Bone and soft tissue tumors
Part one

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Cliniques universitaires
SAINT-LUC
UCL BRUSSELS

Objectives

1. Guidelines to analyze Bone Tumors.

2. Focus on leave-me-alone/no-touch bone lesions.

3. Concepts in imaging of Soft Tissue Tumors.

Bone and STT - Epidemiology – 2019 - USA

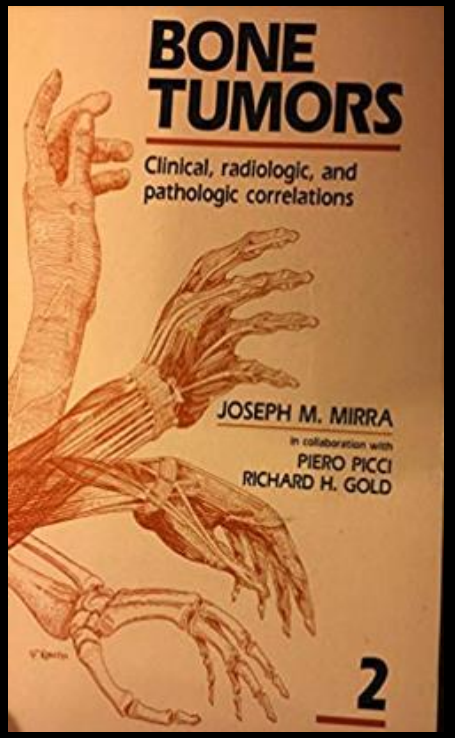
- All cancers: 1,762,450 new cases
- Bone sarcomas : 3500 new cases (0,2% / 30°)
- Soft tissue sarcomas : 12750 new cases (0,7% / 22°)

- Bone, and not soft tissue, is third most common site for metastases (after lung and liver)

Siegel RL et al CA Cancer J Clin 2019; 69:7-34

This lecture will not adress

- all bone tumors or tumor-like conditions
- Vertebral tumors and tumor-like conditions
- Histology, genetics
- Treatment options & monitoring
- Texture analysis, elastography, AI,…



By the end of this lecture, you should

- have a « structured » brain (if not yet).
- be familiar with common no-touch bone lesions.
- be able to propose and guide imaging strategies.

CASE 1: 16-year-old boy; increasing knee pain. Pain at night; limited knee flexion

CASE 2: 16-year-old girl with spontaneous anterior knee pain.

What are the similarities between case 1 and 2 ?

- 16-year old
- …..

What are the similarities between case 1 and 2 ?

- 16-year old
- Metaphyseal location

What are the differences between case 1 and 2 ?

Describe the lesions !

Describe the lesion !

Describe the lesion !

Describe the lesion !

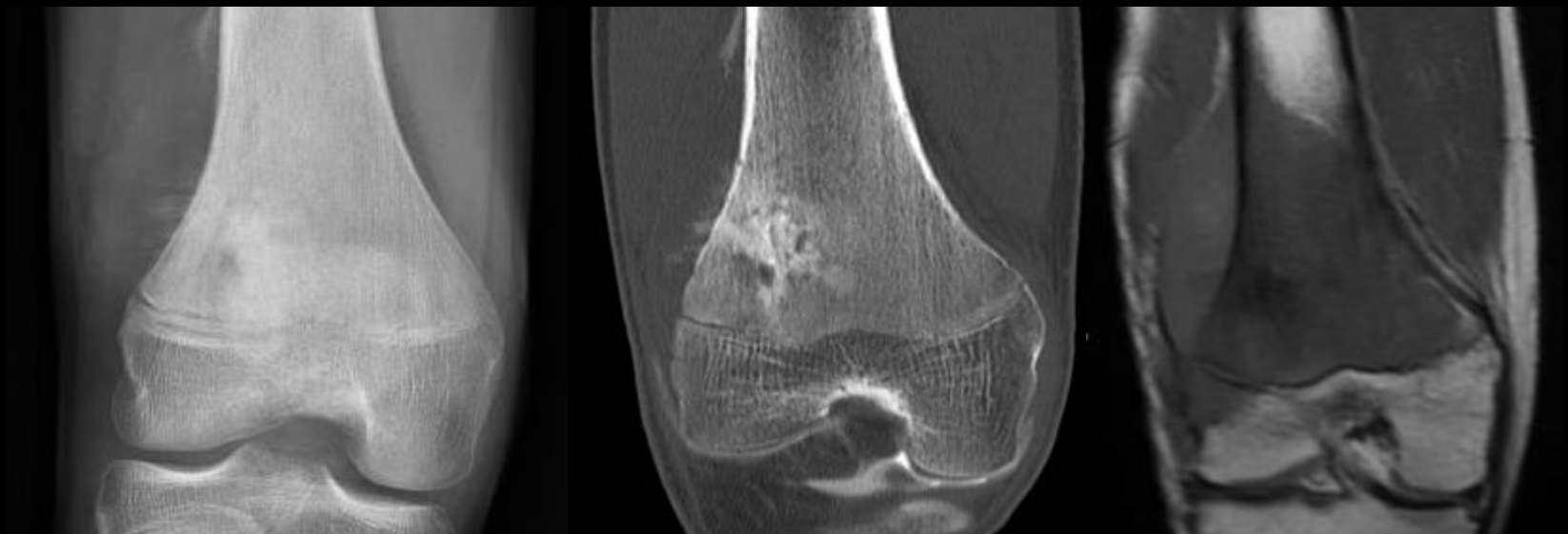
Describe the lesion !

Strengths of each imaging modality

- X-ray: ?
- CT : ?
- MRI: ?
- Bone scan/FDG-Pet : ?

Strengths of each imaging modality

- X-ray: first line imaging for lesion detection
- CT : characterization of lesion
- MRI: local extent (medullary cavity/soft tissue/joint)
- Bone scan/FDG-Pet : whole-body extent



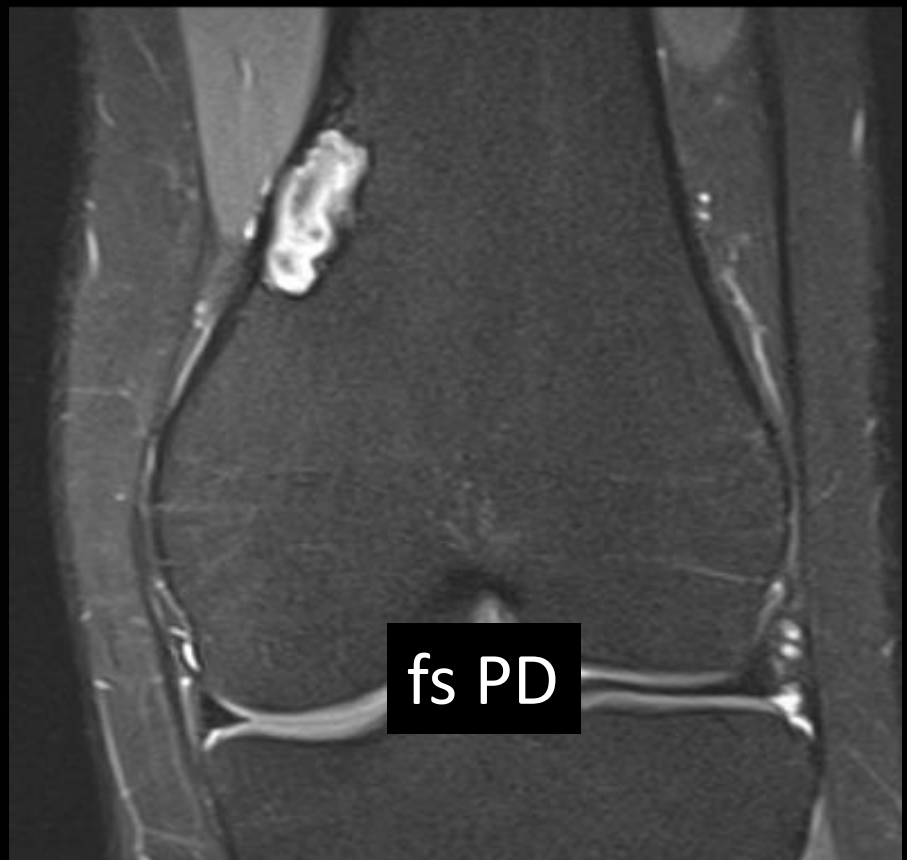
Osteosarcoma

Longitudinal imaging of involved bone
Skip metastases ?

CASE 2: 16-year-old girl with spontaneous anterior knee pain. Describe the lesion …..

CASE 2: Non-ossifying fibroma

- Cortical lytic and sclerotic lesion
- Longitudinal >>> transverse extent
- No periosteal reaction
- Normal adjacent soft tissues and marrow



Analysis of bone lesions

- Medullary, metaphyseal
- Ill-delimited
- Bone matrix
- Periosteal reaction

- Cortical,metaphyseal
- well-delimited
- No matrix
- No periosteal reaction

Distinguishing imaging features of bone lesions

1. Location
2. Structural bone changes
3. Margins (intra- and extra-osseous)
4. Mineralized matrix patterns

~~Distinguishing imaging features of bone lesions~~
Distinguishing clinical features of bone lesions

1. ?
2. ?
3. ?

Distinguishing clinical features of bone lesions

1. Age of patient (growing /mature skeleton)
2. Number of lesions (unique/multiple)
3. Symptoms (fortuituous / fracture / bone pain)

Bone tumors

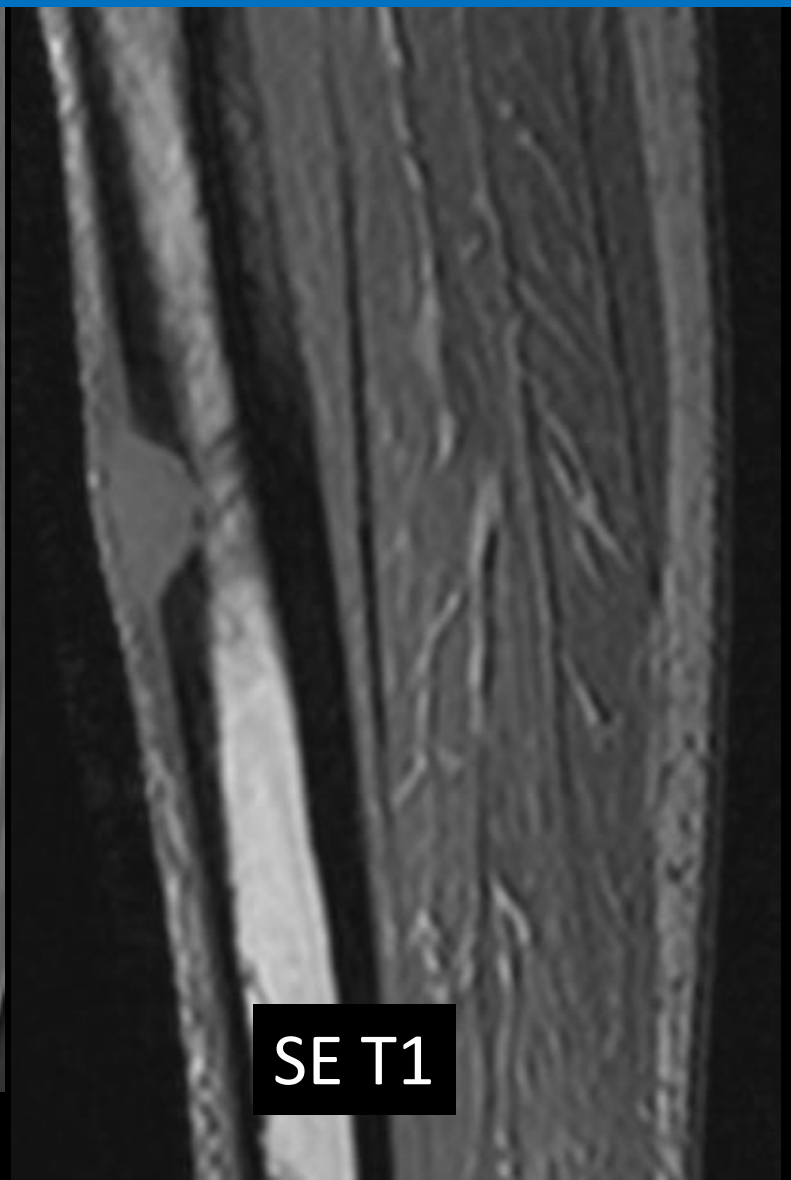
	1^{ary} malignant	1^{ary} benign	2^{ary} malignant*
Frequency	Rare	frequent	Very frequent
Age	< 25 years	Any	>50 years
Growth	Non-limited	Self-limited	Non-limited
Symptoms	Bone pain, #	Fortuituous, bone pain	Bone pain, #

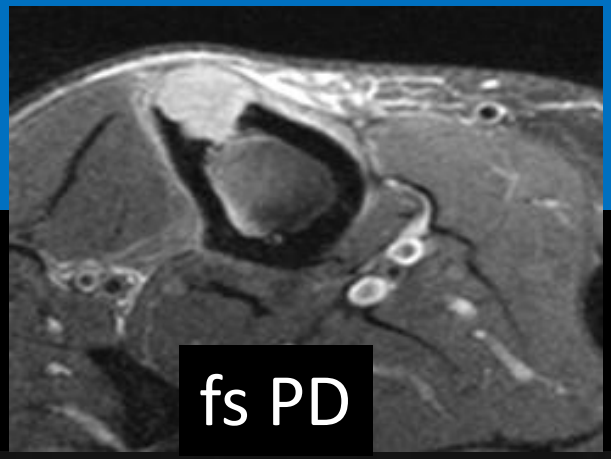
* metastasis, multiple myeloma, lymphoma

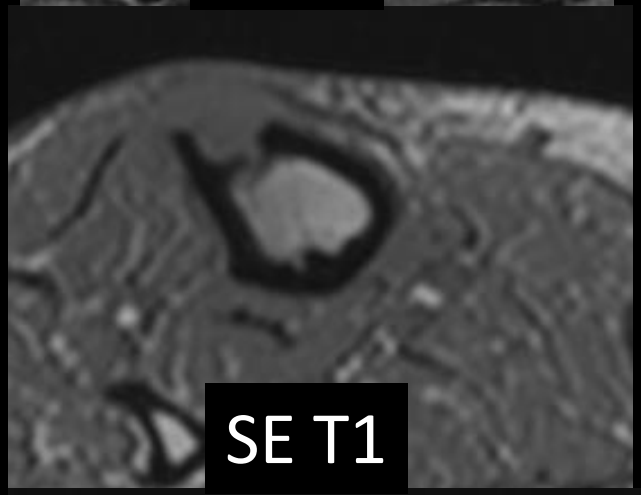
CASE 3: 63-year-old woman; mild spontaneous anterior leg pain since 3 months; feels a bump.

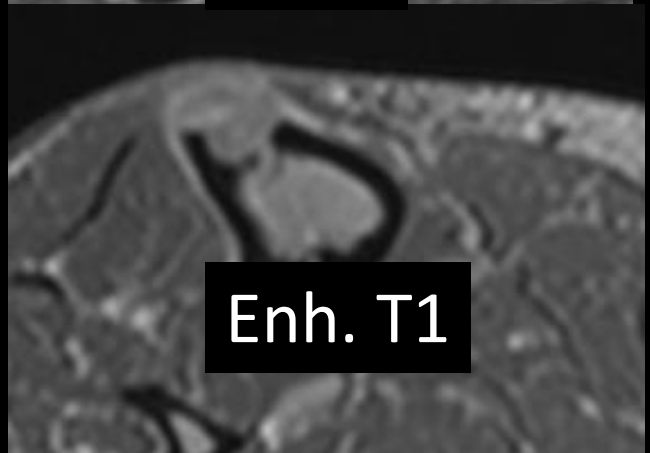
CASE 3: 63-year-old woman;
Describe the lesion ……

CASE 3: 63-year-old woman; Describe the lesion ……

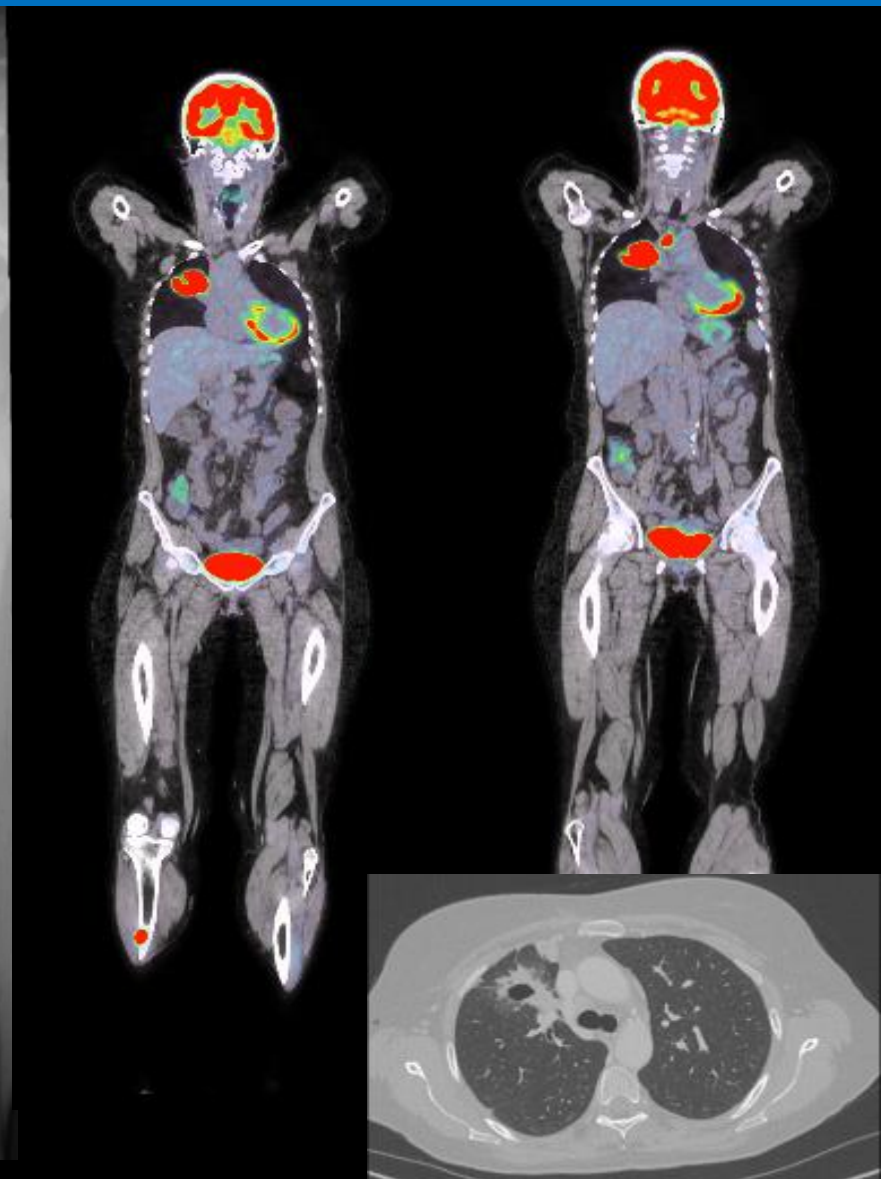








CASE 3: 63-year-old woman; Isolated cortical metastasis from bronchial carcinoma



Rules when facing a bone lesion

- Rule #1 : age of patient
  If patient > 50 years, think metastases/MM/lymphoma
  Even if uncomon imaging features !

- Rule #2 : number of lesion
  unique or multiple ?

Distinguishing imaging features of bone lesions. Do you remember ?

1. ?
2. ?
3. ?
4. ?

Distinguishing imaging features of bone lesions

1. Location
2. Structural bone changes
3. Margins
4. Matrix patterns

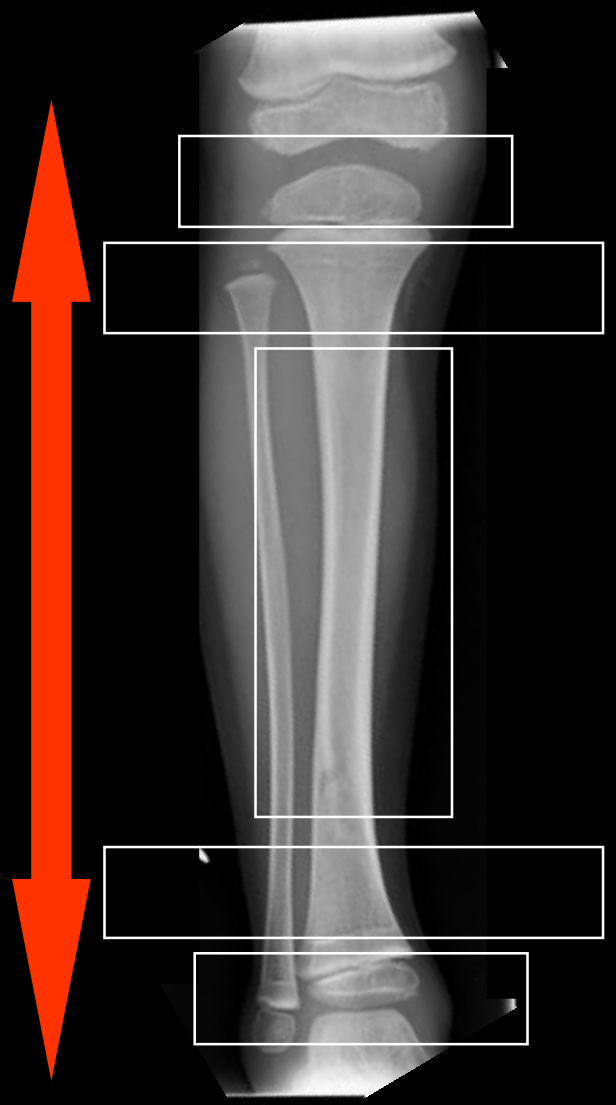
Location of bone lesions

Connect each image (letter) with the corresponding lesion location (number).

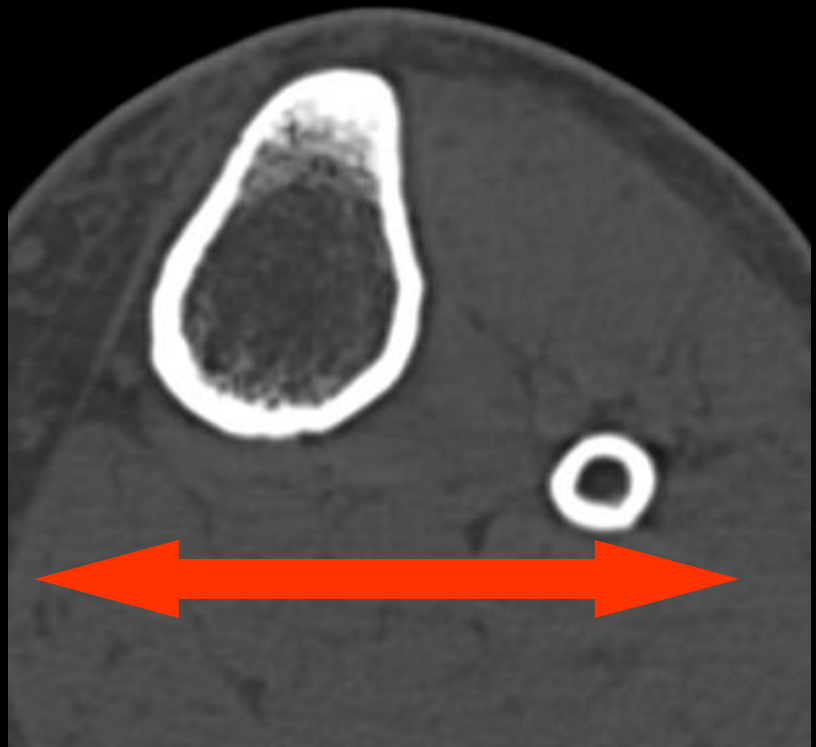
1. Epiphyseal , medullary
2. Diaphyseal, medullary
3. Meta-epiphyseal medullary
4. Diaphyseal , cortical
5. Metaphyseal subperiosteal
6. Metaphyseal, cortical

Location of bone lesions: longitudinal and radial

- Epiphysis
- Metaphysis
- Diaphysis



- Medulla
- Cortex
- Periosteum



Structural bone changes

Connect each image(letter) with the corresponding lesion type.

1 Geographic type 1A

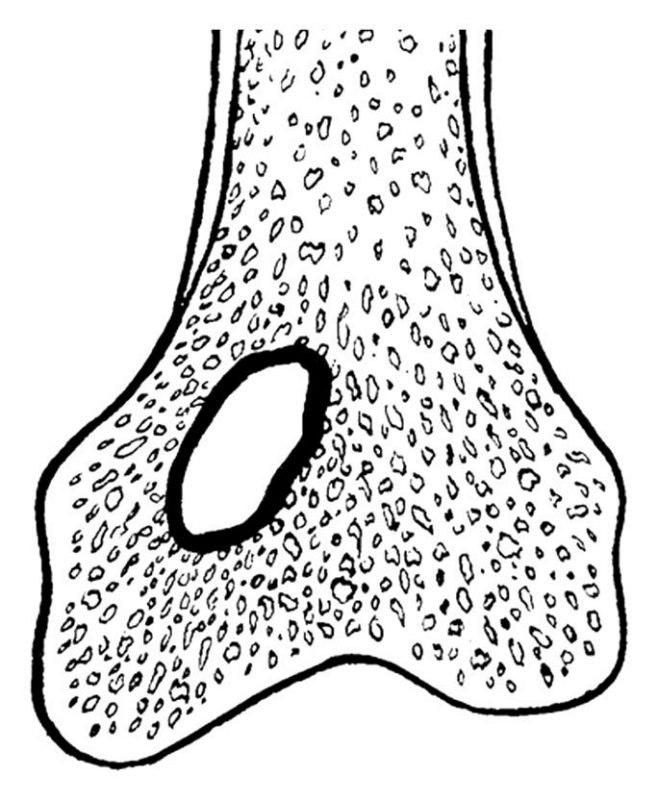
2 Permeative lesion

3 Moth-eaten lesion

4 Geographic type 1B

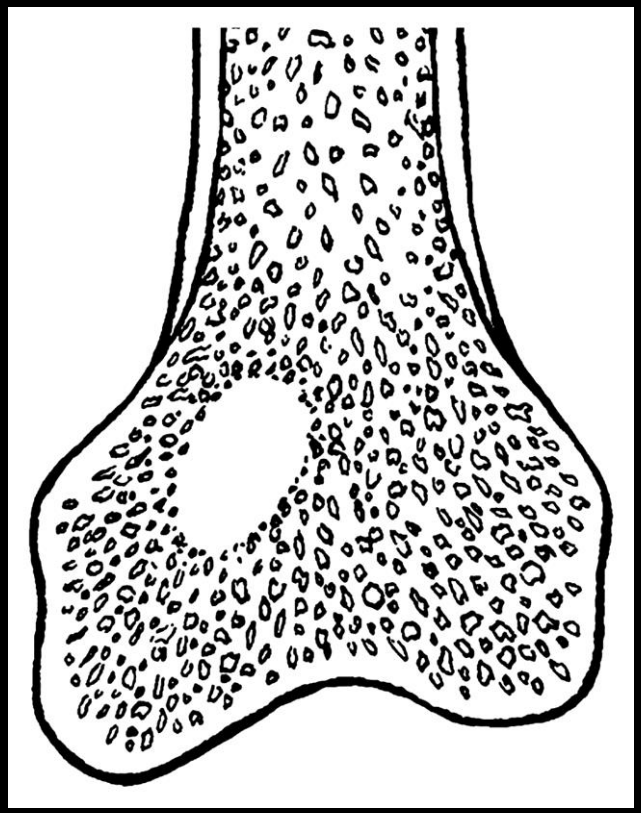
5 Geographic type 1 c

Type 1A geographic lesion



Radiologic and pathologic analysis of solitary bone lesions.
I. Internal margins.
Madewell JE, Ragsdale BD, Sweet DE.
Radiol Clin North Am **1981**; 19: **715**–748.

Type 1B geographic lesion



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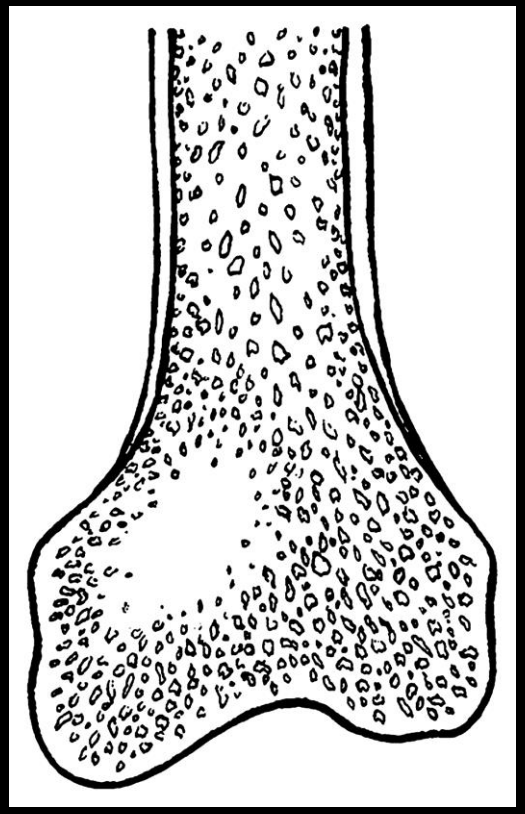
Type 1C geographic lesion



Radiologic and pathologic analysis of solitary bone lesions.
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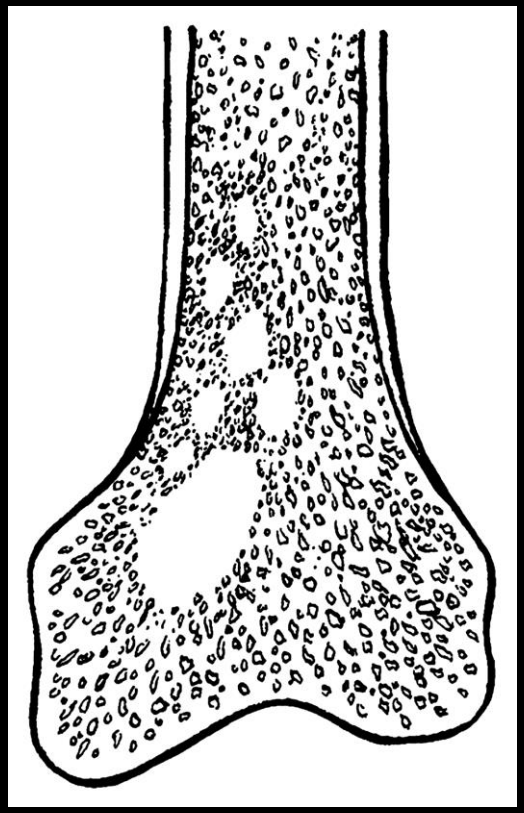
Moth-eaten osteolysis or bone destruction



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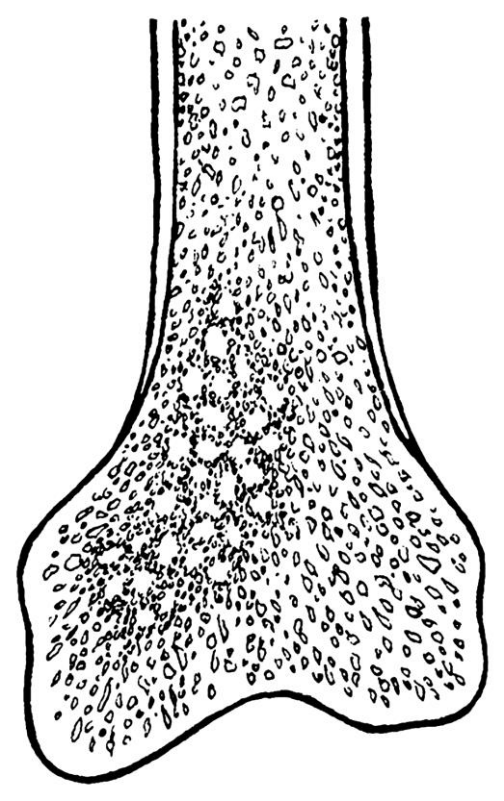
Permeative osteolysis



Radiologic and pathologic analysis of solitary bone lesions.
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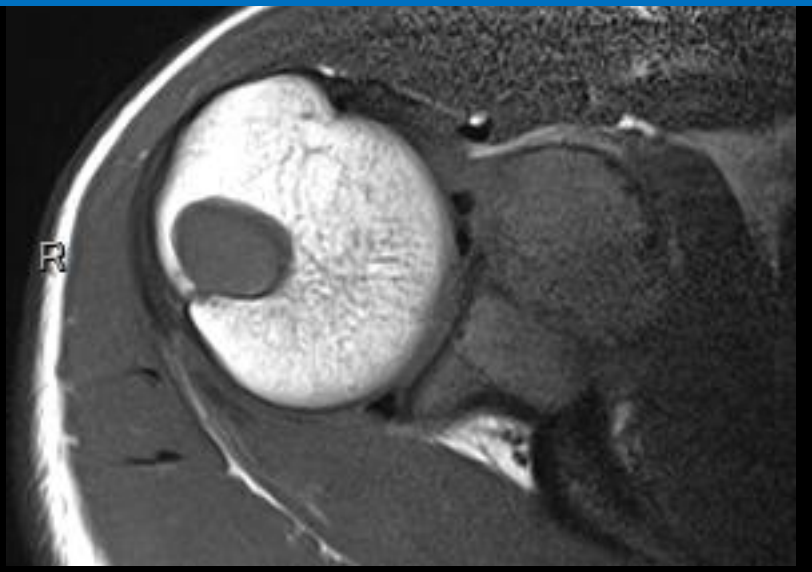
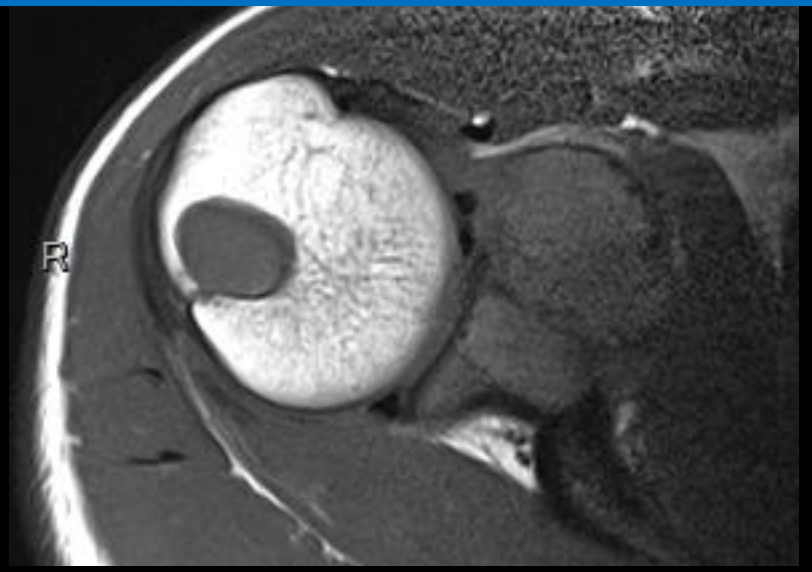
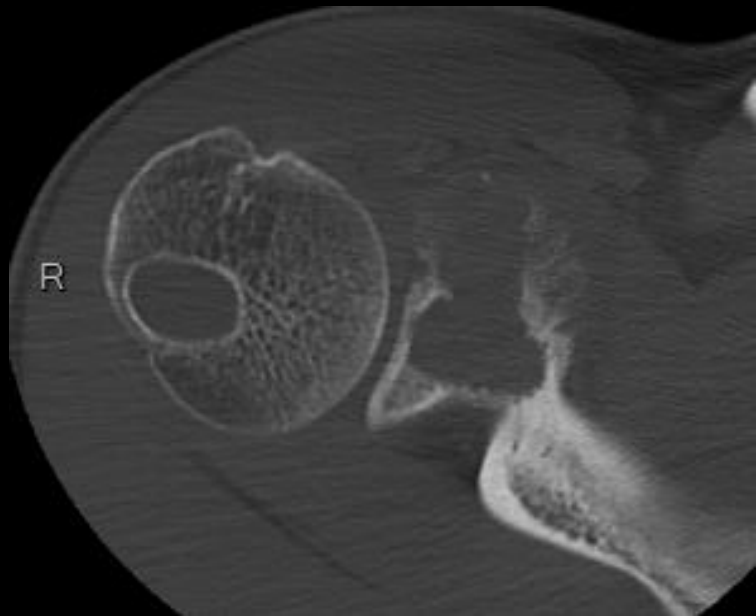
Geo. 1A (very slow/quiescent) versus 1B (growing) lesion ? ?
Can you answer the question with MRI ?

SE T1



Geo. 1A (very slow/quiescent) versus 1B (growing) lesion ? ?
Can you answer the question with MRI ? NO !



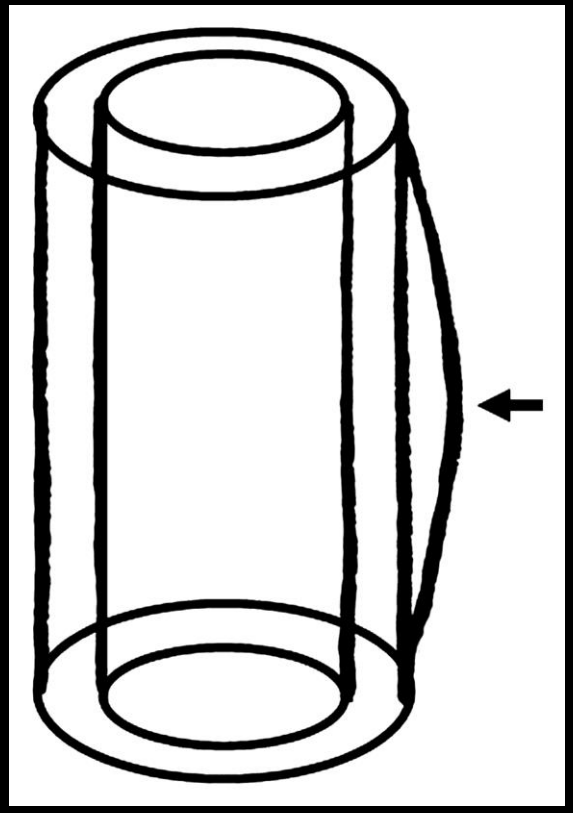


Periosteal reaction

Connect each image (letter) with the corresponding pattern of periosteal reaction.

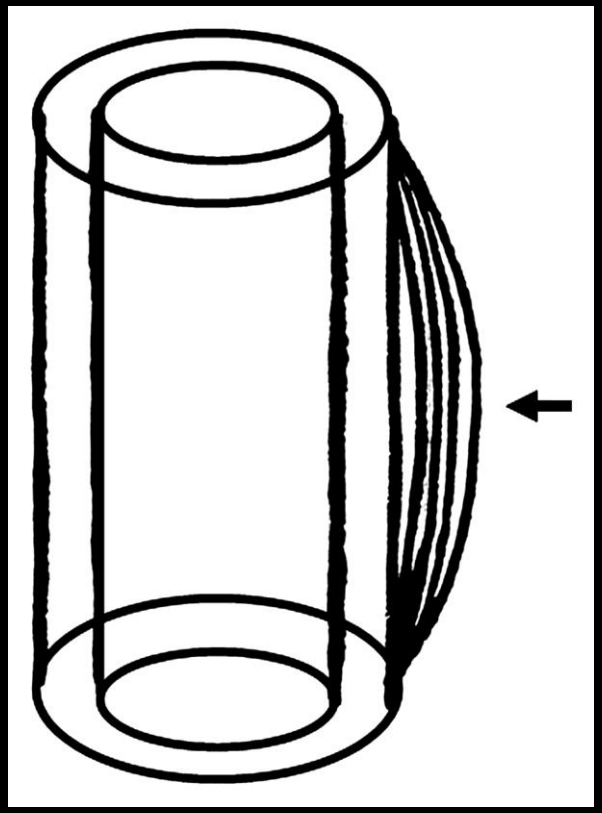
1 Lamellar 2. Sun-burst 3. Codmann-’s triangle 4. Multilamellar/Onion-skin

Lamellar periosteal reaction



II. Periosteal reactions.
Ragsdale BD, Madewell JE, Sweet DE.
Radiol Clin North Am **1981**;19:**749**–783. 3.

Multi-lamellar periosteal reaction « Onion-skin »



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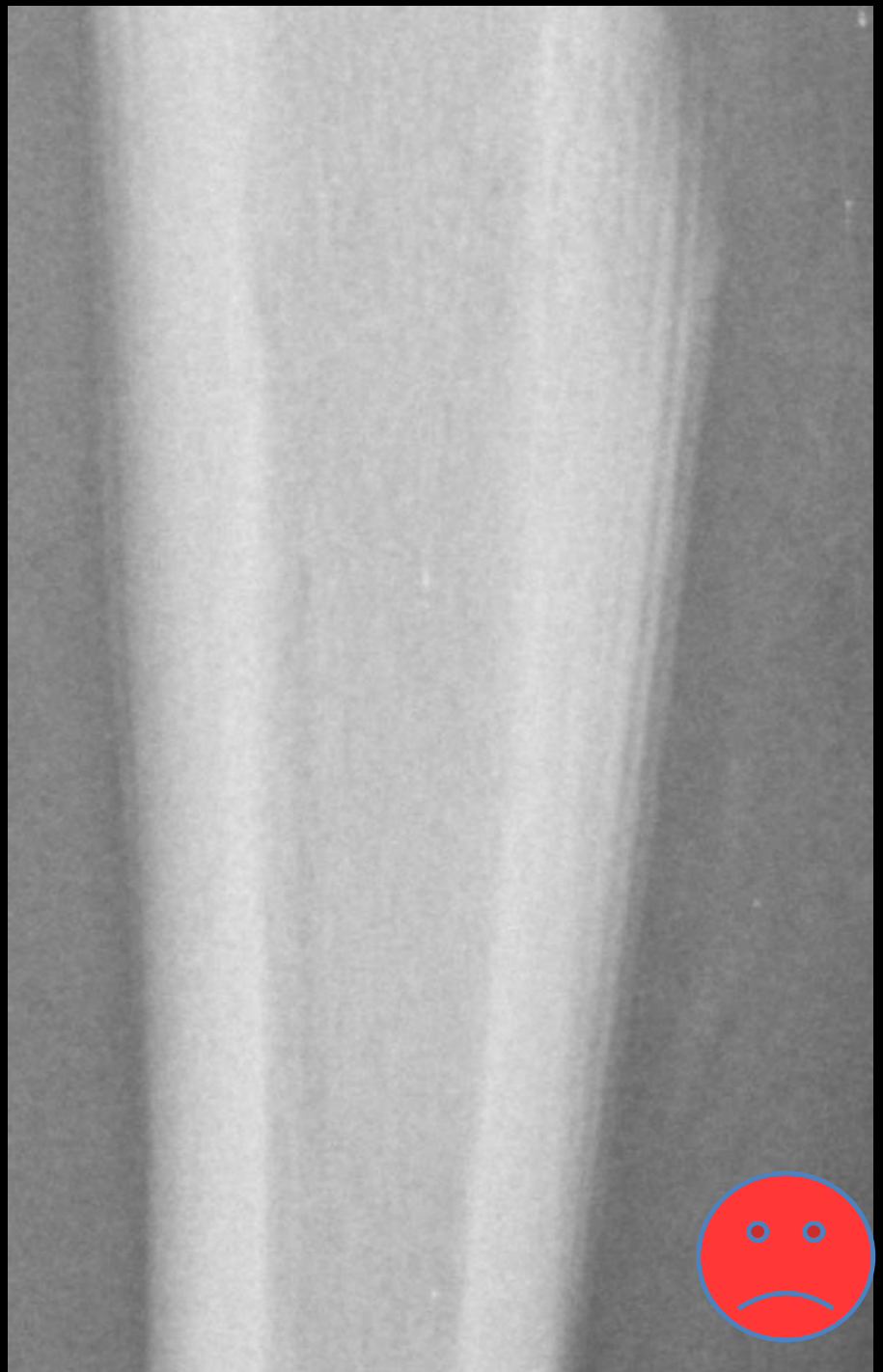
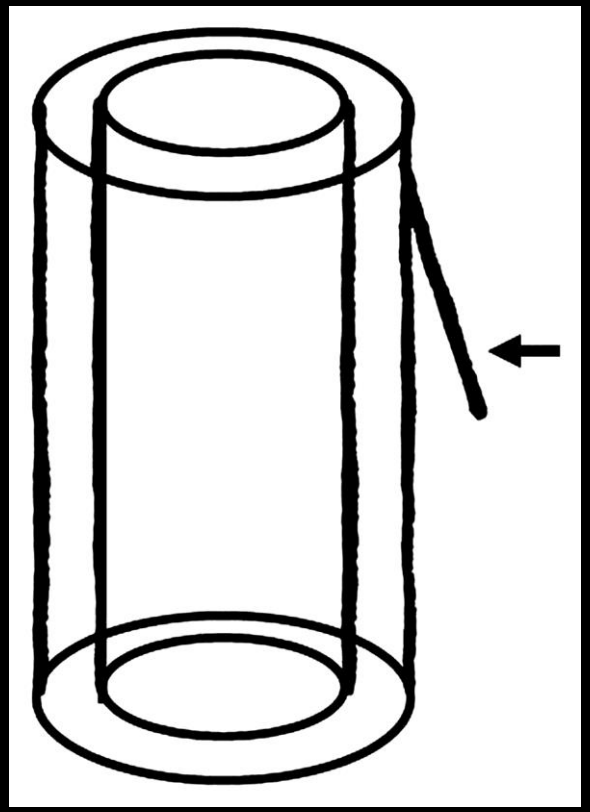


Codmann’s triangle



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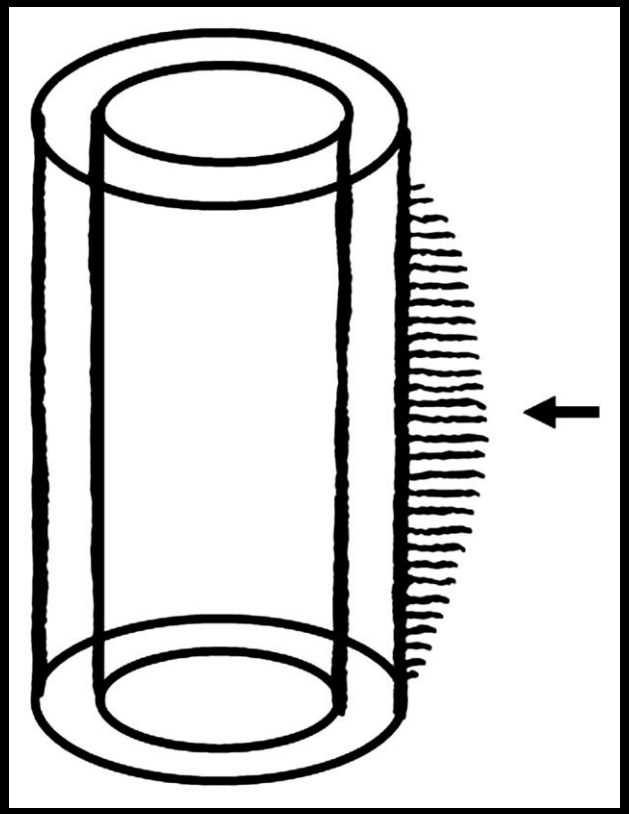
Radiol Clin North Am **1981**;19:**749**–783. 3.

Transverse periosteal reaction « Sun-burst »



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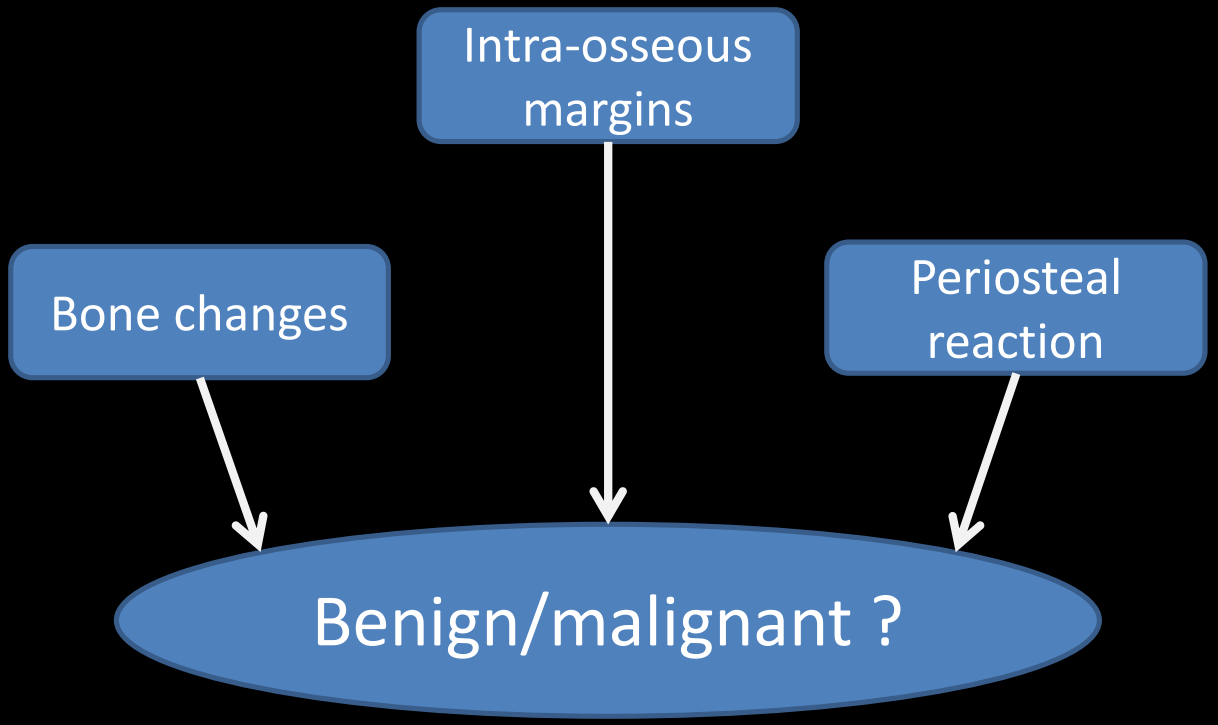
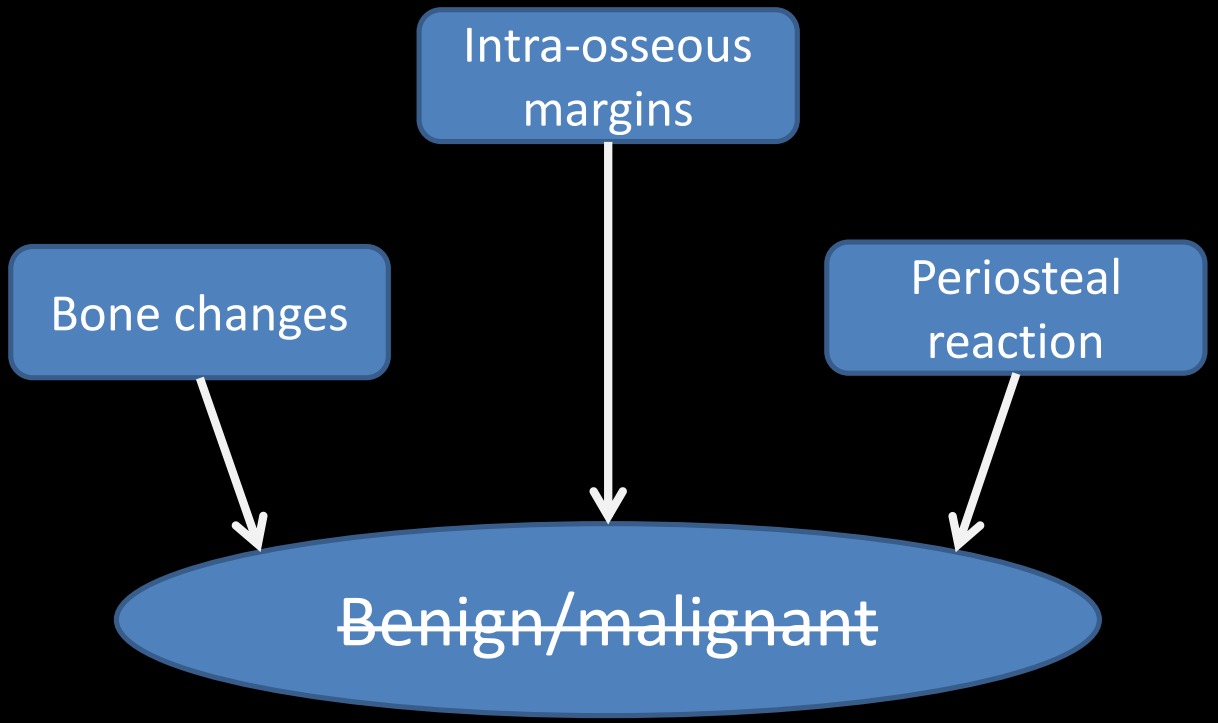
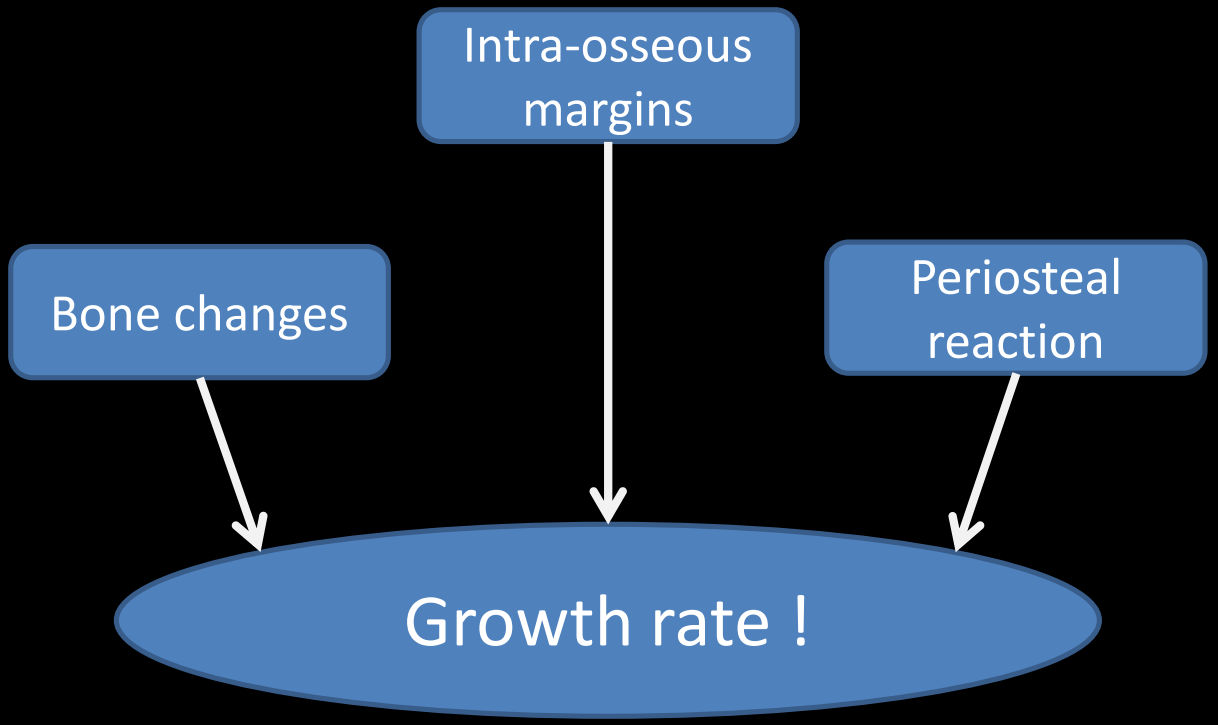
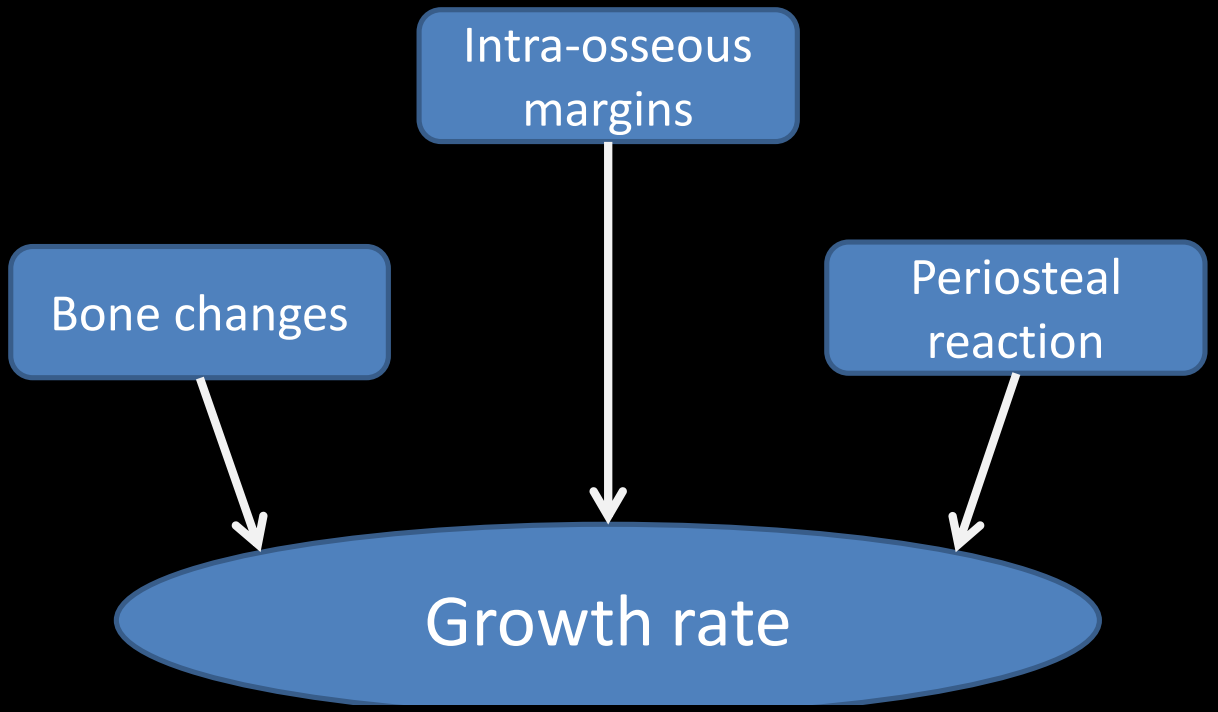

Intra-osseous margins
Bone changes
Periosteal reaction
Benign/malignant ?


Intra-osseous margins
Bone changes
Periosteal reaction
~~Benign/malignant~~


Intra-osseous margins
Bone changes
Periosteal reaction
Growth rate !



Most rapidly growing lesions are malignant (not all).

Most slowly growing lesions are benign (not all).

Non-growing lesions are benign (all).

Determining Growth Rates of Focal Lesions of Bone from Radiographs[1]

Gwilym S. Lodwick, M.D., Anthony J. Wilson, M.D., Corinne Farrell, M.D., Pekka Virtama, M.D., and Frederick Dittrich, B.S.[2]

Rate of growth divides focal lesions of bone into two classes which are largely mutually exclusive. Not all focal lesions require biopsy, and grading is especially helpful in deciding which should be biopsied and which may be safely followed. The statistical proof and logic of grading as an expression of growth rate are presented with a set of rules establishing each of the five grades in the presence of bone destruction. The radiologic signs necessary to establish rates are described and illustrated.

INDEX TERMS: Bone neoplasms, diagnosis • (Skeletal system, error in diagnosis, 4[0].940) • (Skeletal system, fundamental observation, 4[0].910)

Radiology 134:577–583, March 1980

Slow growing malignant	Rapidly growing benign
Multiple myeloma	Aneurysmal bone cyst
Chondro/osteosarcoma Ewing	Eosinophilic granuloma
Metastasis kidney, thyroid, breast	Infection
….	…..

Rules when facing a bone lesion

- Rule #1 : age of patient
  If patient > 50 years, think metastases/MM/lymphoma
  Even if uncomon imaging features !

- Rule #2 : number of lesion
  unique or multiple ?

- Rule #3: growth rate of lesion
  structural bone changes/intra- and extra-osseous margins
  Not growing ? Slow growing / rapidly growing ?
  X-ray/CT are highly contributive.

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