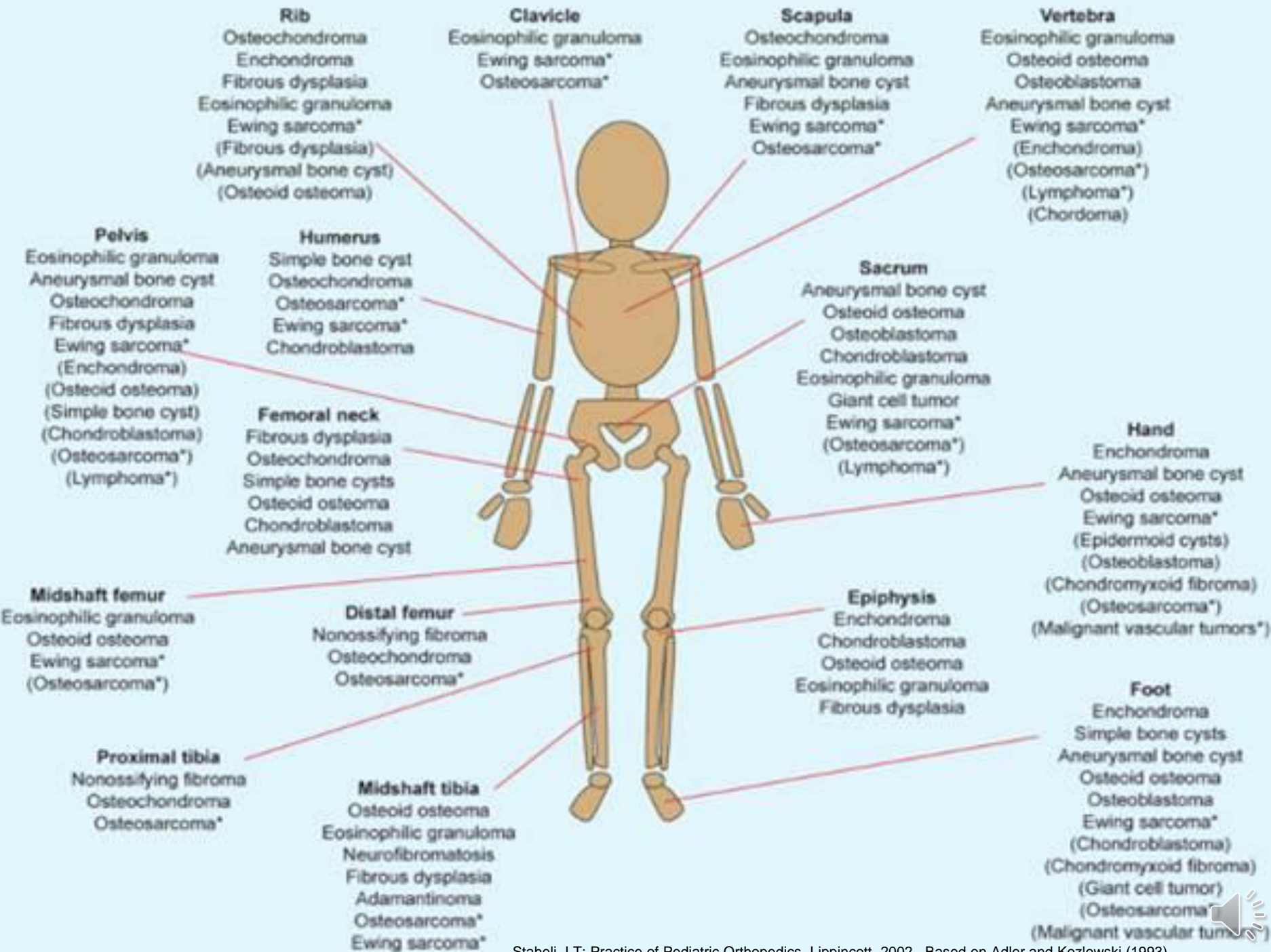


X-ray Characteristics = “LMD”

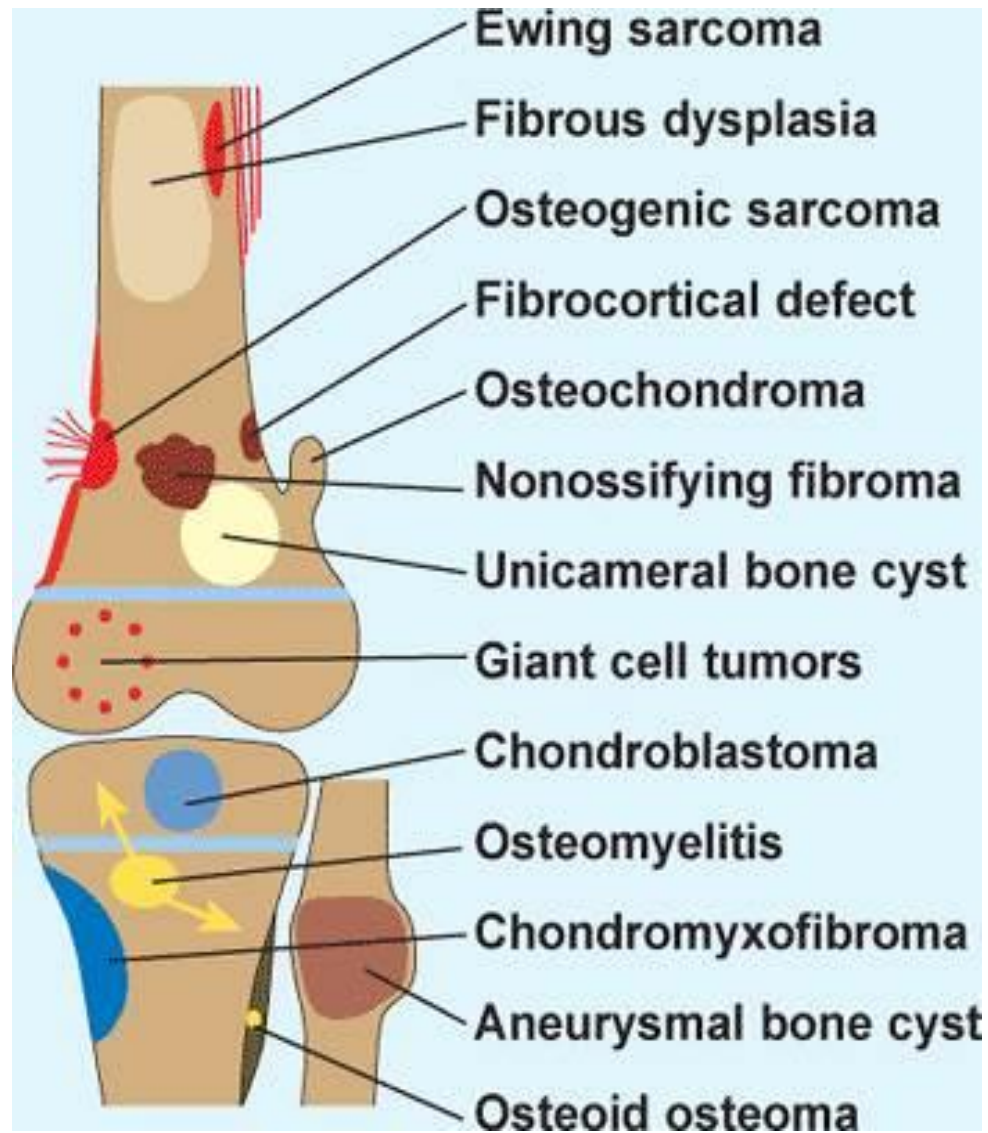
LMD

1. **Location** – Tumors like certain bones and locations within the bone
2. **Margin** - the interaction of the tumor and surrounding bone
3. **Density** - what does the center look like (lucent, empty, calcified, osteoblastic)



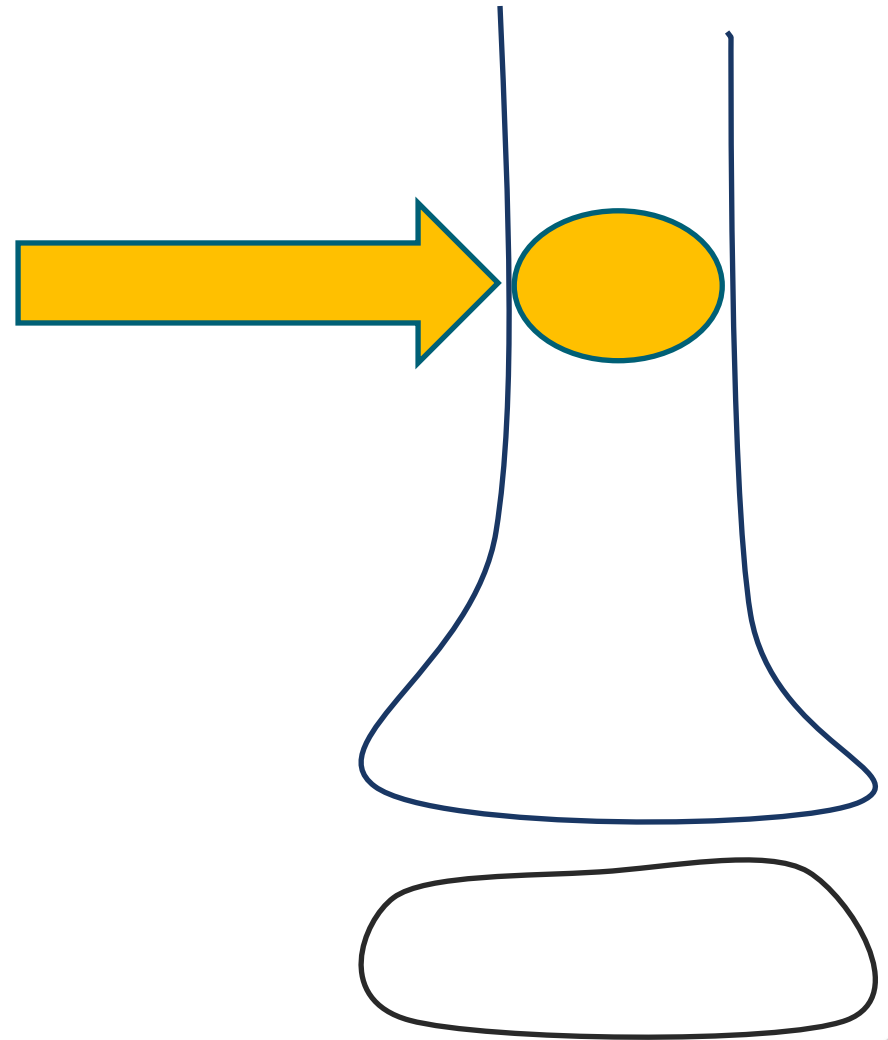


Location, location, location...



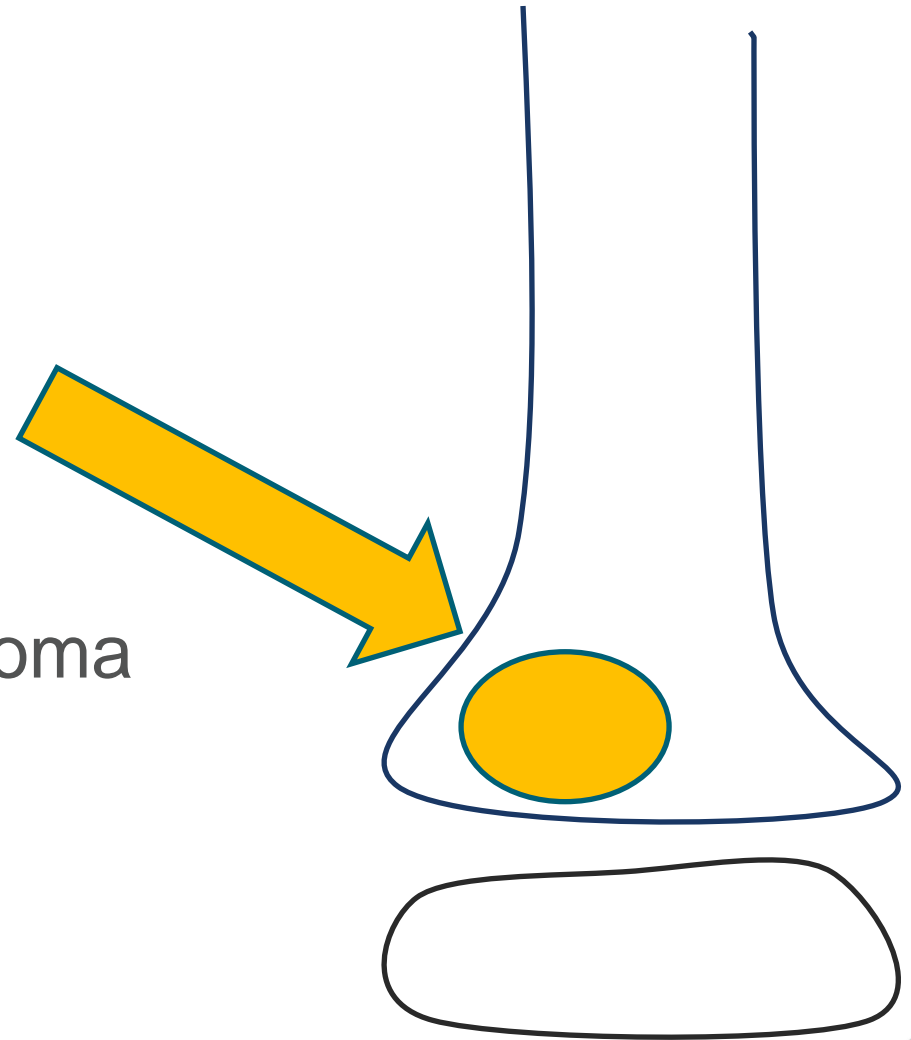
Location: Diaphysis

- F** Fibrous Dysplasia
- E** Ewings Sarcoma
- A** Adamantinoma
- L** Lymphoma
- U** UBC
- O** Osteoid Osteoma
- H** Hystiocytosis



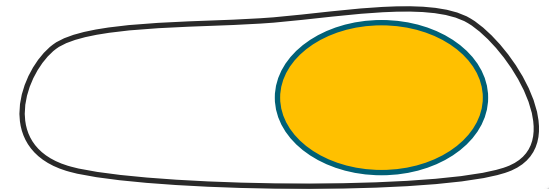
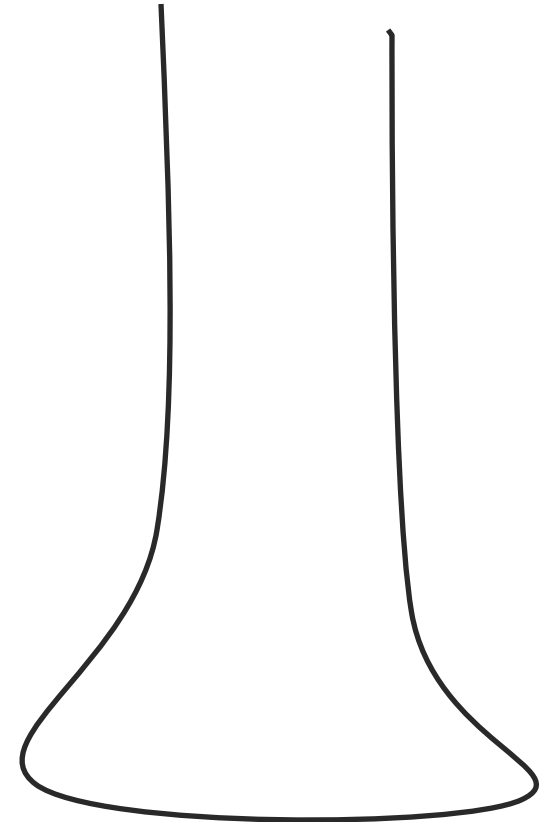
Location: Metaphysis

- O** Osteosarcoma
- N** NOF
- O** Osteochondroma
- U** UBC
- A** ABC
- E** Enchondroma
- O** OsteoidOsteoma/blastoma
- C** Chondromyxofibroma



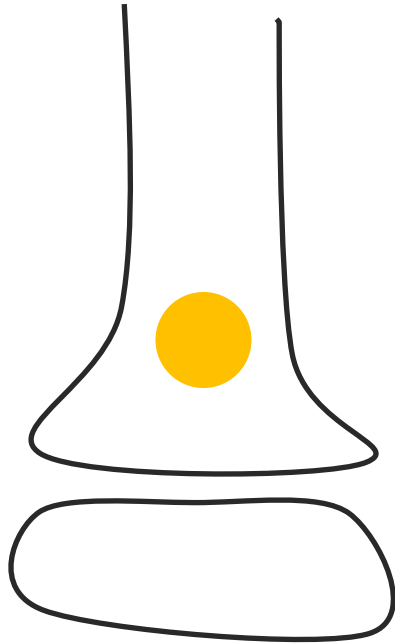
Location: Epiphysis

- G** Giant Cell Tumor
- O** Osteomyelitis
- D** Dysplasia Epiphysialis Hemimelica
- C** Chondroblastoma



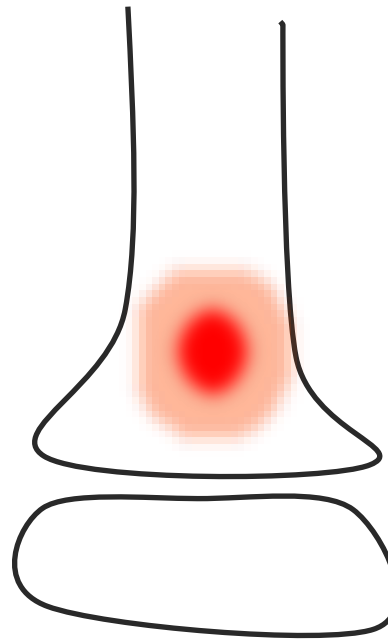
Margin

Effects of lesion on bone:



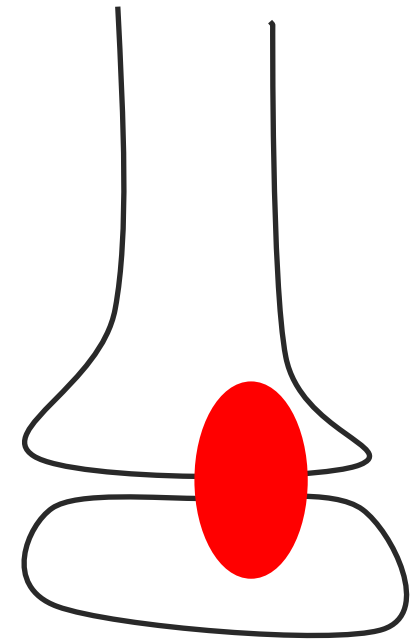
Punched Out Margins

Eosinophilic Granuloma
Bone Cyst



Destructive

Poorly defined margins
Malignant tumor
Infection



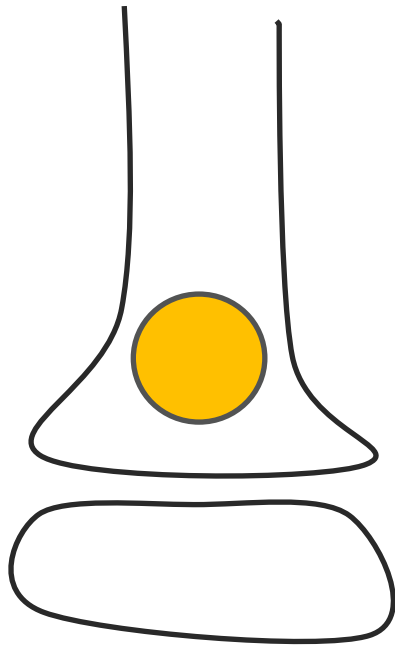
Aggressive

Crosses physis
Malignant tumor
Infection



Margin

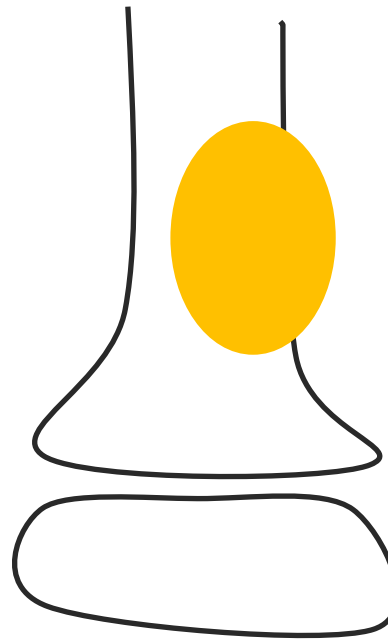
Effects of lesion on bone:



Sclerotic Margins

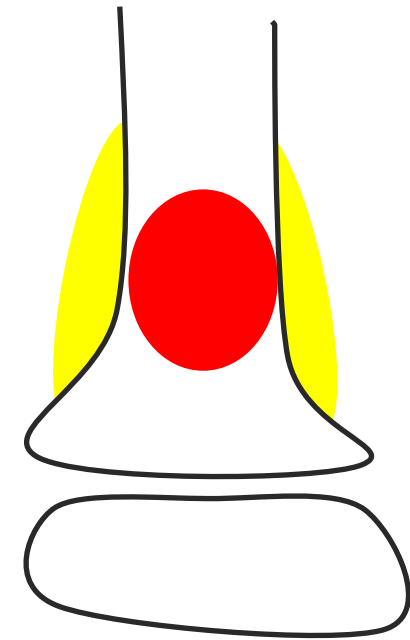
NOF

Eosinophilic granuloma



Expansile

Aneurysmal bone cyst



Reactive Bone

Varied diagnoses

Osteogenic sarcoma
Eosinophilic granuloma

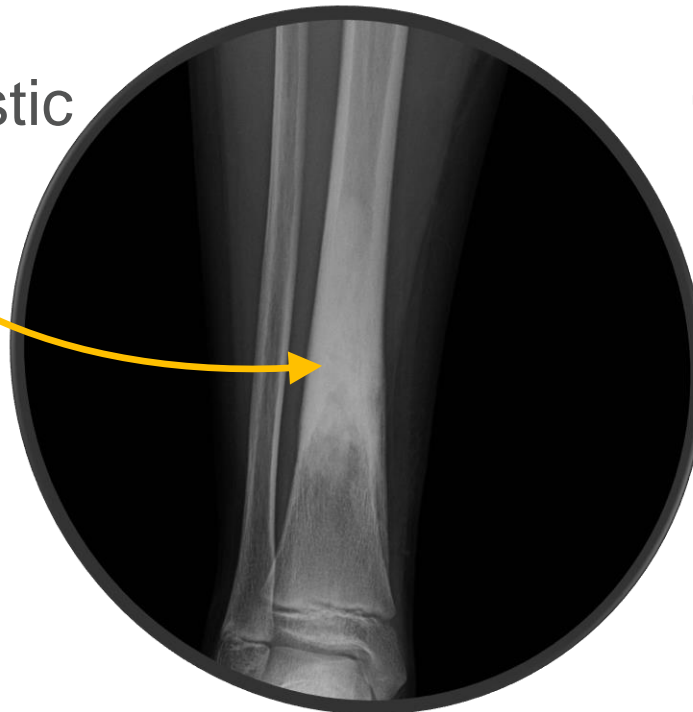
Infection



Density

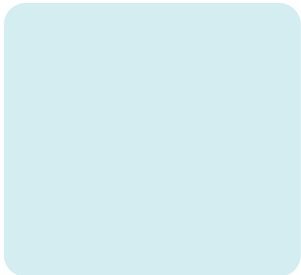


- Lucent
- Lytic
- Empty
- Calcified
- Osteoblastic





Practice Round



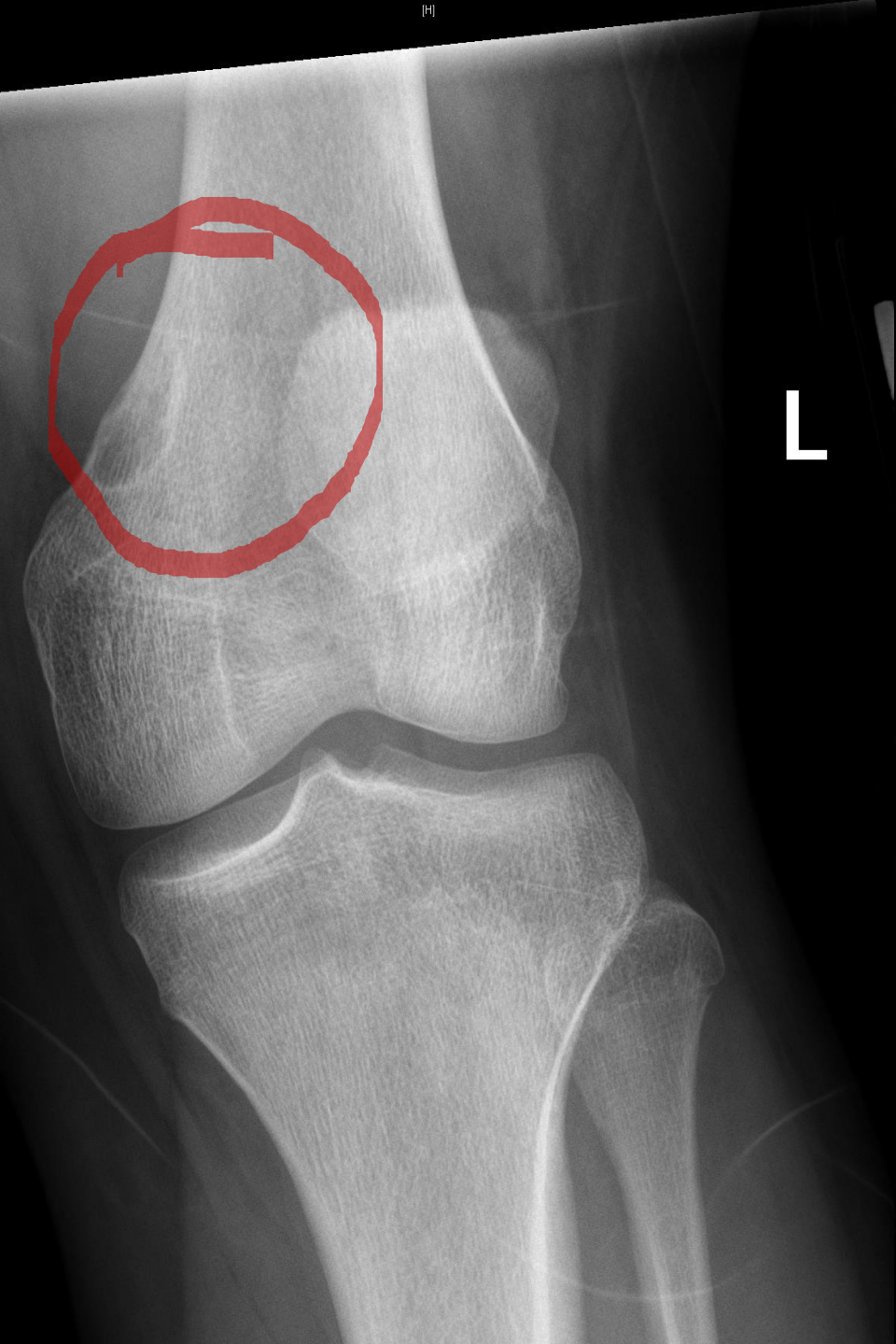
Case 1

HPI: 17yo boy with left anterior knee pain after a fall while playing floor hockey

Exam: Pain over anterior tibia, full ROM, no swelling.

X-ray:





Case 1

Location

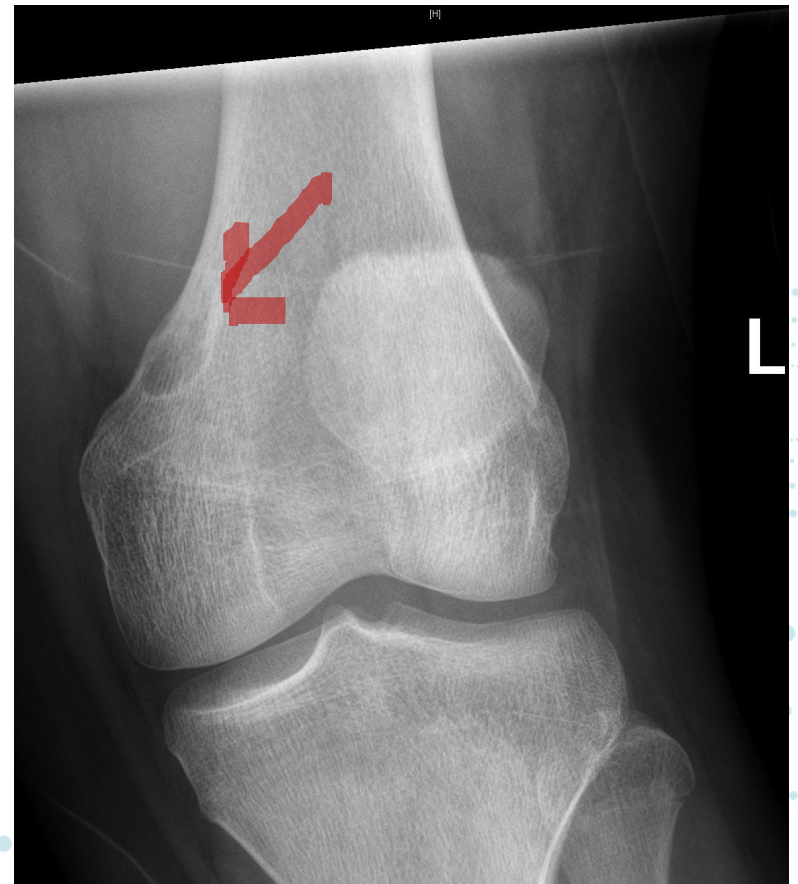
- Femoral Metaphysis
- (Not tender!)

Margin

- Well defined
- Sclerotic Margin

Density

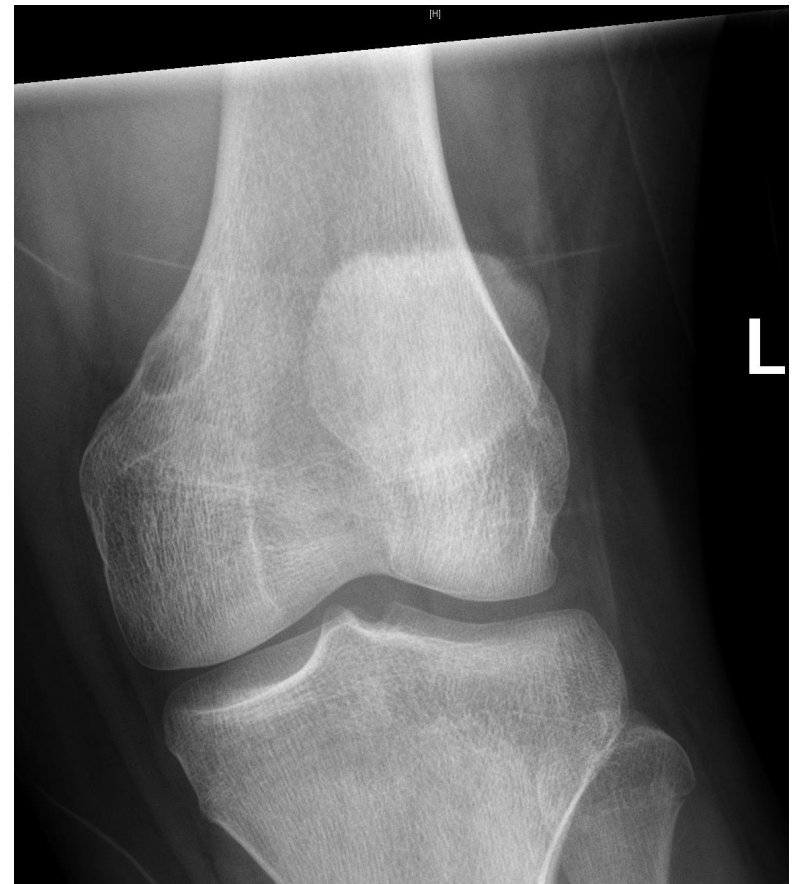
- Lucent with filling in of the superior aspect of the lesion



Fibrocartilagenous Defect (FCD)

FCD

- Most common bone tumor
- Metaphyseal, eccentric with scalloped sclerotic margins
- <3 cm
- Found incidentally
- At the insertion of a tendon or ligament
- Resolve in 1-2 years



Initial X-ray



L

2 Years Later



Case 2

HPI: 17yo girl with achilles pain for 3 weeks. She is a cross-country runner and currently running 25-30 miles/week.

Exam: Pain through achilles tendon.

X-ray:





L

Not for diagnostic use

ZF



Case 2

Location

- Tibia Metadiaphysis

Margin

- Well defined
- Eccentric with scalloped sclerotic margins

Density

- Mixed lucent and sclerotic



Nonossifying Fibroma (NOF)

NOF

- The “Big Brother” of FCD
- Metaphyseal, eccentric with scalloped sclerotic margins
- >3 cm
- **NOF = FRACTURE RISK!**
- Follow!



GUTIERREZ, ALE
Study Date: 12
Study Time: 1:
MRN

2014



WEIGH

2017



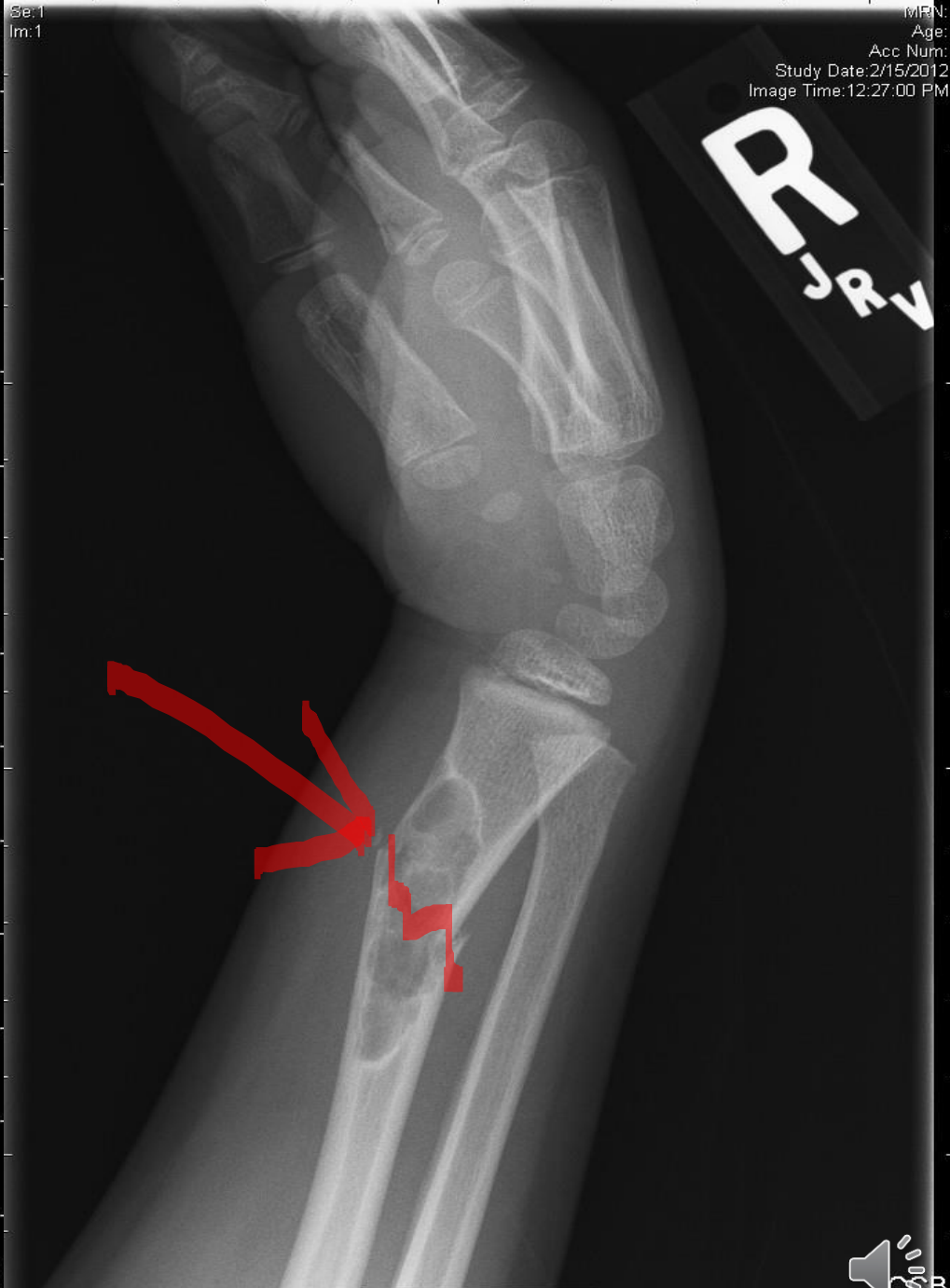
Case 3

HPI: 9yo boy FOOSH, right UE, pain and deformity

Exam: Swelling, pain and deformity of right UE

X-ray:





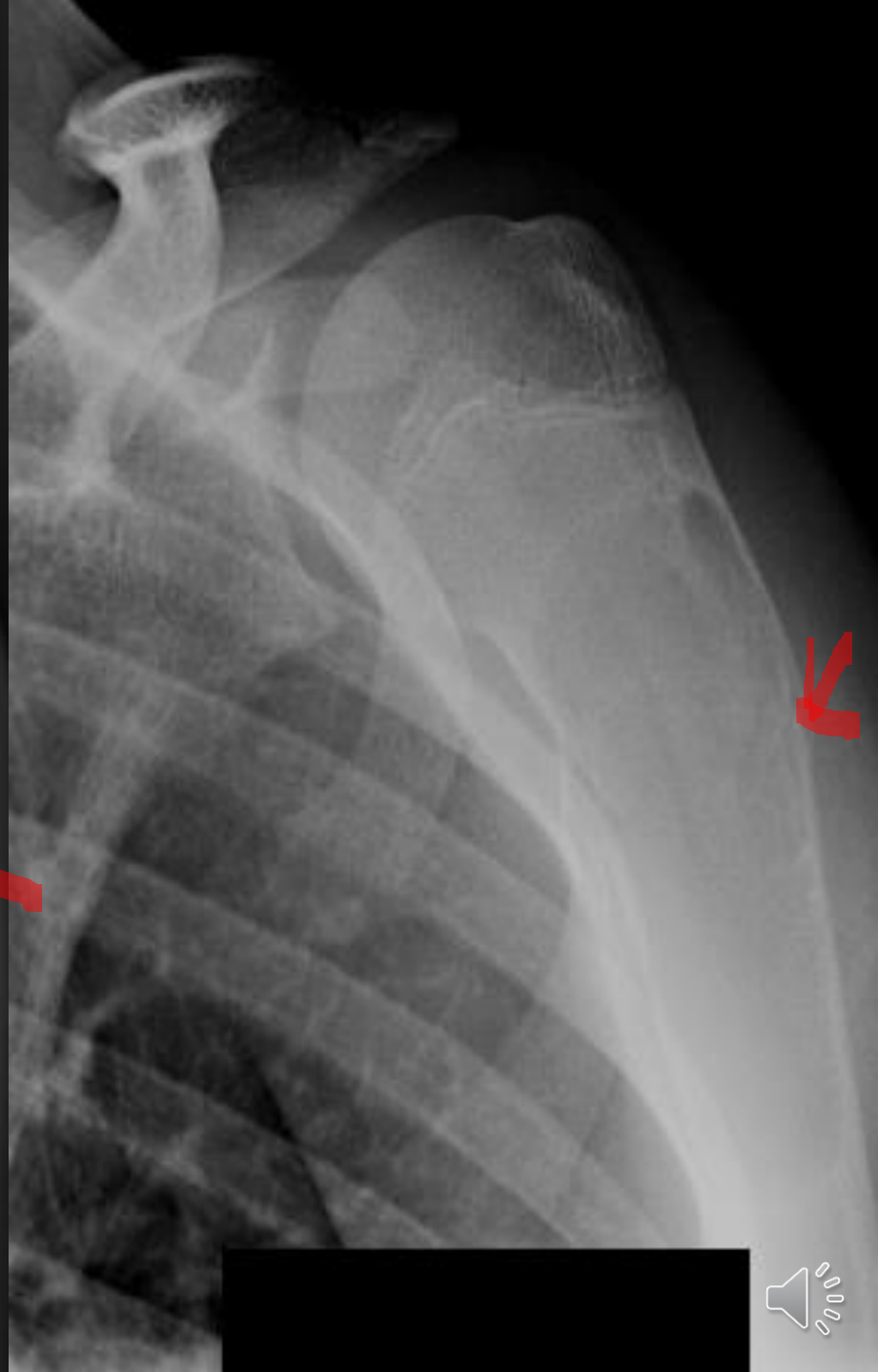
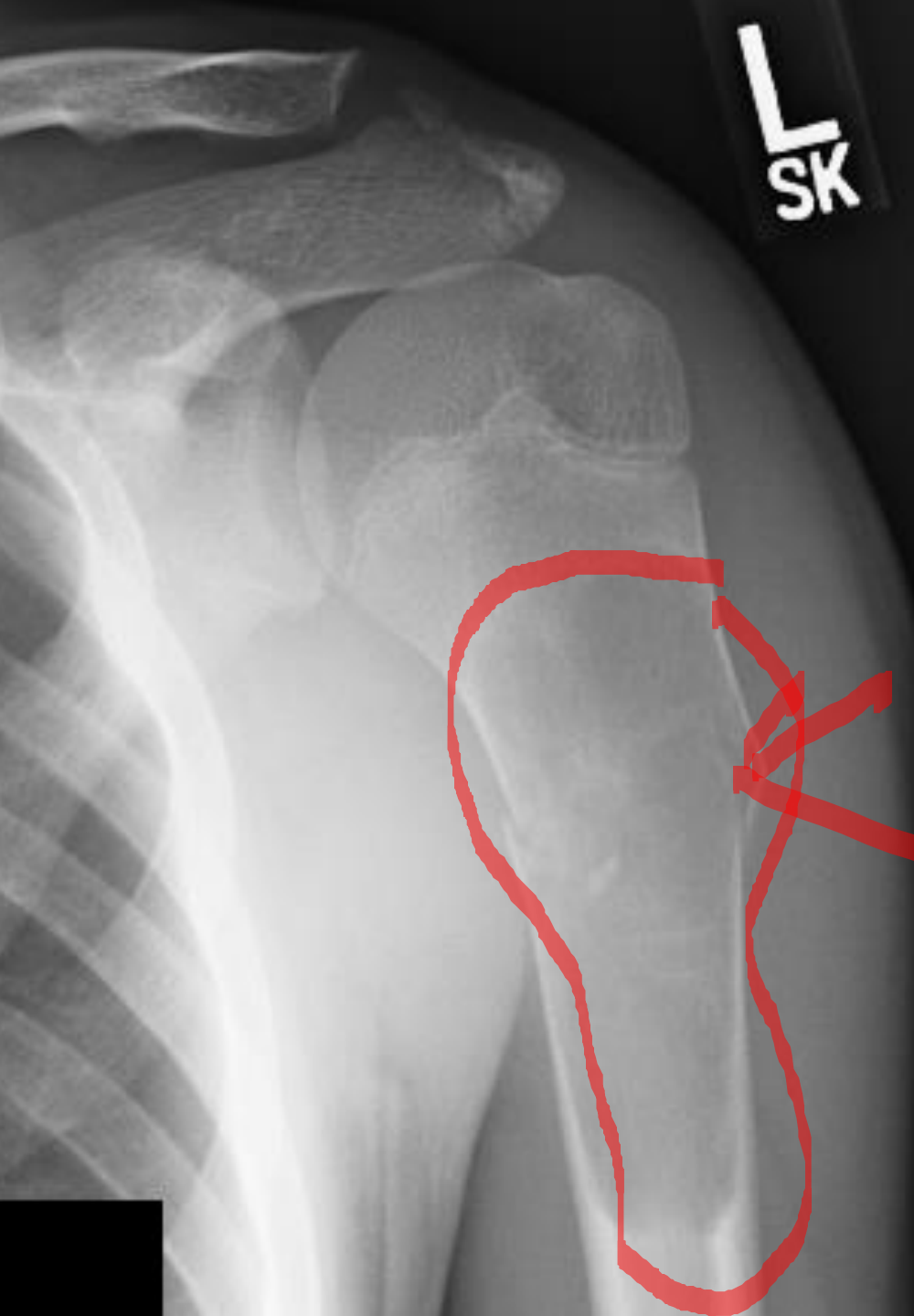
Case 4

HPI: 15yo boy FOOSH while playing basketball. Pain in left shoulder.

Exam: Significant pain and refusal to move L arm. Neuro intact.

X-ray:





Case 4

Location

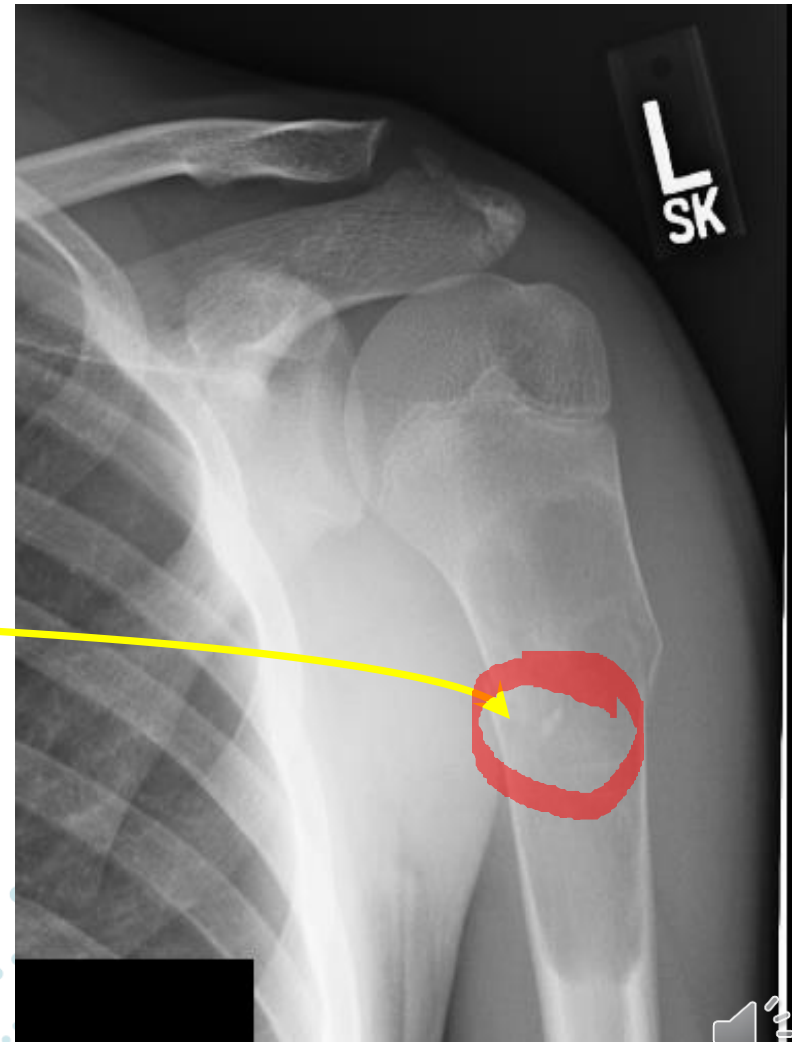
- Proximal Humeral Metaphysis

Margin

- Well defined, no reactive bone, fracture

Density

- Cystic, irregular septa, “fallen leaf sign”



Unicameral Bone Cyst (UBC)

UBC

- AKA Simple or Solitary Cysts
- Metaphyseal, well-defined margin, cystic with irregular septa
- Fallen Leaf Sign
- Proximal Humerus, Femur, Calcaneus
- Fracture usually presenting complaint

- Management:
 - Humerus – treat fracture, curettage and injection debatable
 - Femur – curettage and IM fixation



Initial

L
SK



One year later...



Case 5

HPI: 14yo girl with 6 mo of knee pain. Now with intermittent swelling and inability to return to volleyball.

Exam: Antalgic gait, pain along posterior and medial distal femur. No swelling.

X-ray:



6 months ago



WT BEARING



Today



L
JKP



Case 5

Location

- Distal Femur Metaphysis

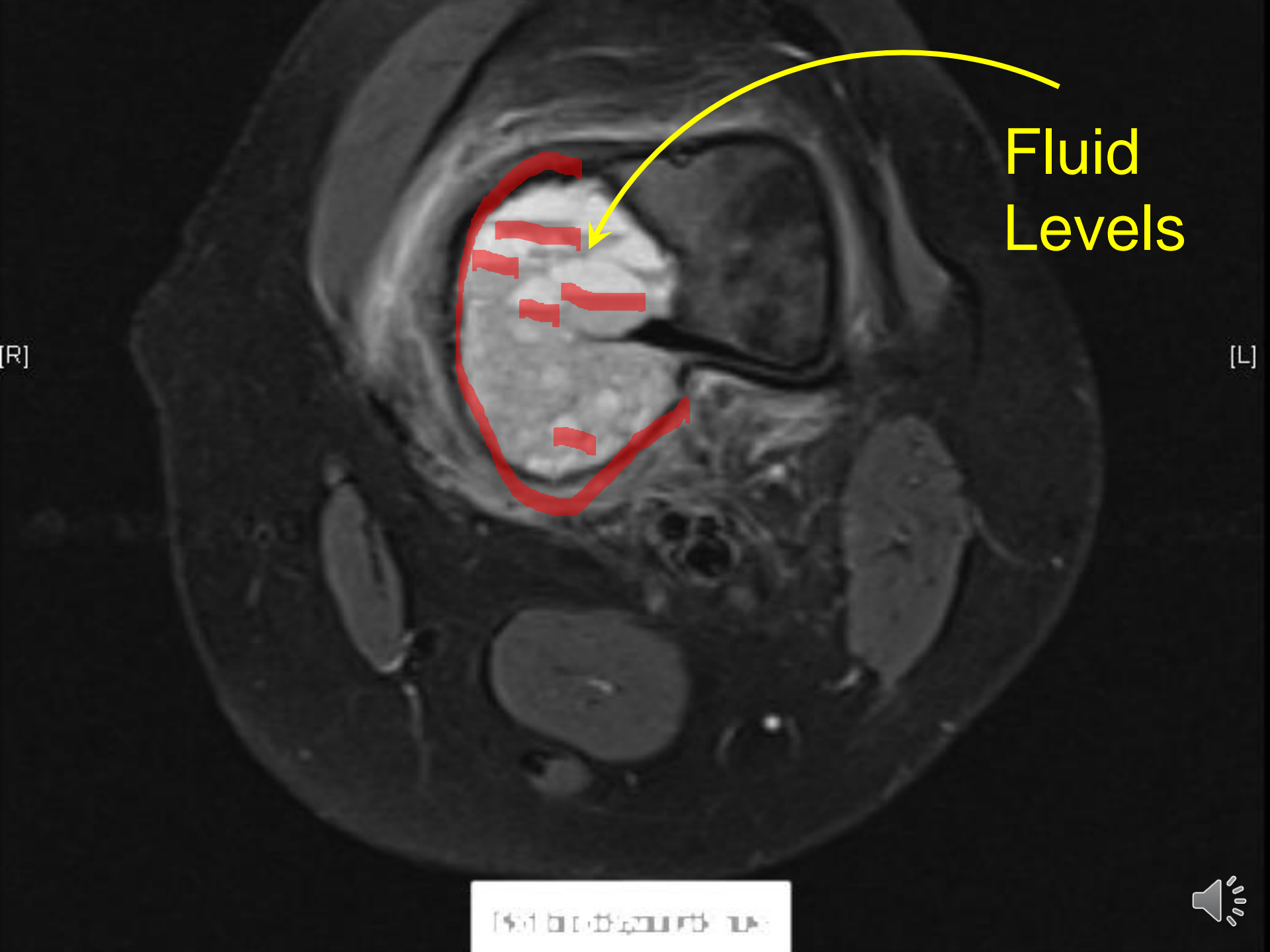
Margin

- Expansile, erosive, poorly defined with breakthrough of medial cortices, periosteal reaction

Density

- Lytic





Fluid
Levels

[R]

[L]

19:01 | 100% | 100%



Aneurysmal Bone Cyst (ABC)

ABC

- Metaphysis, expansile, eccentric
- Fluid/fluid levels on MRI
- Inactive, active and aggressive
- Biopsy (rule out Telangiectatic Osteosarcoma)



Case 6

HPI: 16 yo boy recently noticed bump over lateral thigh.
No pain.

Exam: Palpable, firm, non mobile mass in the distal femur

X-ray:





L
SKT



Case 6

Location

- Metaphyseal

Margin

- Cortices continuous with femur
- Pedunculated (on a stalk)

Density

- Continuous with femur



Osteochondroma

Osteochondroma (Exostosis)

- LMD: Metaphyseal, pedunculated or sessile (attached at base without stalk), cortical continuity
- Cartilage cap
- Point away from joint
- Can cause deformity (ankles)
- Malignant transformation rare
- Multiple Osteochondromas



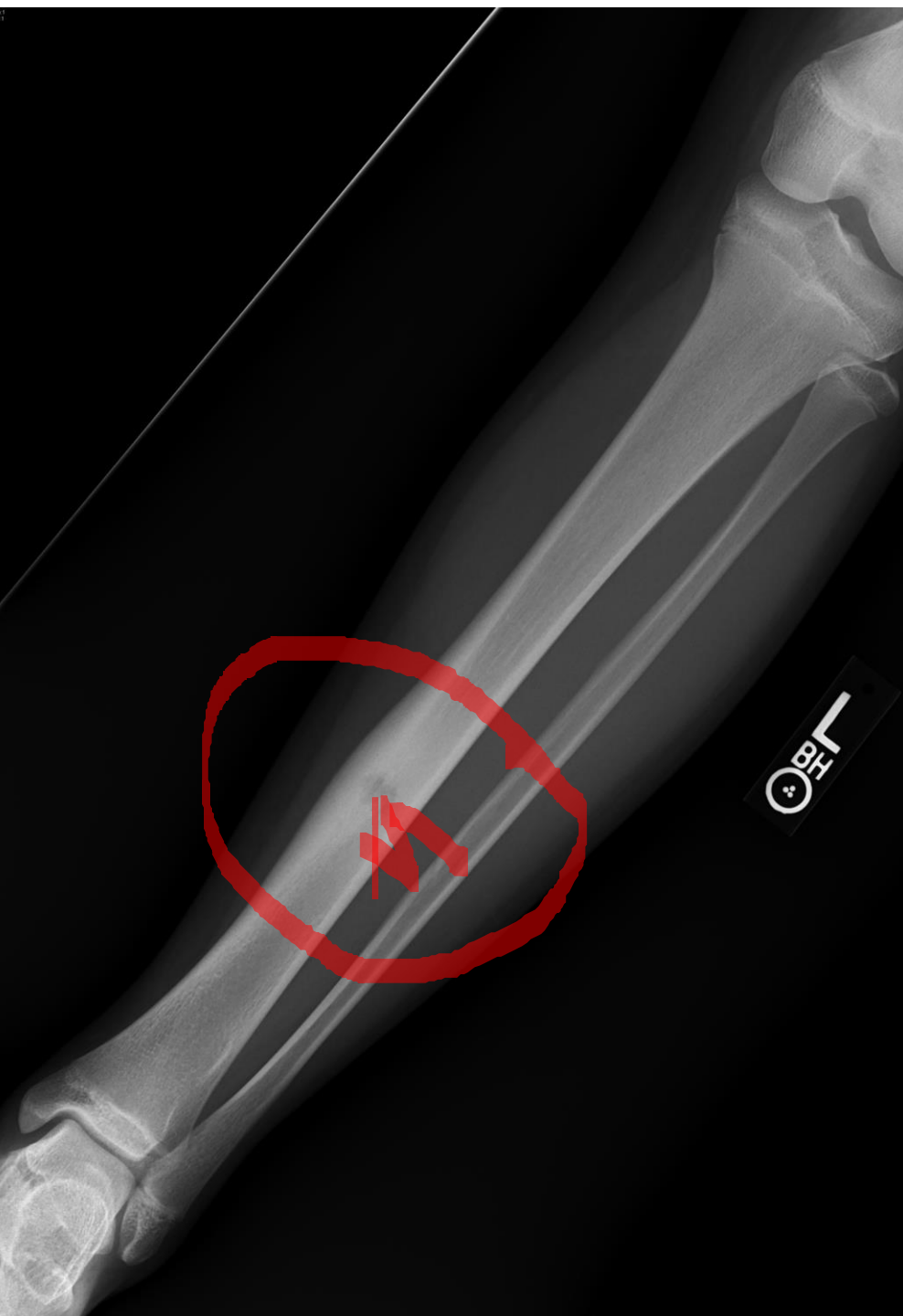
Case 7

HPI: 13 yo girl, tibia pain x 1 week with activity's and night waking. Pain resolved with NSAID use.

Exam: Painful over tibia shaft.

X-ray:





Case 7

Location

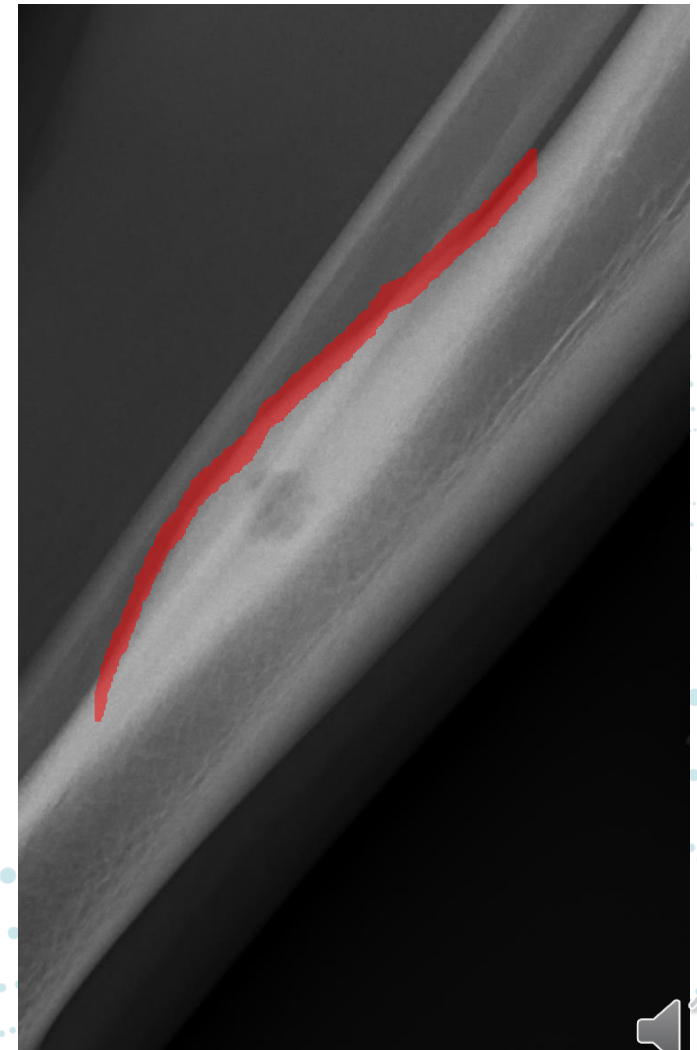
- Tibia Diaphysis

Margin

- Punched out central lucent lesion with well defined margins

Density

- Cortical thickening with lucent nidus



Osteoid Osteoma

Osteoid Osteoma

- LMD: Diaphyseal, radiolucent center (nidus)
- surrounded by reactive bone with definitive margins.
- Benign, bone-producing
- *Night pain*



Case 8

HPI: 14yo boy who fell playing football last month. Has had increasing leg pain since that time. Now waking from sleep and unable to ambulate due to pain.

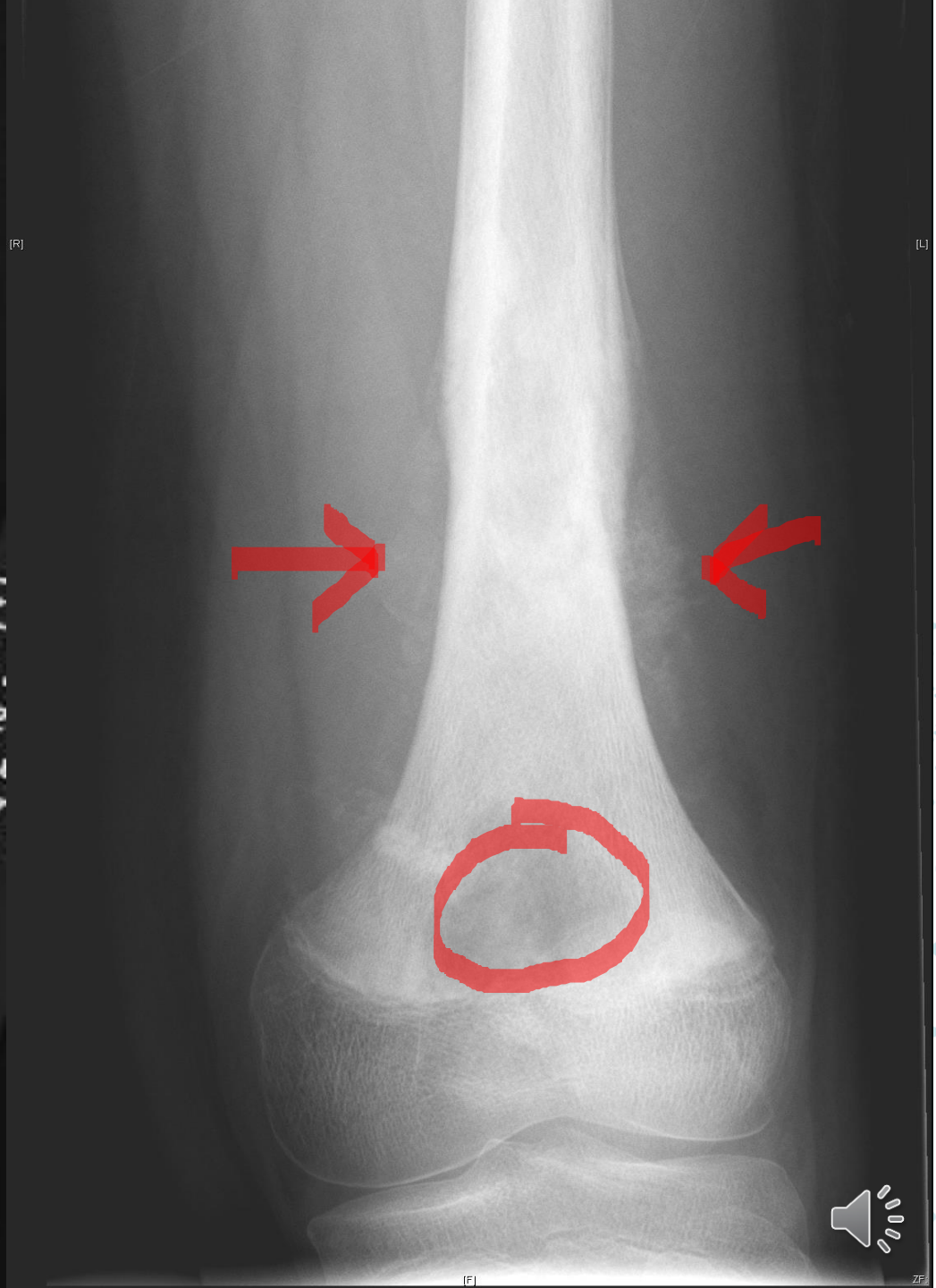
Exam: Tender, swollen and warm over distal femur

X-ray:





[R]



[L]

[F]

ZF

Case 8

Location

- Metadiaphyseal

Margin

- Undefined

Density

- Mixed osteoblastic and osteolytic with reactive bone



Osteosarcoma

Ostosarcoma

- LMD: Metaphyseal, osteolytic, osteogenic, “sun burst”
- Most common malignant tumor
- *Adolescent with night pain!*
 - 21%



Case 9

HPI: 16yo boy who fell playing football last month. Has had intermittent proximal tibial pain since that time. Diagnosed with “Osgood”. Pain persisted, x-rays negative as read by outside provider.

Exam: Antalgic gait, swelling laterally over proximal tibia.

X-ray:





Not for diagnostic use



Not for diagnostic use



Case 9

Location

- ?

Margin

- ?

Density

- ?



DELAYS

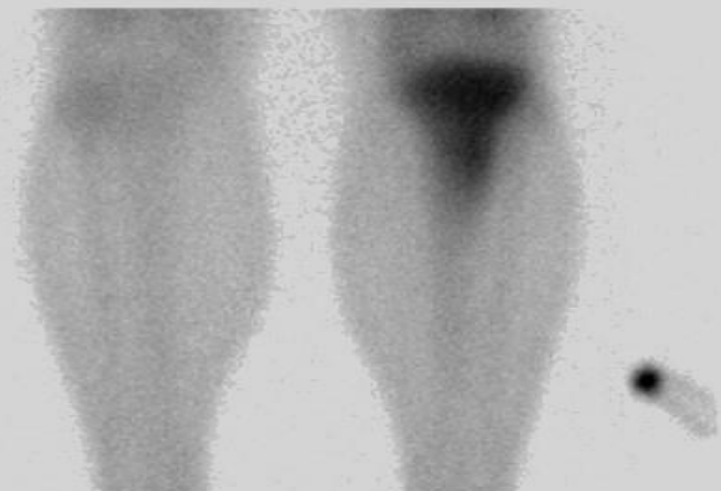
893 max
1214K



RT ANT LT

457 max
719K

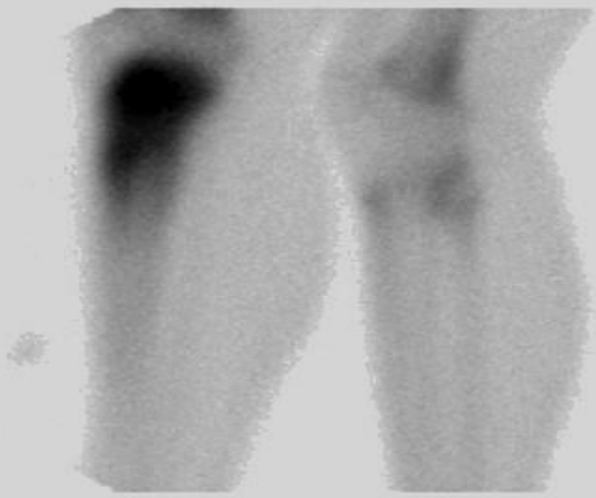
DELAYS



LT PST RT

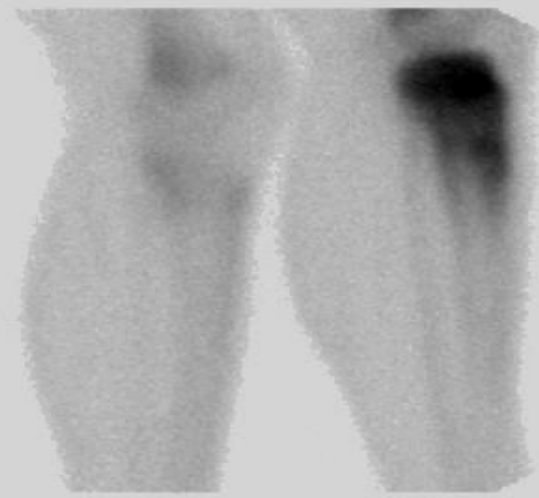
DELAYS

17 avg
709 max
1133K



DELAYS

14 avg
732 max
938K



Not for diagnostic use



[R]

[L]



Ewings Sarcoma

Ewings

- LMD: Usually diaphyseal, osteolytic
- Bone scan and MR
- Can cause fever, leukocytosis, anemia and elevated ESR



Lessons for Practice/Pearls

- Location, Margin, Density
 - What is the tumor doing to the bone
 - What is the bone doing to the tumor
 - Periosteal reaction?
- Benign tumors can cause significant pain and disability
- Night waking in adolescent should worry you
- Unilateral ALWAYS deserves an X-ray



Question 1

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- b. Location, presence of pathologic fracture, fallen leaf sign
- c. Location, Margin, Density
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Question 2

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Question 3

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- b. Metadiaphyseal, eccentric, scalloped sclerotic margins.
- c. Metadiaphyseal, eccentric, expansile, cystic
- d. Metaphyseal, osteogenic, destructive.



Bibliography

1. Staheli, LT: Practice of Pediatric Orthopedics, Lippincott, 2002.
2. Childhood cancer by the ICCC. In: Howlader N, Noone AM, Krapcho M, et al., eds.: SEER Cancer Statistics Review, 1975-2009 (Vintage 2009 Populations). Bethesda, Md: National Cancer Institute, 2012, Section 29. Also available online. Last accessed April 06, 2015





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