Bone and soft tissue tumors
Part two

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Cliniques universitaires
SAINT-LUC
UCL BRUSSELS

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)

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 ?

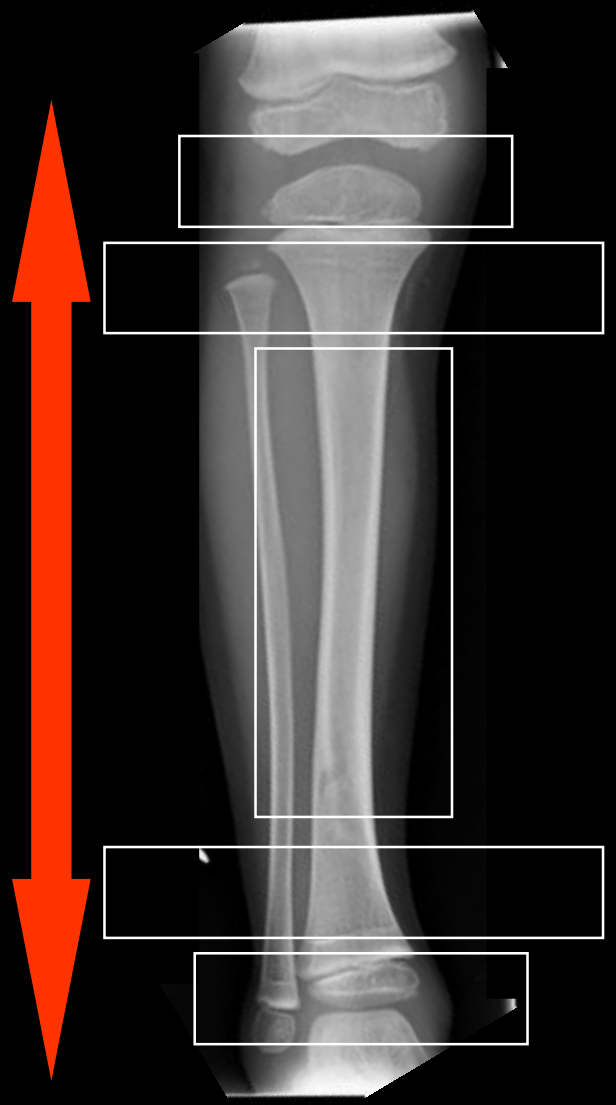
- Rule #3: growth rate of lesion
  structural bone changes/intra- and extra-osseous margins
  Not growing ? Slow growing / rapidly growing ?
  X-ray/CT are highly contributive.

Distinguishing imaging features of bone lesions

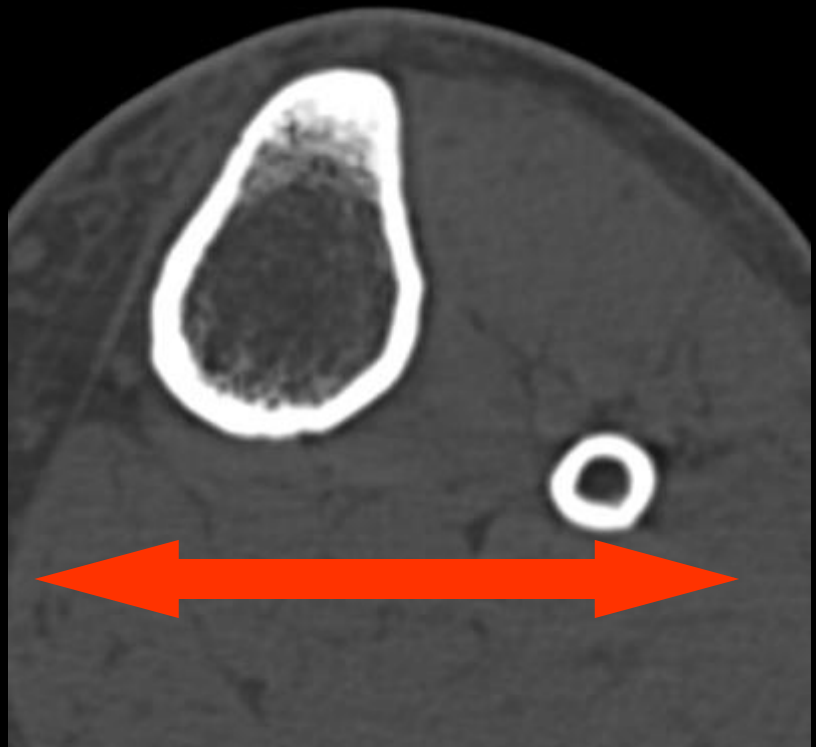
1. Location
2. Structural bone changes
3. Margins
4. Matrix patterns

Location of bone lesions: longitudinal and radial

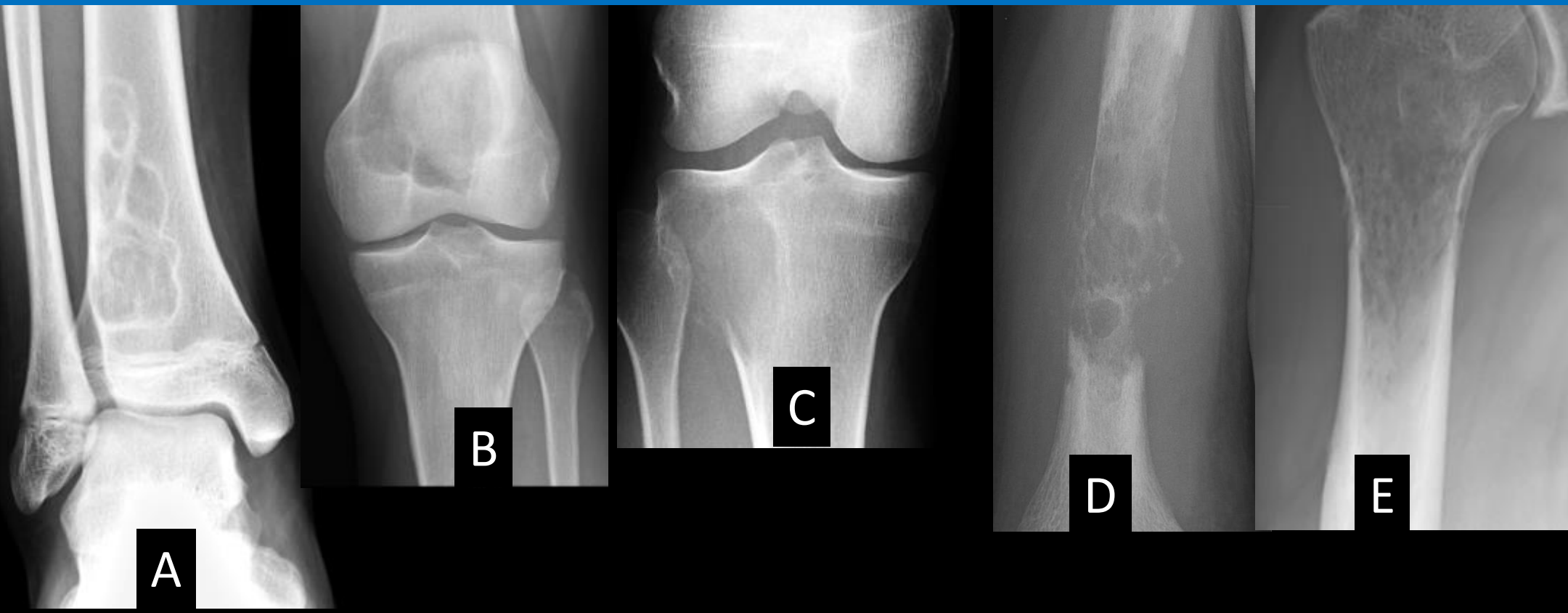
- Epiphysis
- Metaphysis
- Diaphysis



- Medulla
- Cortex
- Periosteum



Structural bone changes

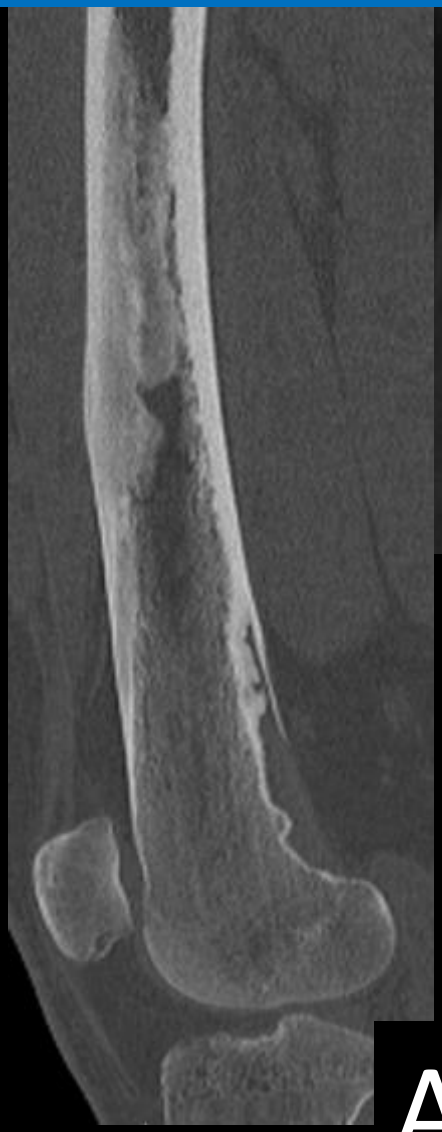


Structural bone changes
A Geographic type 1A
B Geographic type 1B
C Geographic type 1C
D Moth-eaten
E Permeative

Periosteal reaction

A Sun-burst B Onion skin C Unilamellar periosteal reaction D Codman's triangle

Matrix



Connect each image with the corresponding matrix.

1 chondroid matrix

2 osseous matrix

3 woven bone (ground-glass)

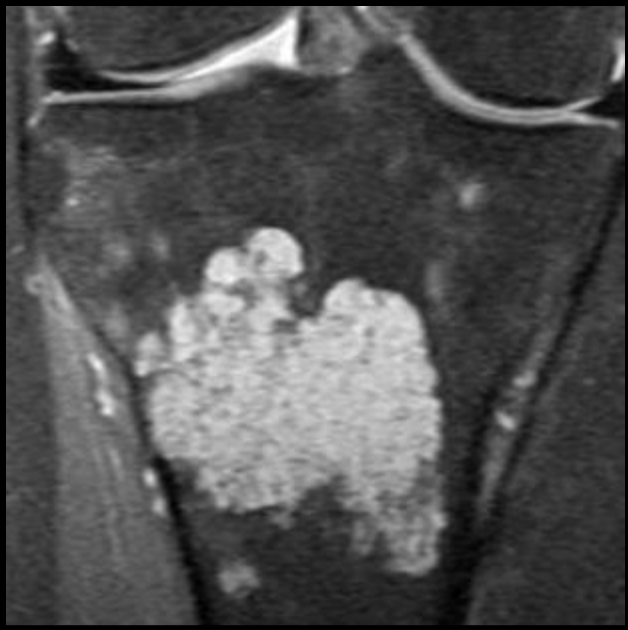
Make your choice:

A. Osteoid matrix

B. Chondroid matrix

C. Fibrous bone

D. Cyst



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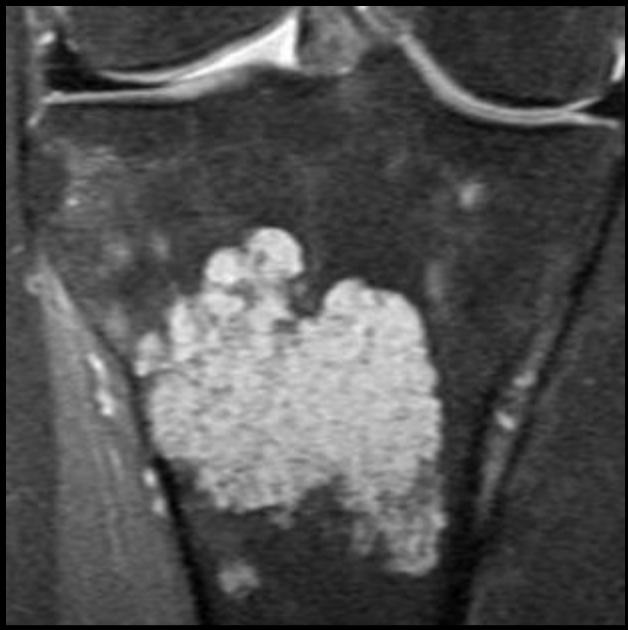

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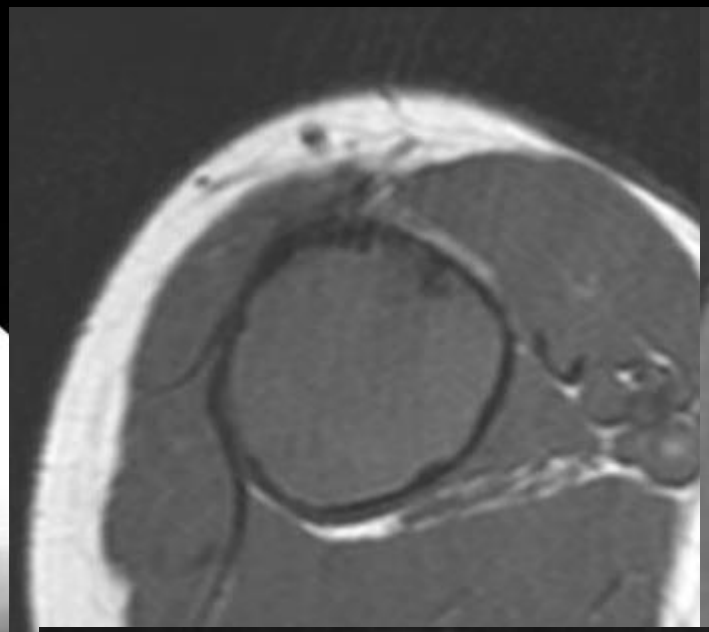

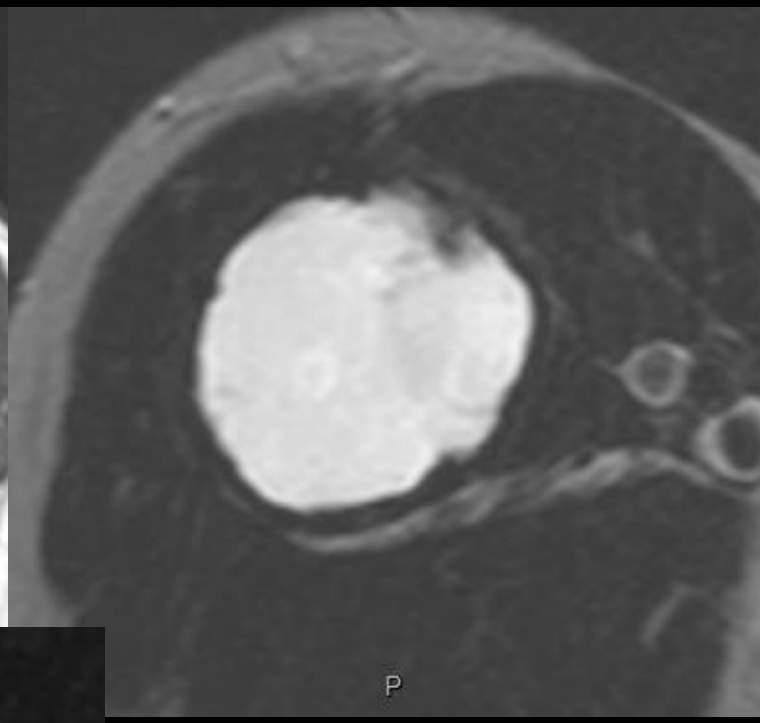

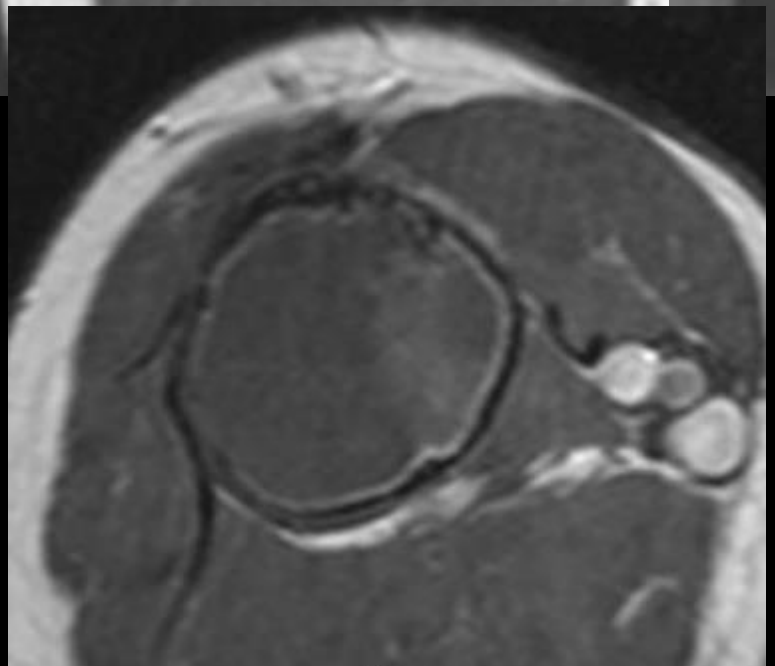

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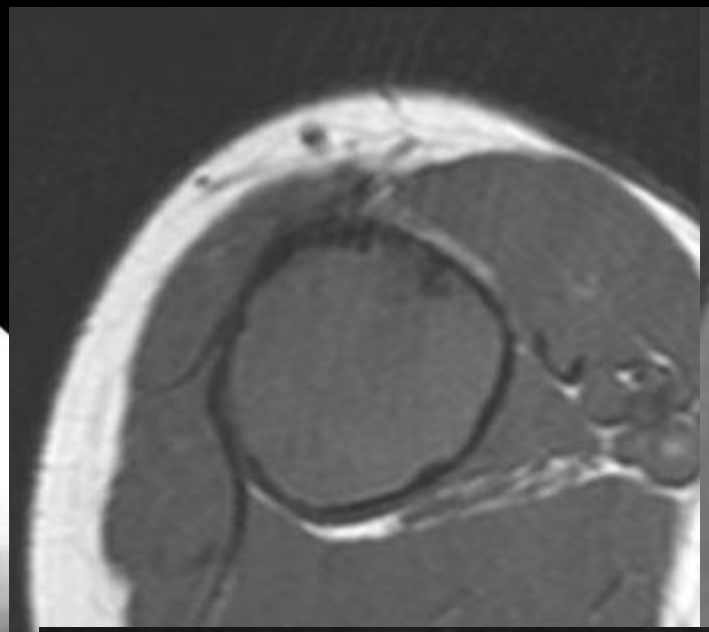

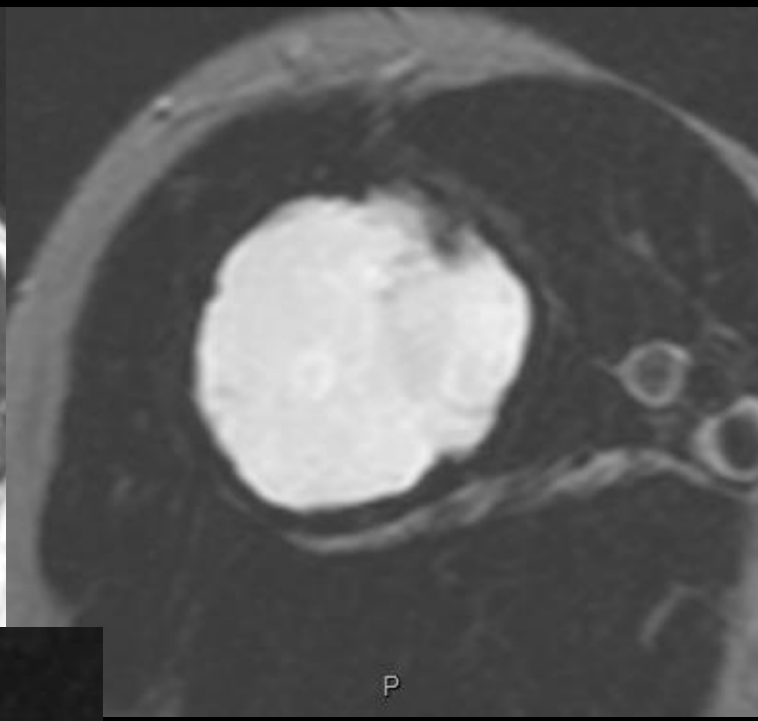

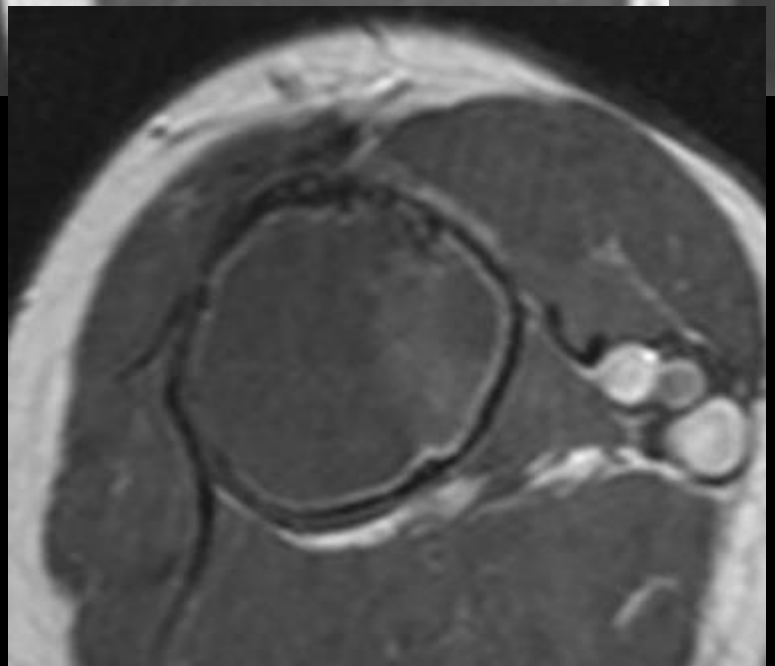

Make your choice:

A. Osteoid matrix

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B. Chondroid matrix

C. Fibrous bone

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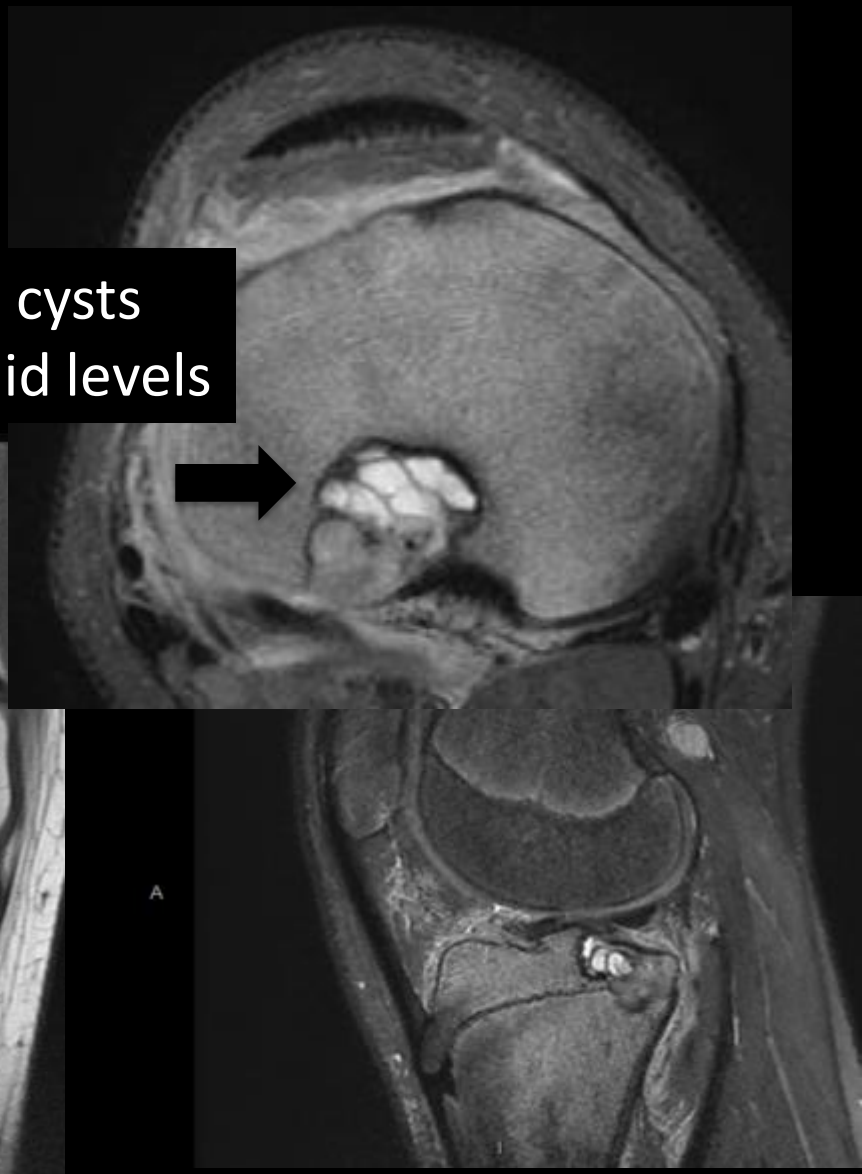
Non-mineralized matrix patterns at MR

Chondroblastoma with
2ary aneurysmal bone cyst

Bone marrow edema-like
changes

Blood-filled cysts
with fuil-fluid levels



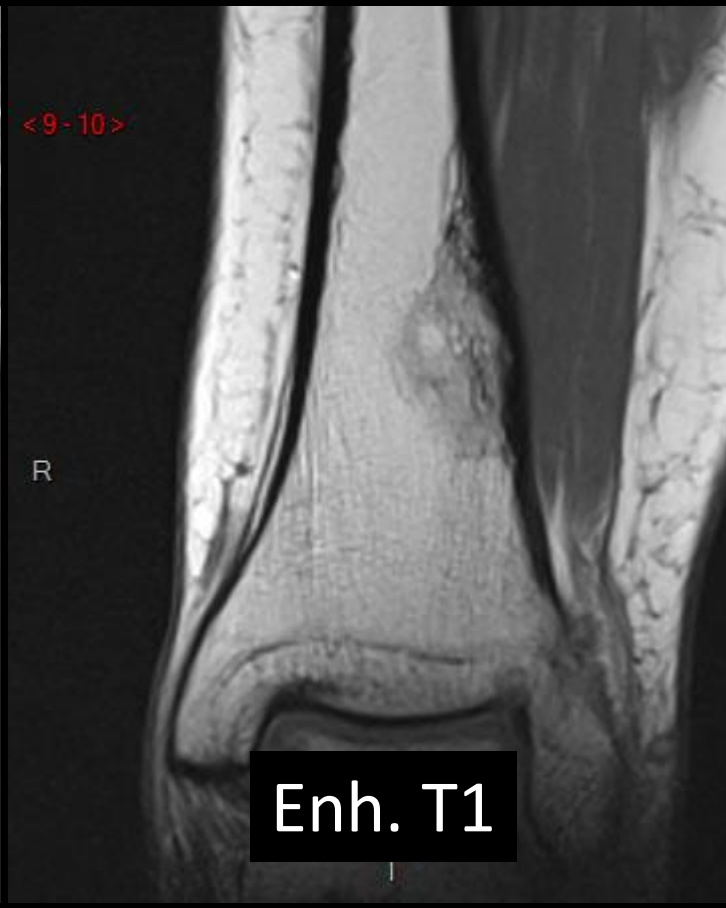
Radiologic and pathologic analysis of solitary bone lesions.

- *I. Internal margins.* **Madewell JE**, Ragsdale BD, Sweet DE. *Radiol Clin North Am* **1981**; 19: **715**–748.
- *II. Periosteal reactions.* **Ragsdale BD**, Madewell JE, Sweet DE. *Radiol Clin North Am* **1981**;19:**749**–783. 3.
- *III. Matrix patterns.* **Sweet DE**, Madewell JE, Ragsdale BD. *Radiol Clin North Am* **1981**;19:**785**–814.

These references available at

http://www.uclimaging.be/ecampus/IDKD_2019.htm

CASE 4 : 35-year-old woman with ankle sprain
Describe the lesion… growth rate ???



Fat within a bone lesion is an excellent sign
To indicate absence of growth !

CASE 4 : 35-year-old woman/ Non ossifying fibroma

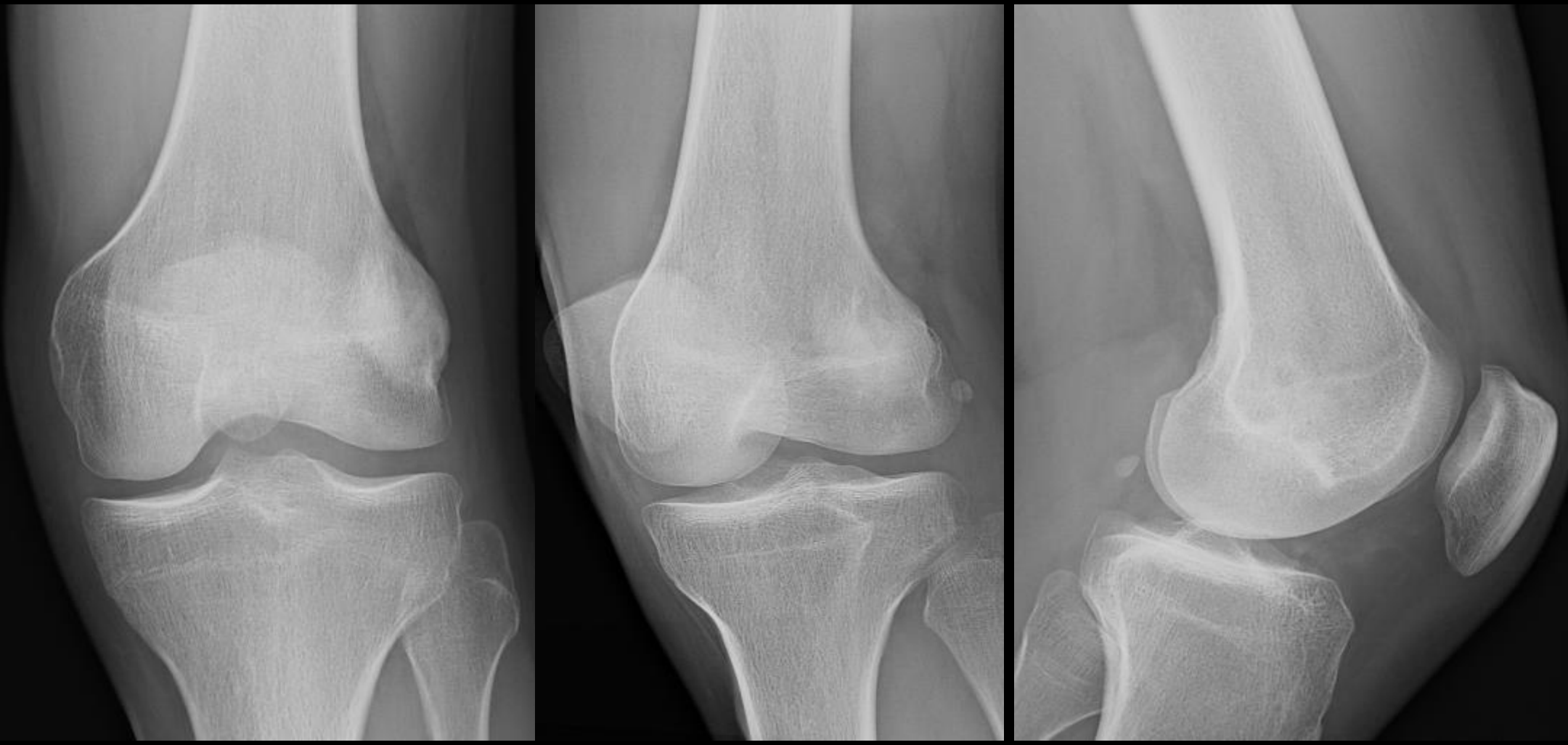
Clinical features

Any age, unique or multiple, variable symptoms

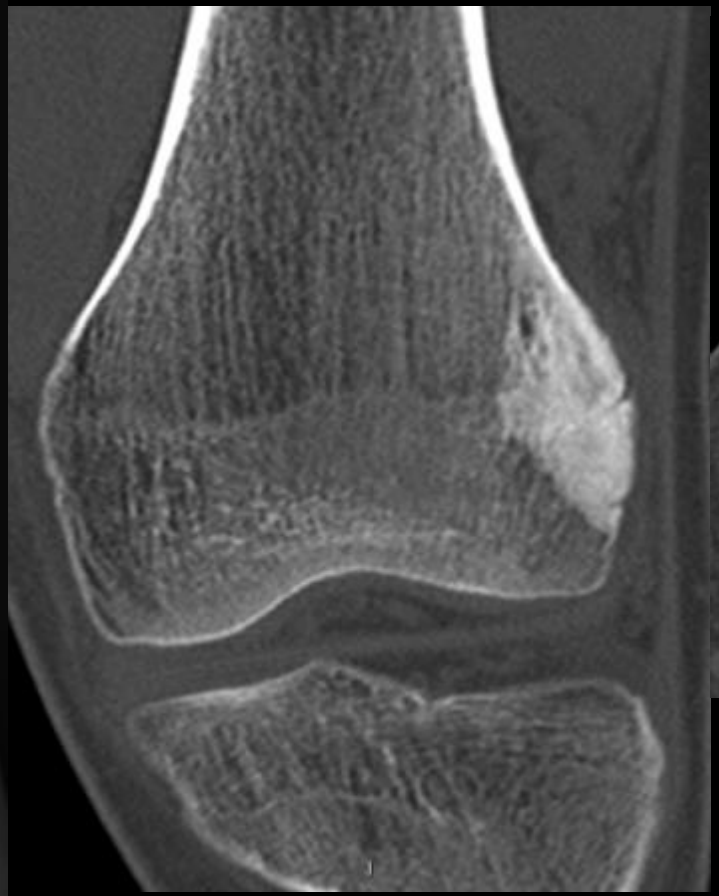
Imaging features

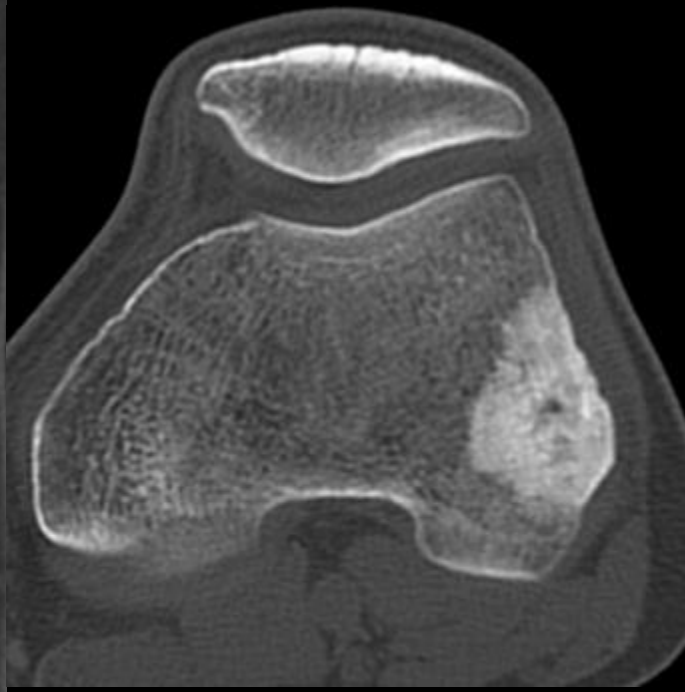
Geographic cortical lesion, produces bone, limited or no growth

CASE 4 bis : 18-year-old man/ mild knee pain

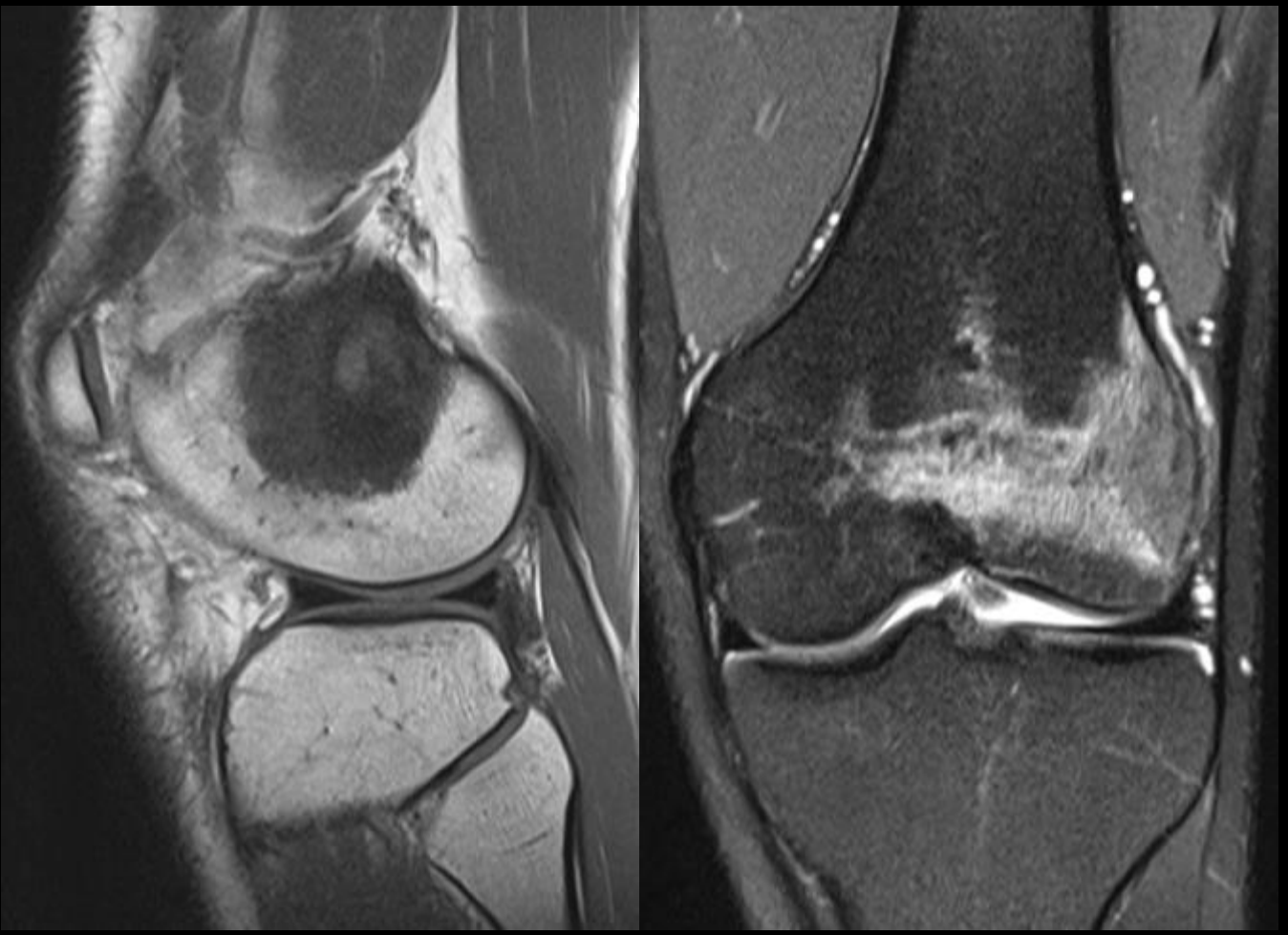


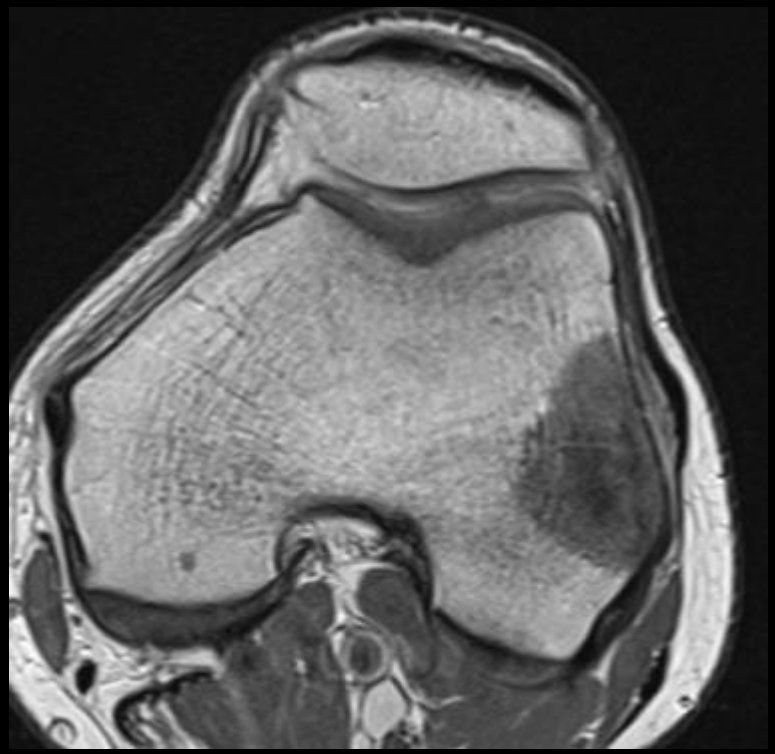
CASE 4 bis : 18-year-old man/ mild knee pain





CASE 4 bis : 18-year-old man/ osteosarcoma





CASE 5 : 16-year-old boy with sport-related knee pain Describe the lesions… growth rate ???

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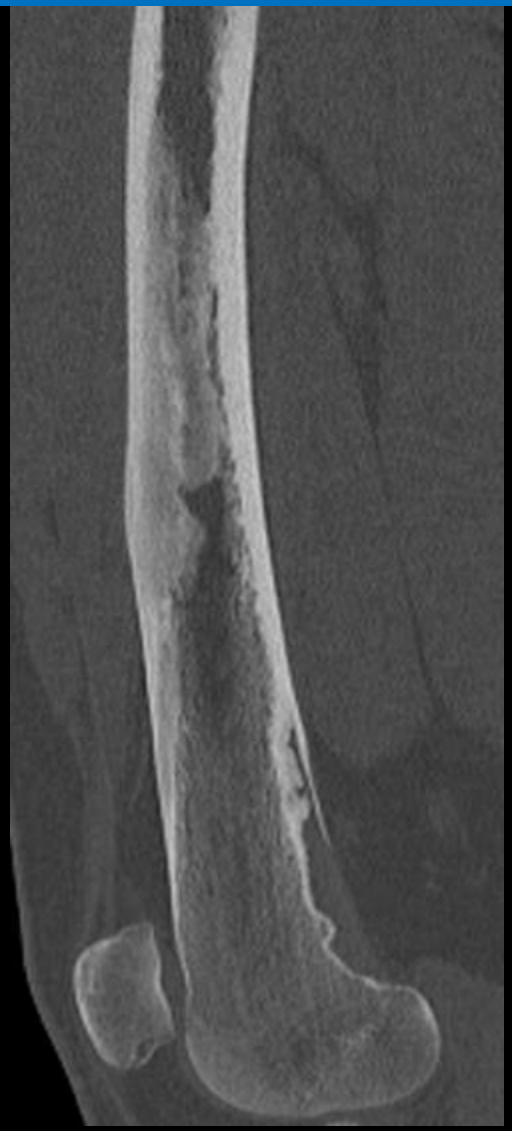
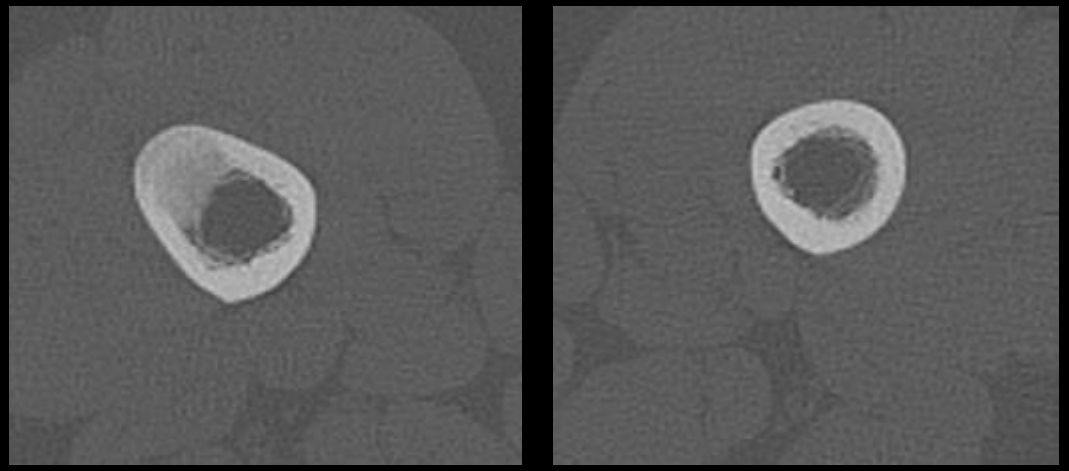
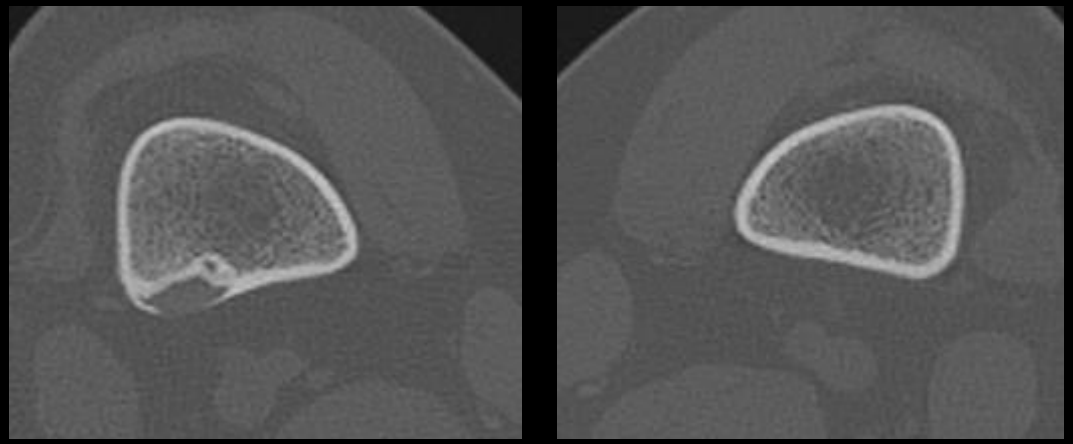


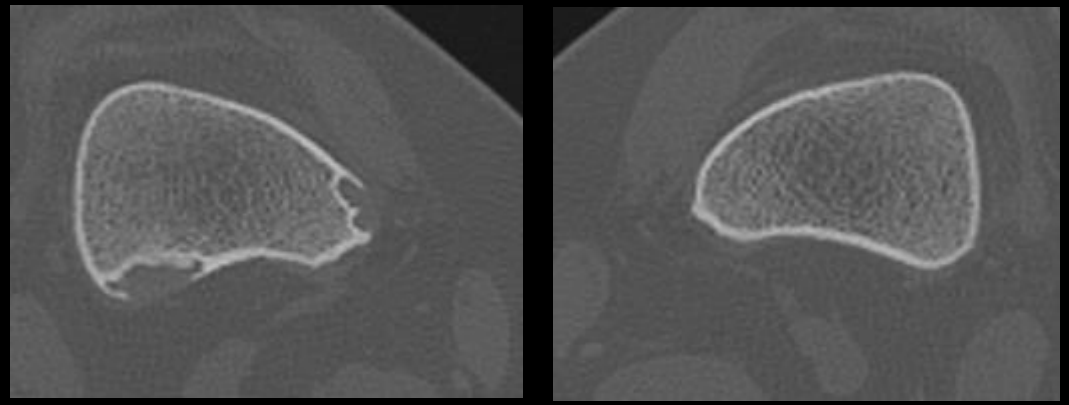
Fibrous dysplasia

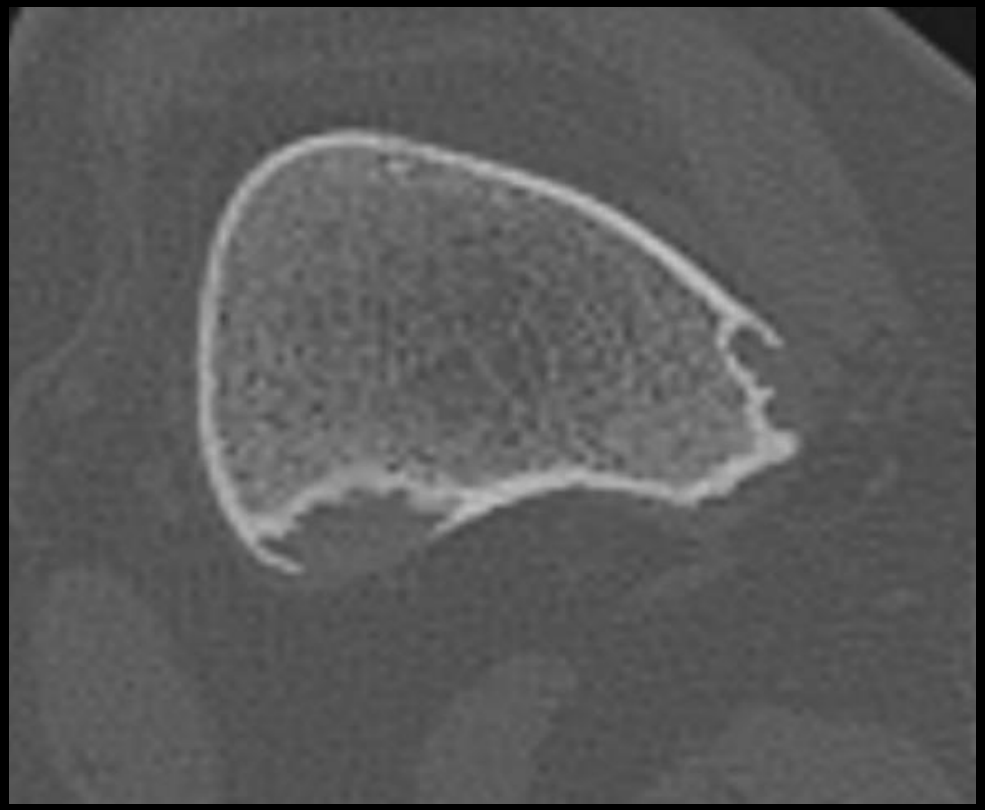


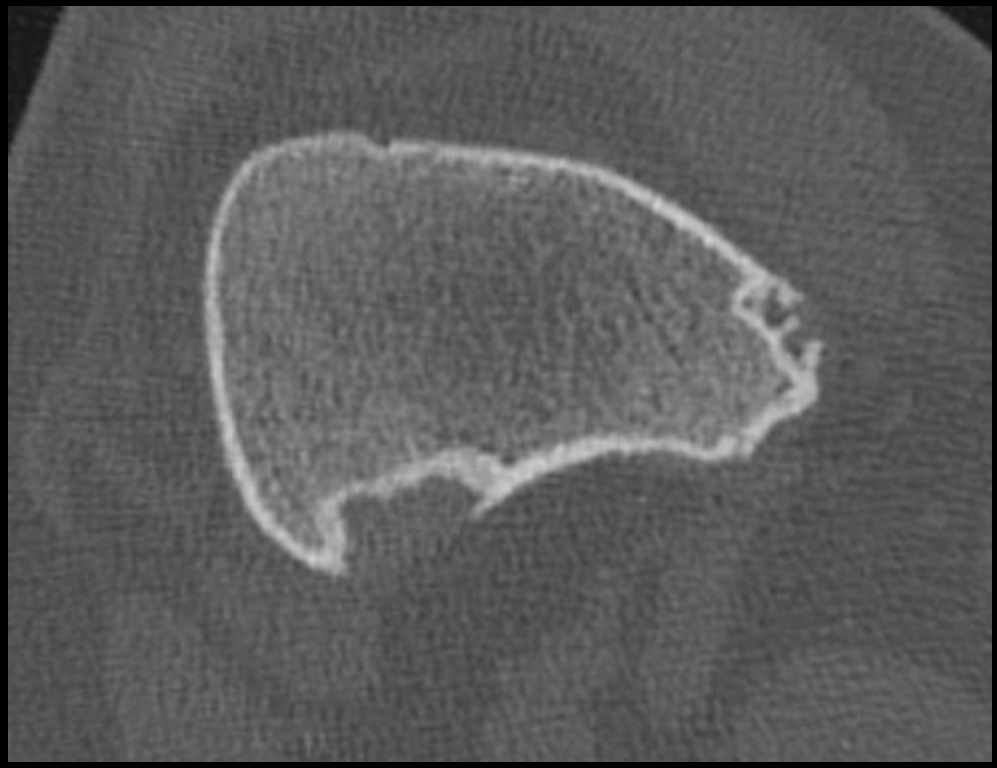
Non-ossifying fibroma



Fibrous cortical defect





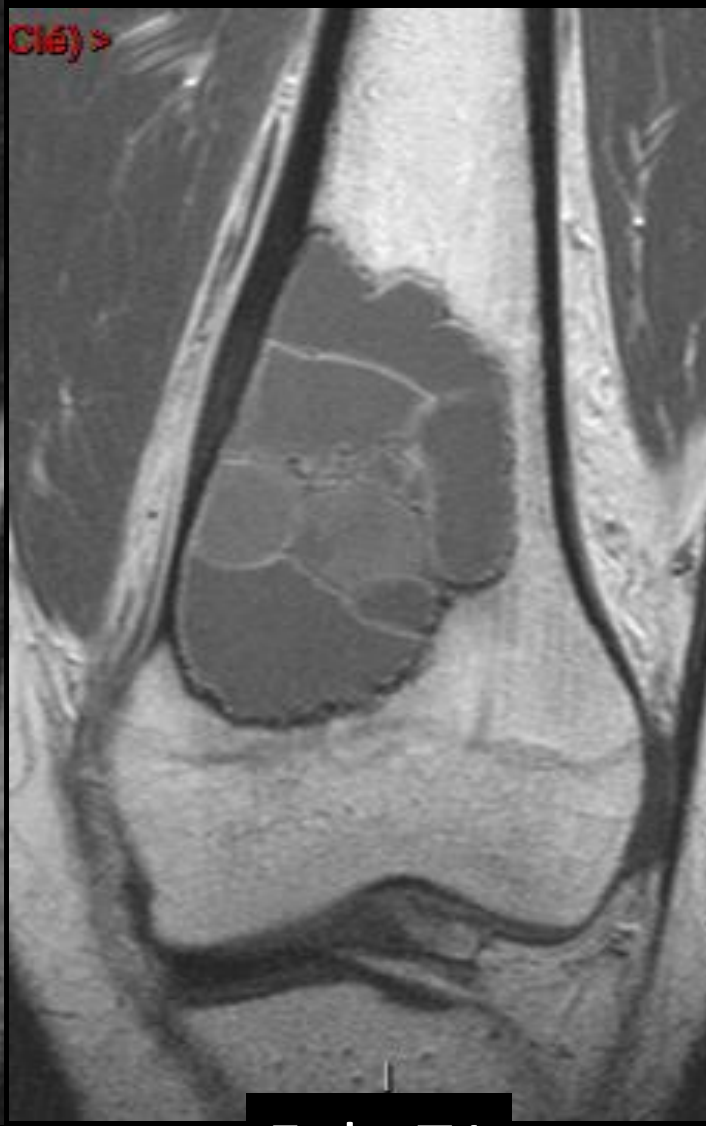


2-years follow-up

CASE 6 : 17-year-old girl with increasing knee pain
Describe the lesion… growth rate ???

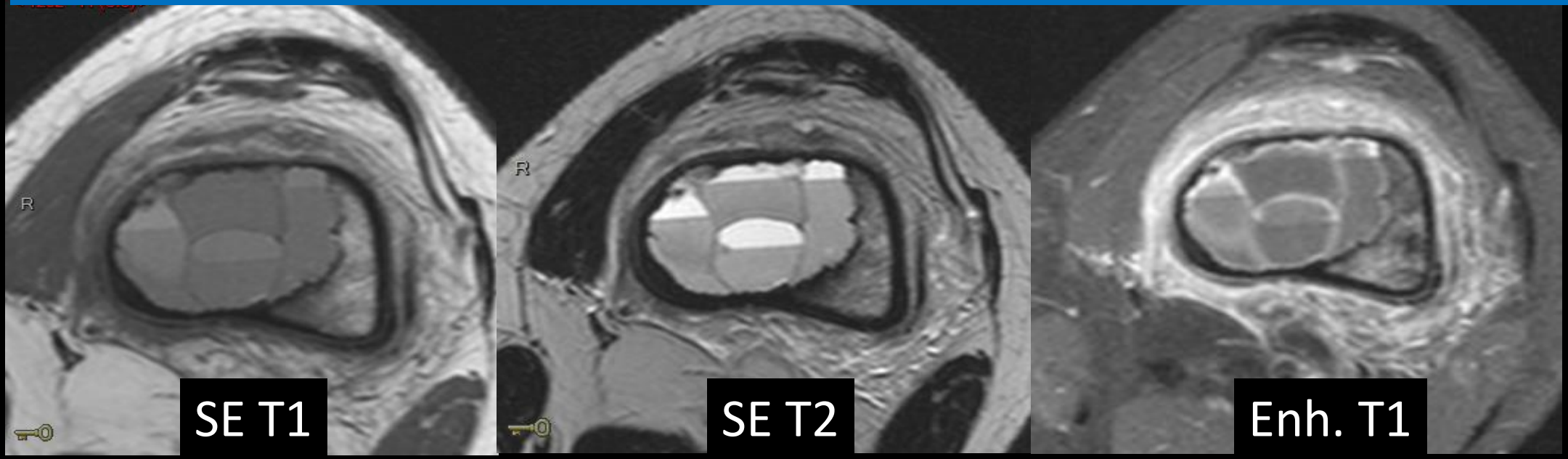
SE T1

SE T2



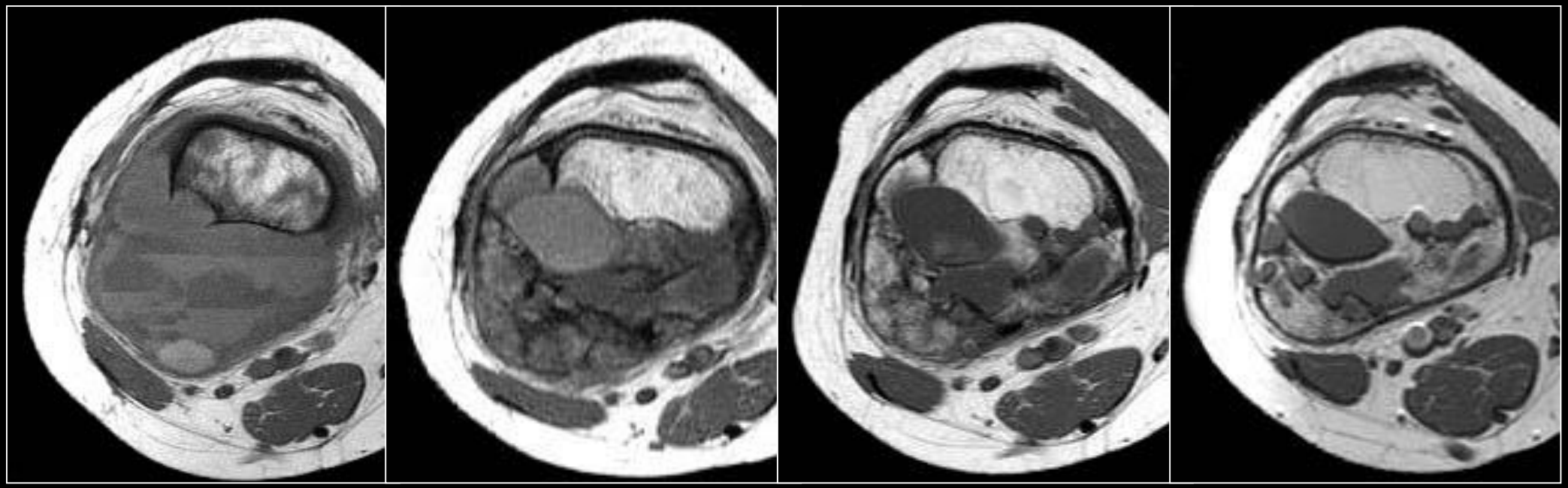
Enh. T1

CASE 6 : Aneurysmal bone cyst



Aneurysmal bone cyst
Most frequent between 15-25 years
Rapidly evolutive expansile lytic lesion, not really a tumor, blood-containing cysts
Primary or secondary to underlying bone lesion (GCT, chondroblastoma, Mets
USP6 / H3F3 + in primary ABC)
Great mimicker : telangiectasic osteosarcoma

Follow-up SE T1 images in an untreated presumed primary ABC

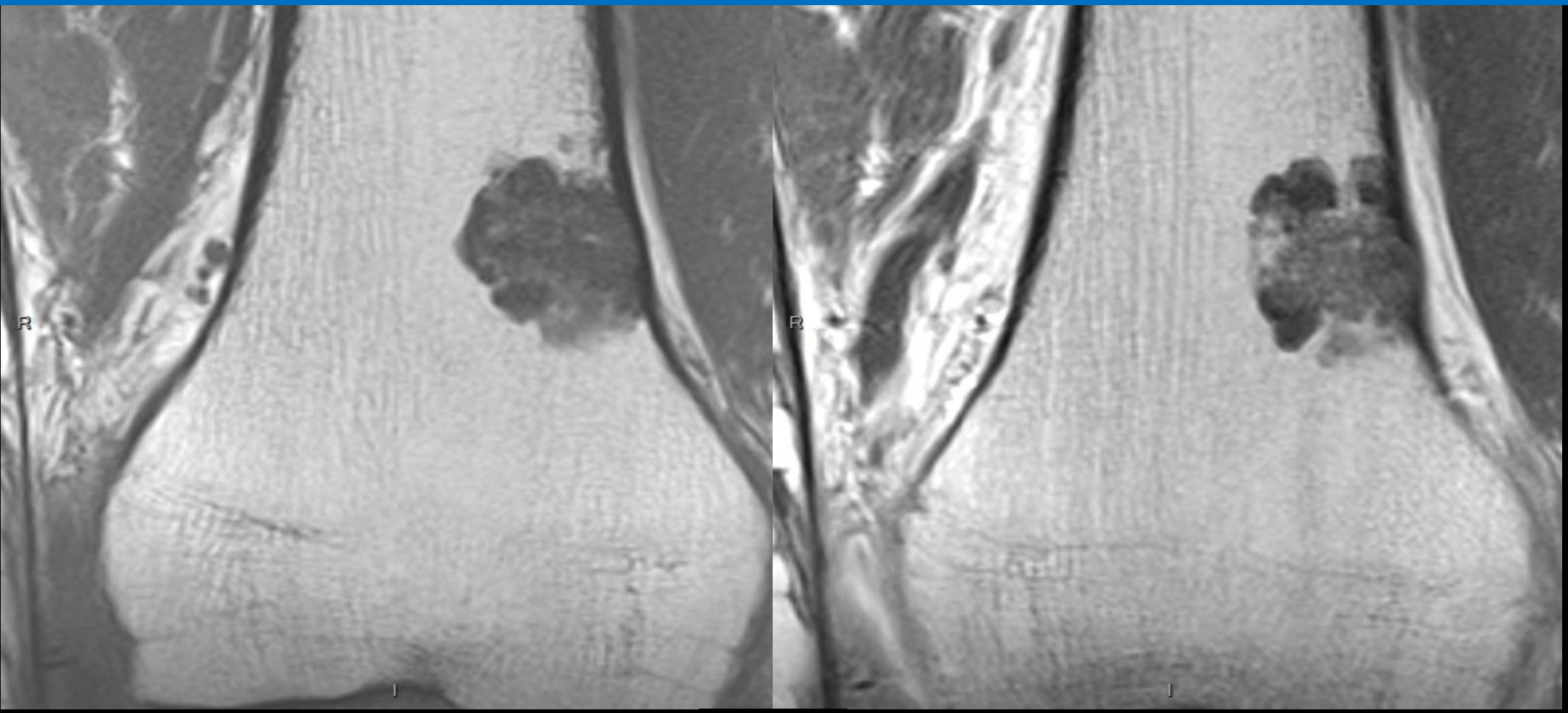


initial **+ 2 years** **+ 3 years** **+ 6 years**

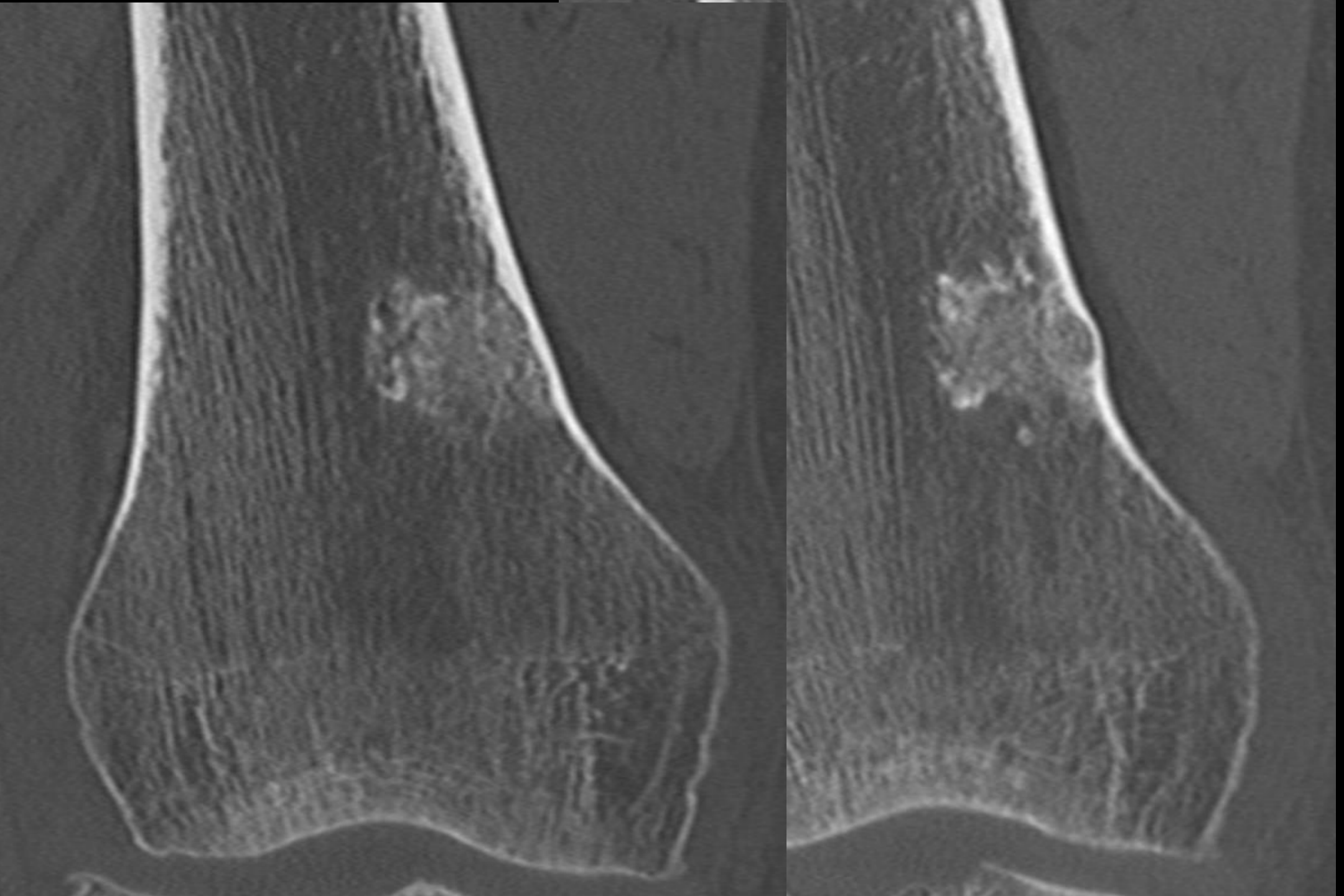
Fat within a bone lesion is an excellent sign to indicate absence of growth !

CASE 7 : 54-year-old woman with anterior knee pain. Describe the lesion …. Growth rate ?

CASE 7 : 54-year-old woman with anterior knee pain. Describe the lesion …. Growth rate ?



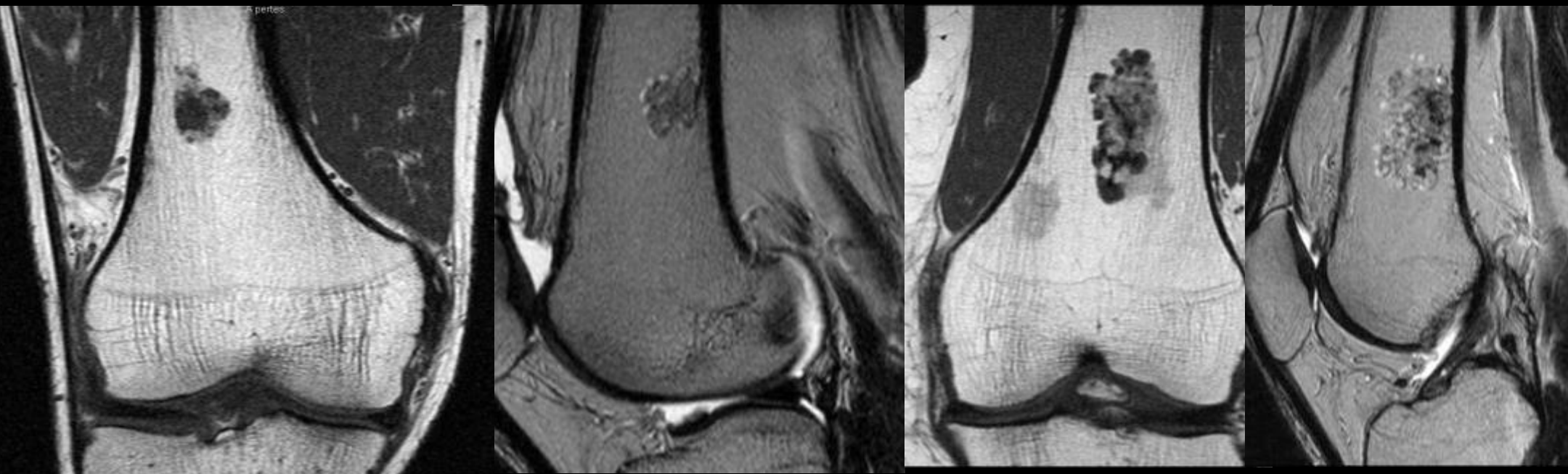
SE T1

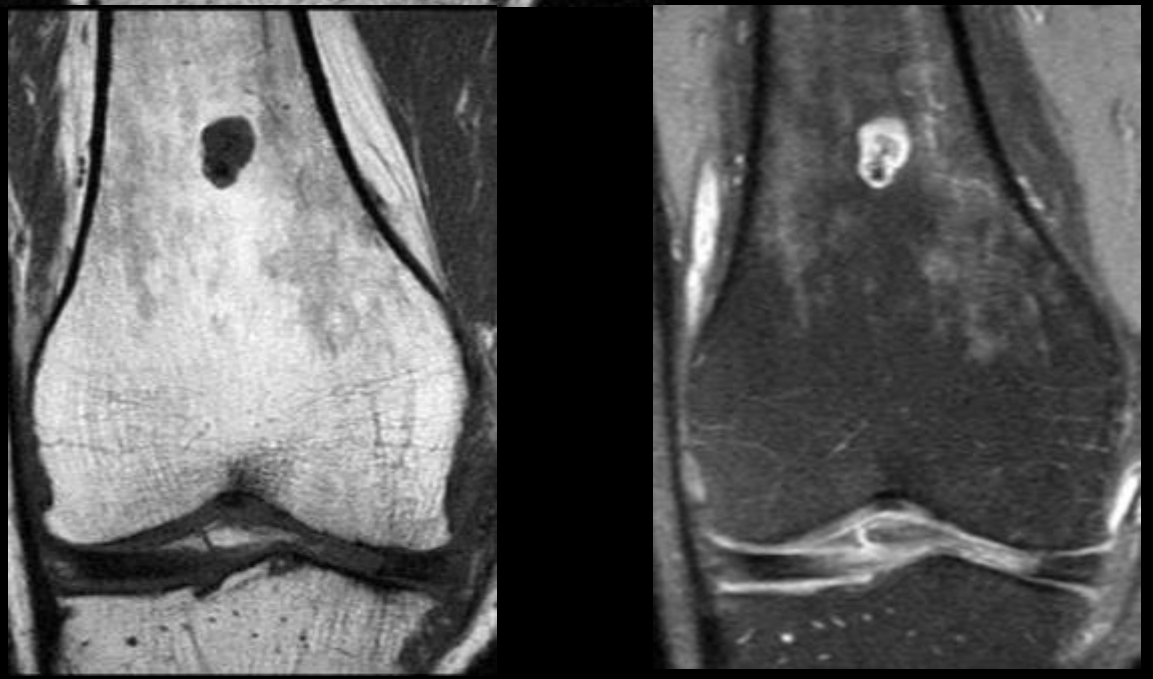


Grade 1 chondrosarcoma

- Frequent low-grade tumor > 50 years
- Curetage / resection
- May recur, late mets
- DD benign ench. >< grade 1 chondrosarcoma

Atypical chondroid/lipomatous/… lesion





Presumed enchondromas

- Medullary
- Lobulated contours
- Heterogeneous on T2
- Normal adjacent marrow

Benign enchondroma vs grade 1 chondrosarcoma

Features in favor of grade 1 chondrosarcoma

1. Endosteal scalloping (> 2/3 of cortical thickness)
2. Periosteal reaction
3. Soft tissue extension
4. « Bone » pain

NB Dynamic contrast enhancement has limited (no) value.

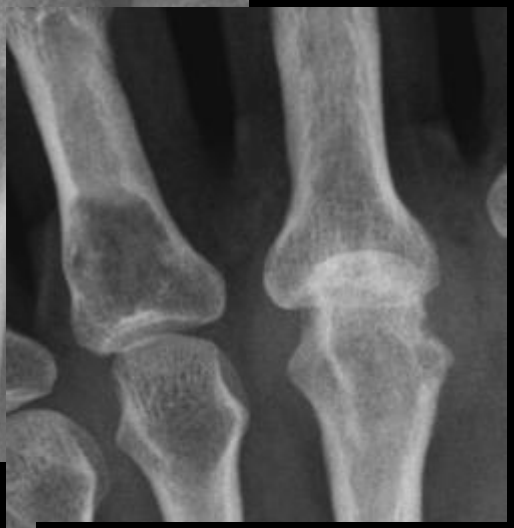
What are the differentiating clinical and MRI-features of enchondromas from low-grade chondrosarcomas? Douis H, Parry M, Vaiyapuri S, Davies AM. Eur Radiol. 2018 Jan;28(1):398-409. doi: 10.1007/s00330-017-4947-0.

Can imaging criteria distinguish enchondroma from grade 1 chondrosarcoma? Crim J, Schmidt R, Layfield L, Hanrahan C, Manaster BJ. Eur J Radiol. 2015 Nov;84(11):2222-30. doi: 10.1016/j.ejrad.2015.06.033.

Chondroid bone lesions:

The rule of « > 2/3 of cortical thinning=malignant » does not apply to small bones !

Finger : almost always benign // Pelvis : frequently malignant



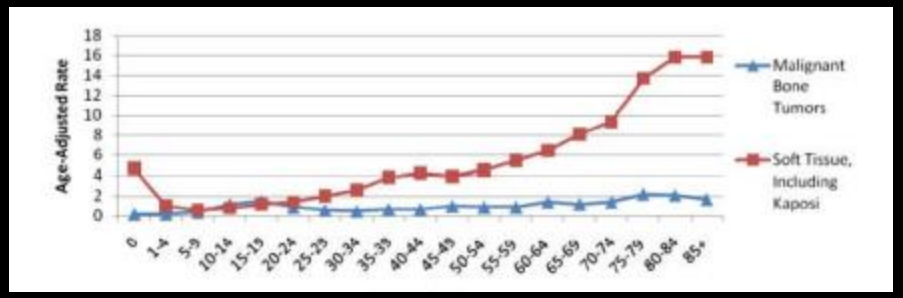
No change 4 years F/U

Objectives

1. Guidelines to analyze Bone Tumors.

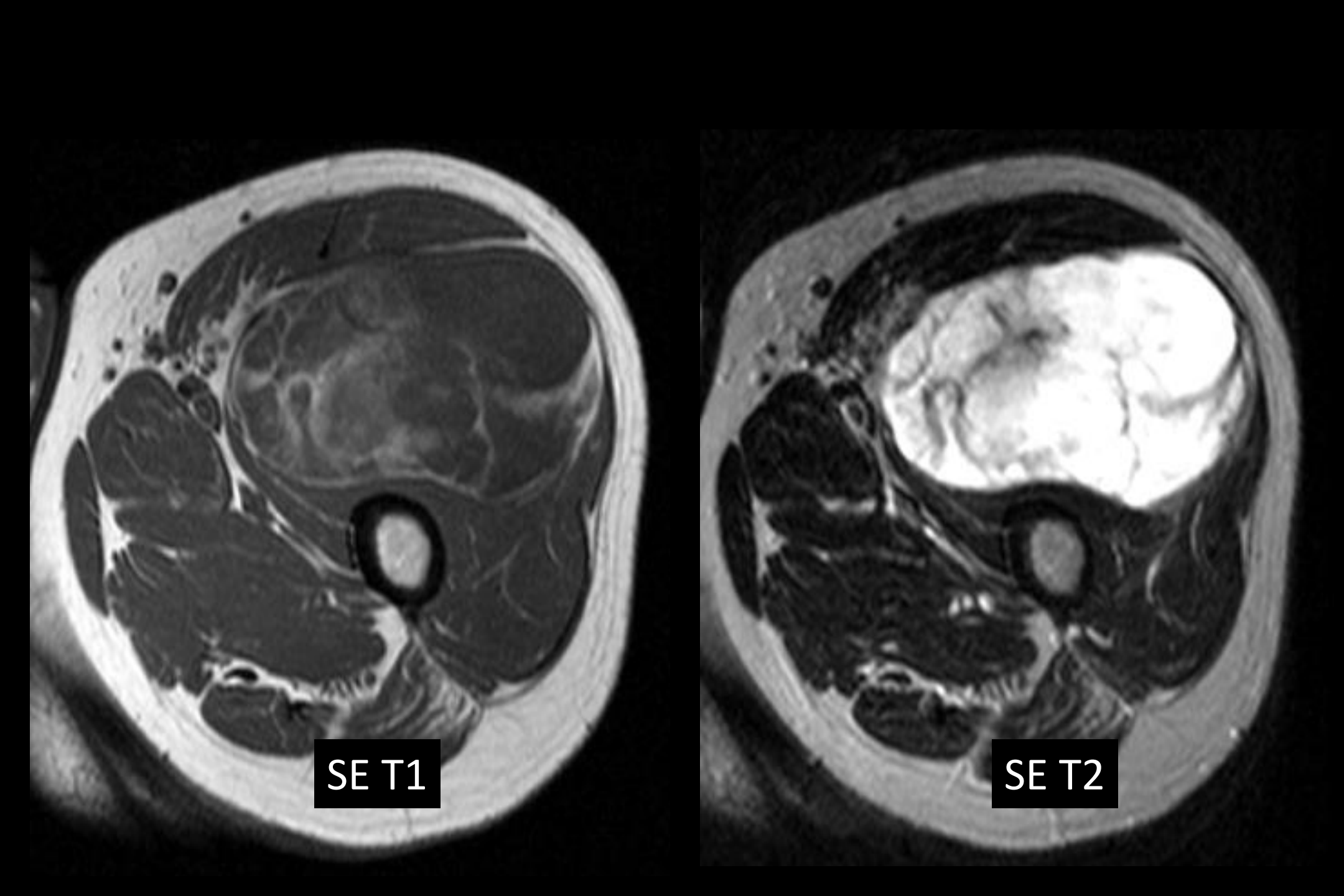
2. Focus on leave-me-alone/no-touch bone lesions.

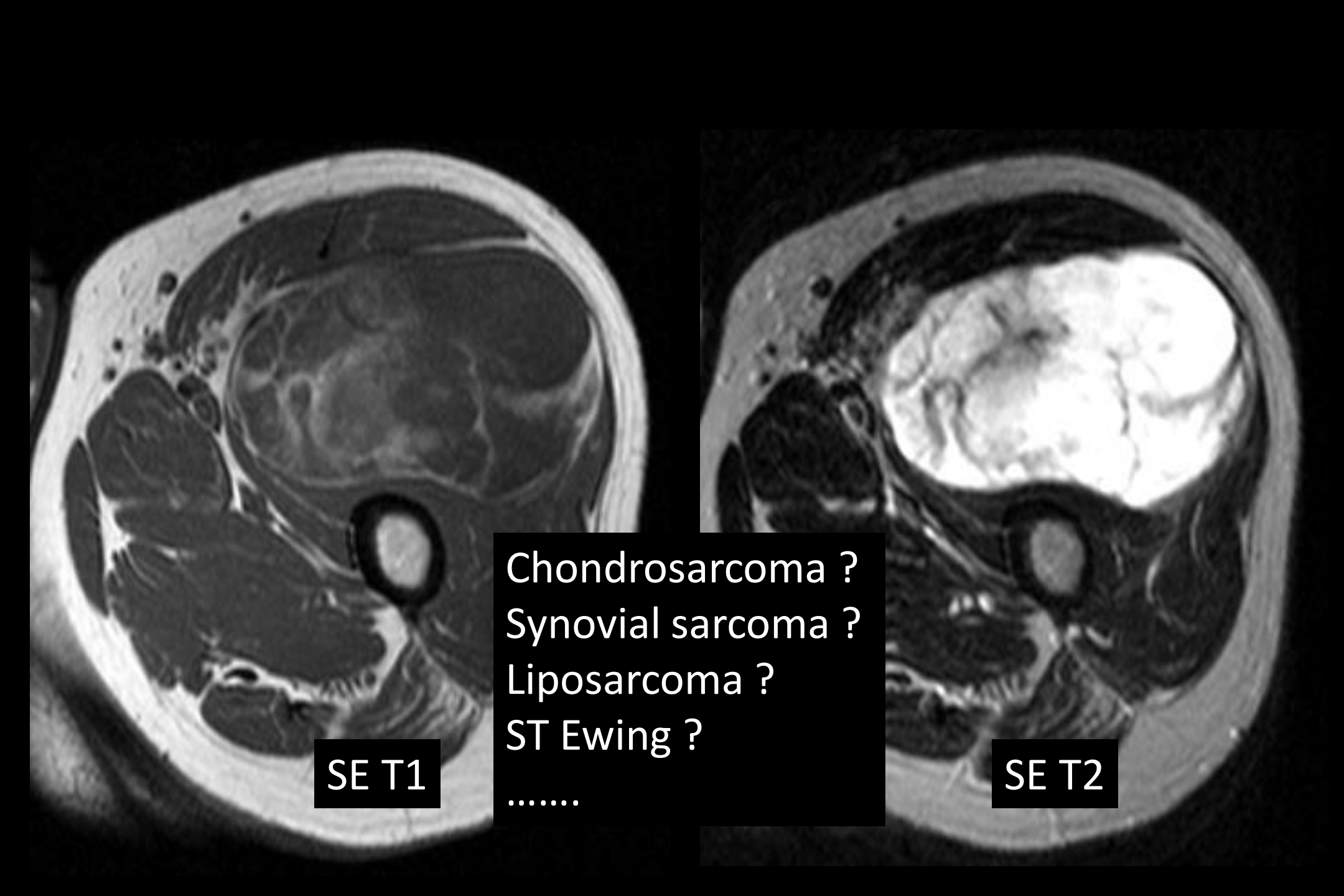
→ Concepts in imaging of Soft Tissue Tumors.



Incidence of new bone and ST sarcoma
by age between 2004-2008.

The epidemiology of sarcoma By Z Burningham et al Clinical sarcoma research 2012 Doi 10.1186/2045-3392-2-12


SE T1
SE T2


SE T1
Chondrosarcoma ?
Synovial sarcoma ?
Liposarcoma ?
ST Ewing ?
…….
SE T2

Imaging features of

Bone lesion

Soft tissue mass

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

?

Imaging features of

Bone lesions

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

Soft tissue mass

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

Imaging features of

Bone lesions

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

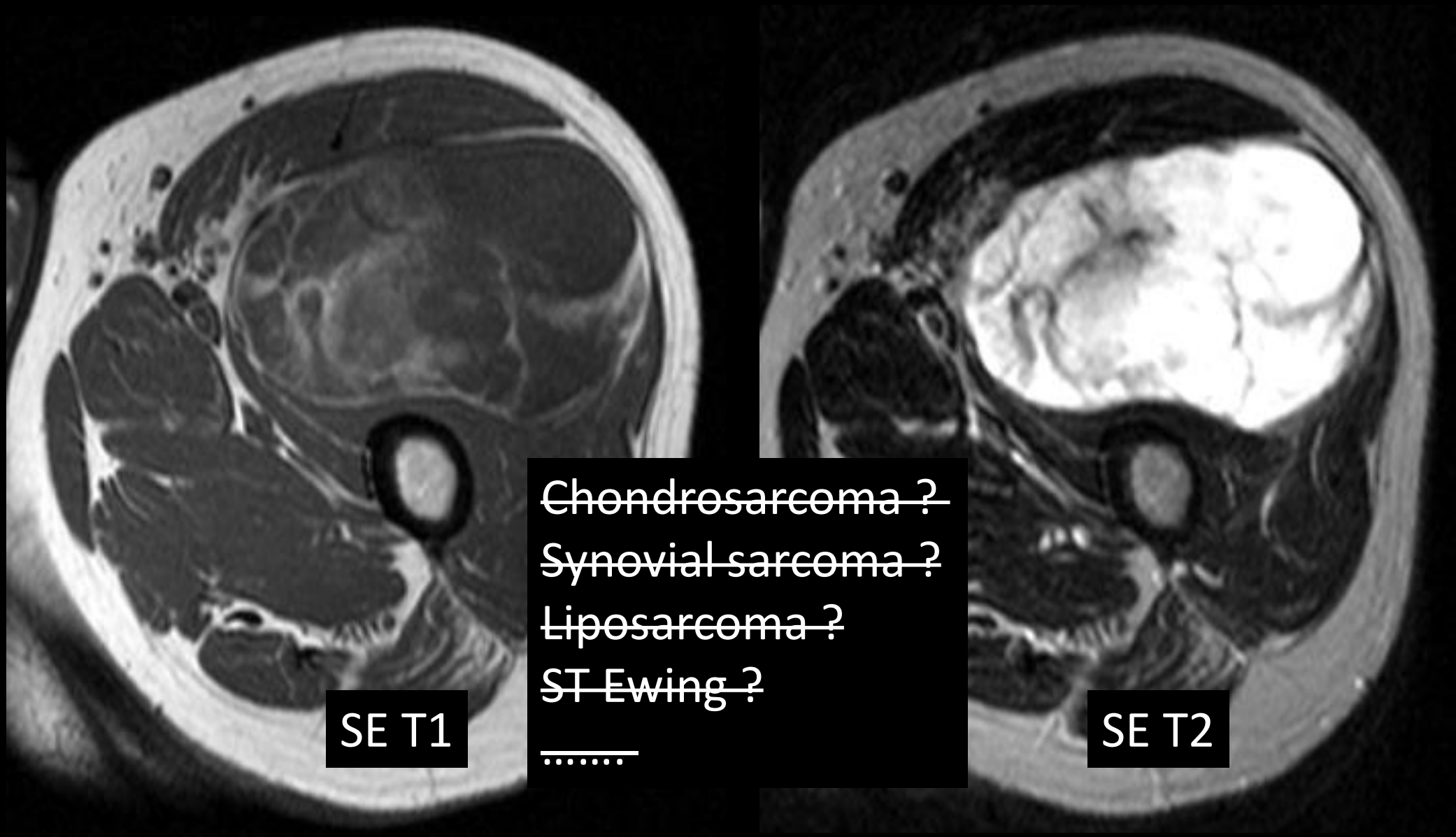
Soft tissue mass

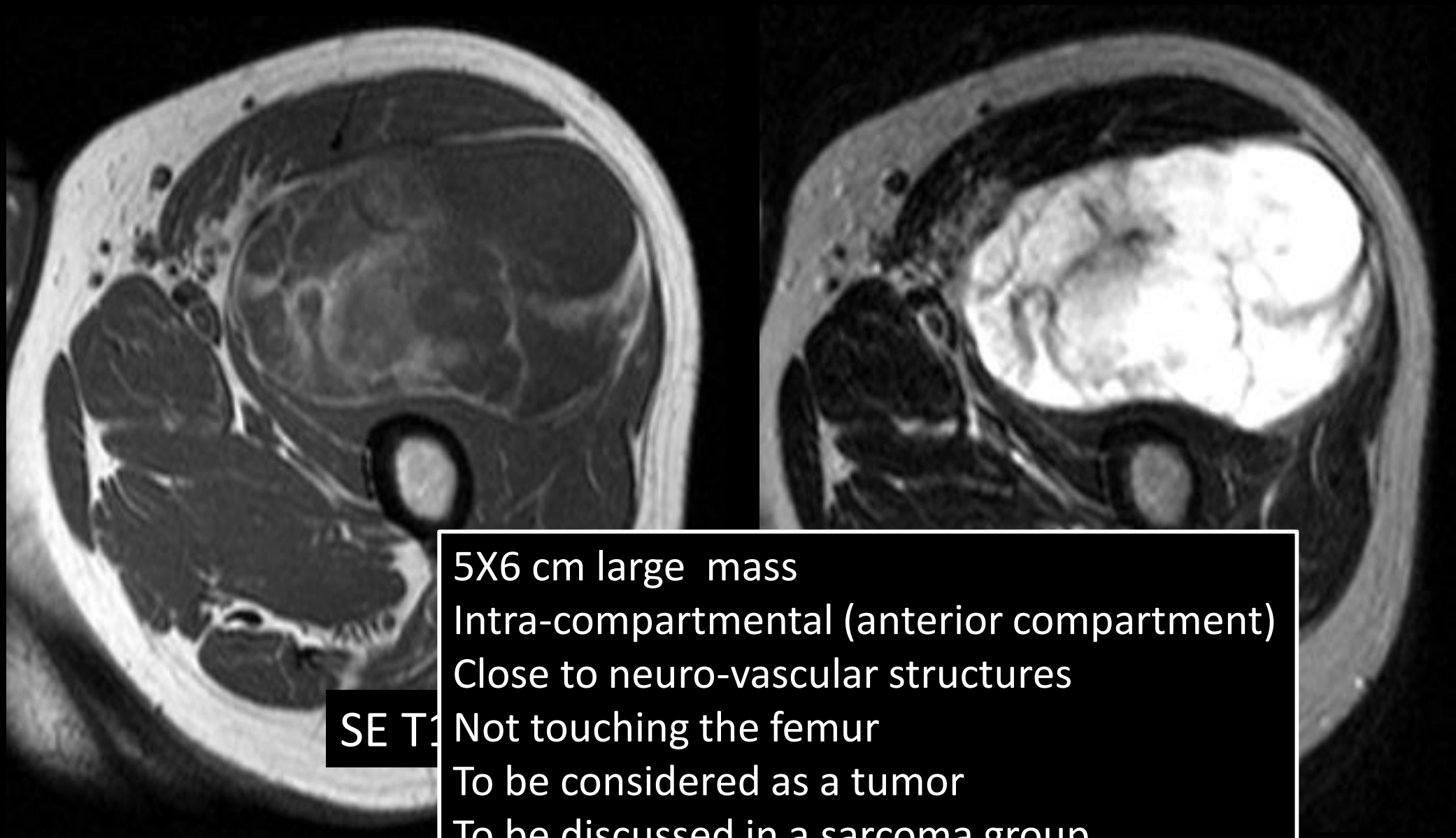
1. Location ./. compartments
2. Location ./. Nerves
3. Location ./. Vessels
4. Location./. Bone, joints

Imaging Soft tissue mass
How accurate are our reports ?

Localisation	100%
Size	64%
Relation with neuro vascular bundles	14%
Relation with bone	4%

An audit of MRI for bone and soft-tissue tumours performed at referral center
Saiffudin et al Clin radiol 2000; 55: 537-541


SE T1
~~Chondrosarcoma ?~~
~~Synovial sarcoma ?~~
~~Liposarcoma ?~~
~~ST Ewing ?~~
~~.....~~
SE T2


SE T1
5X6 cm large mass
Intra-compartmental (anterior compartment)
Close to neuro-vascular structures
Not touching the femur
To be considered as a tumor
To be discussed in a sarcoma group

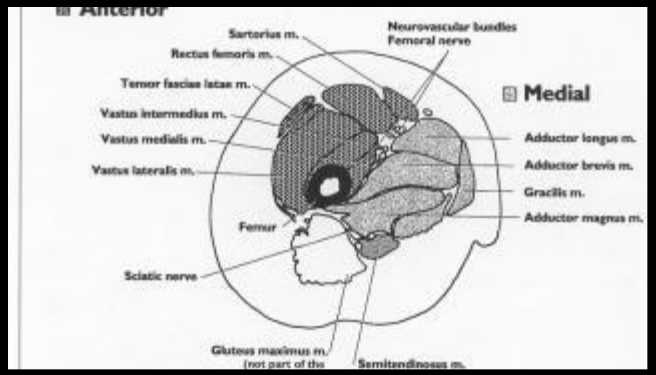
Compartmental anatomy (Fascia)

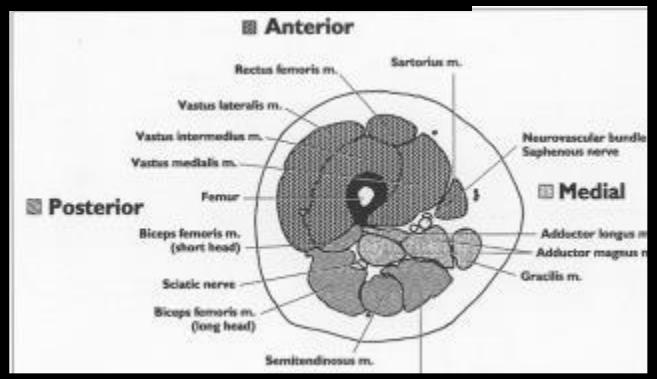
a. Subcutaneous space

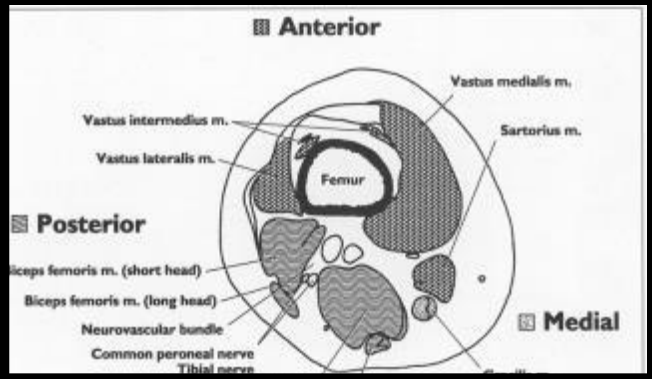
b. Deep compartments

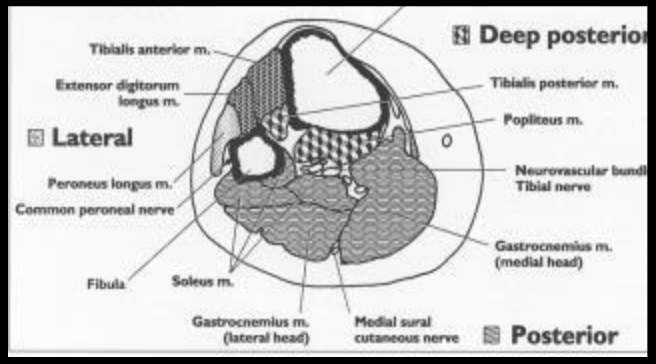
c. Bones and periosteum

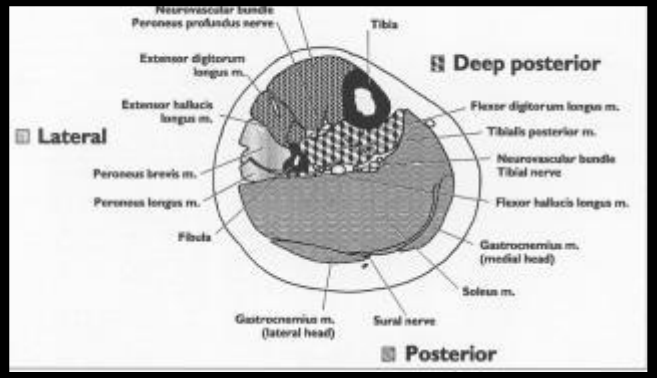
d. Joints

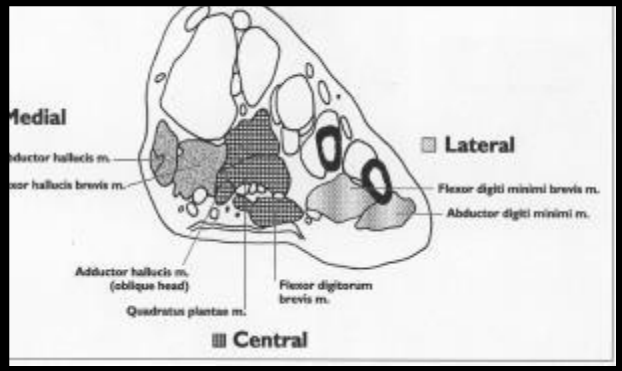




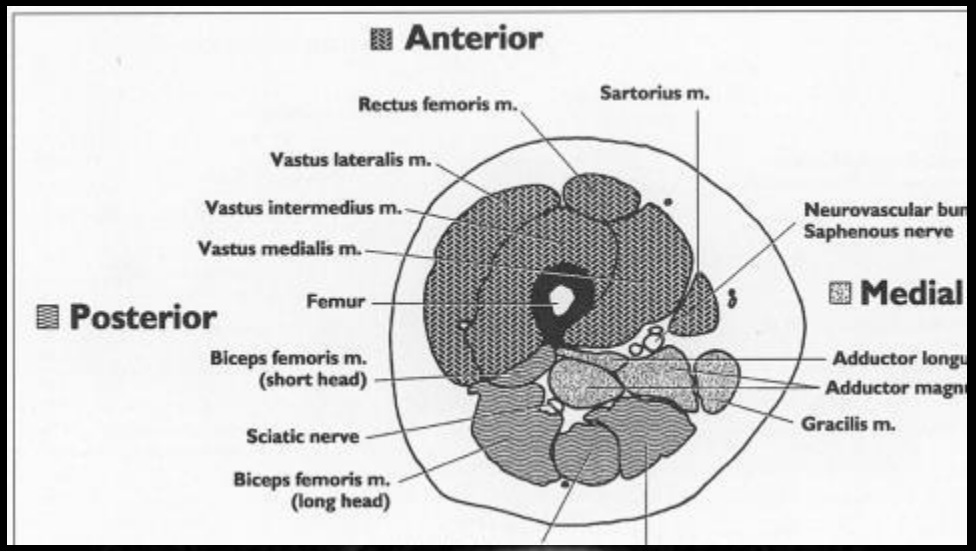


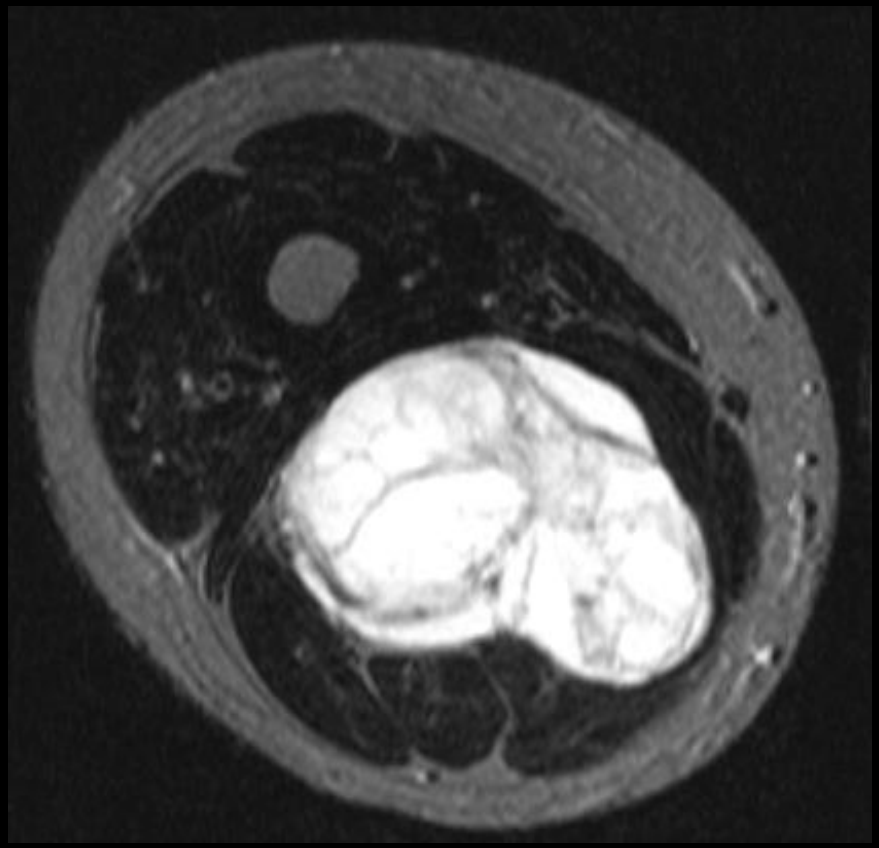


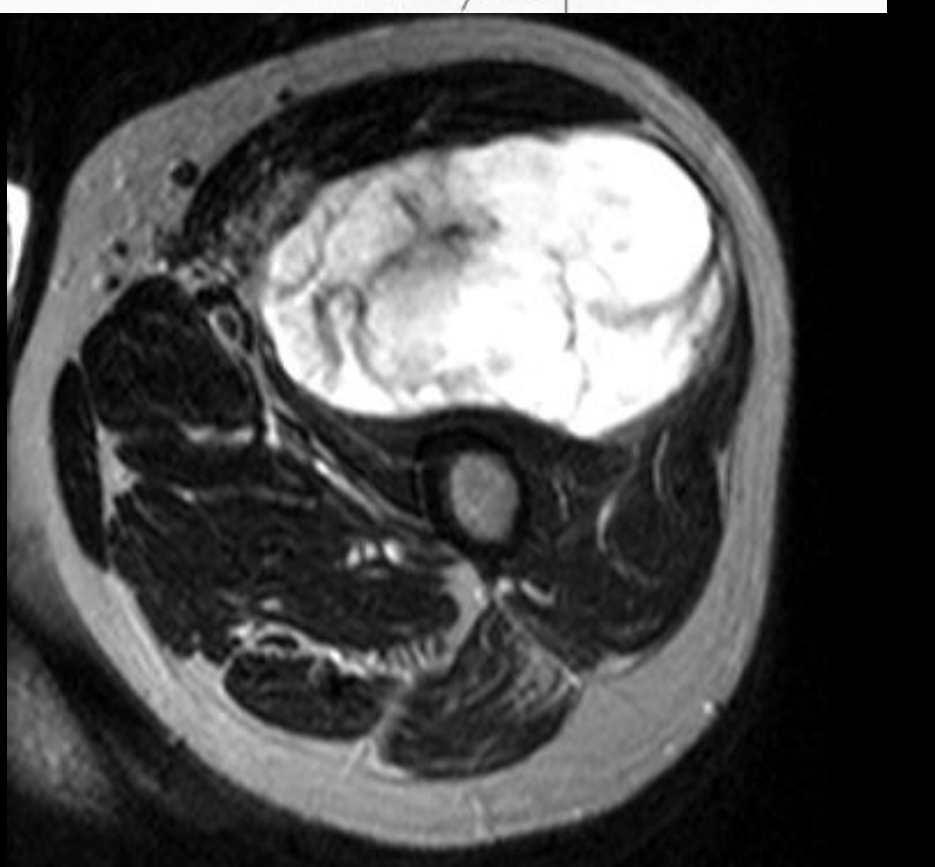




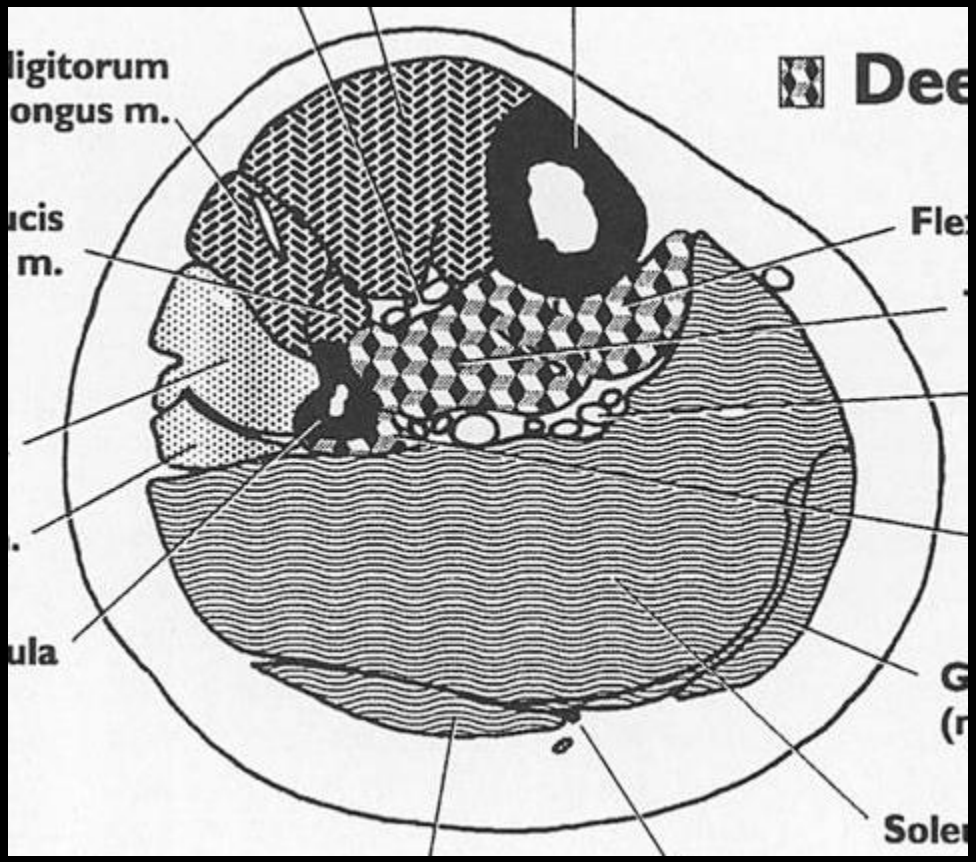
Intra-compartmental lesions

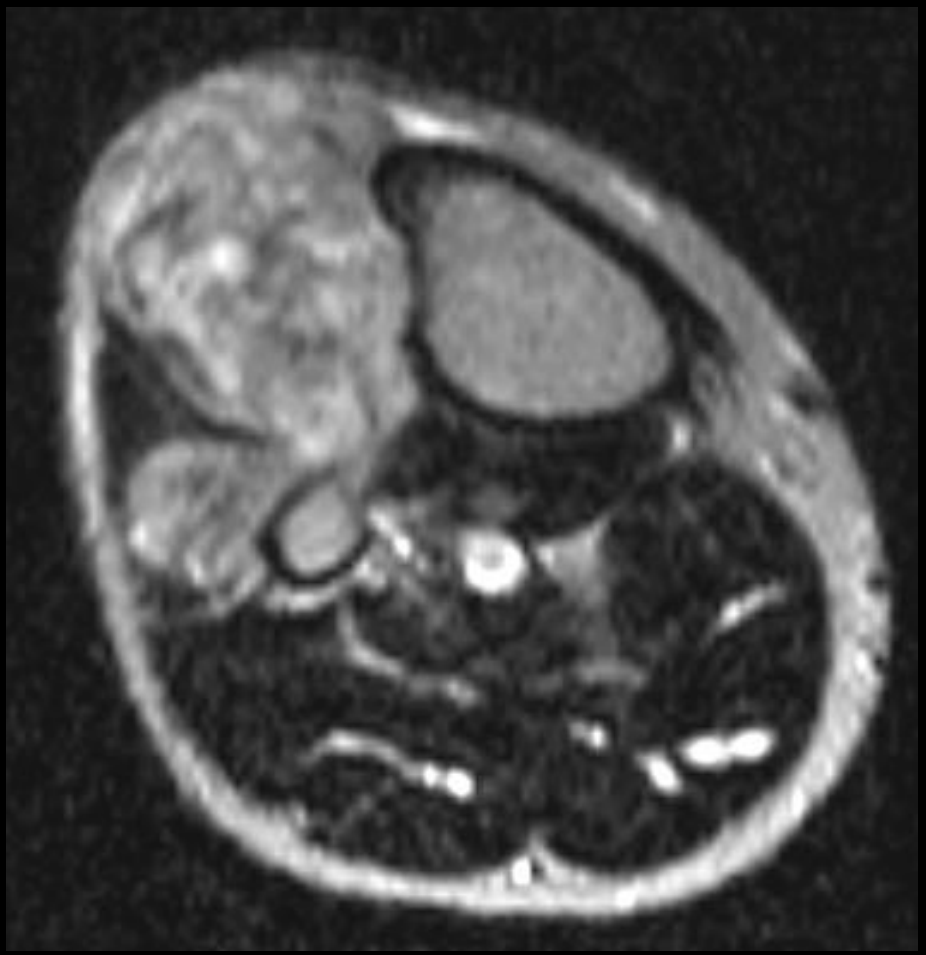




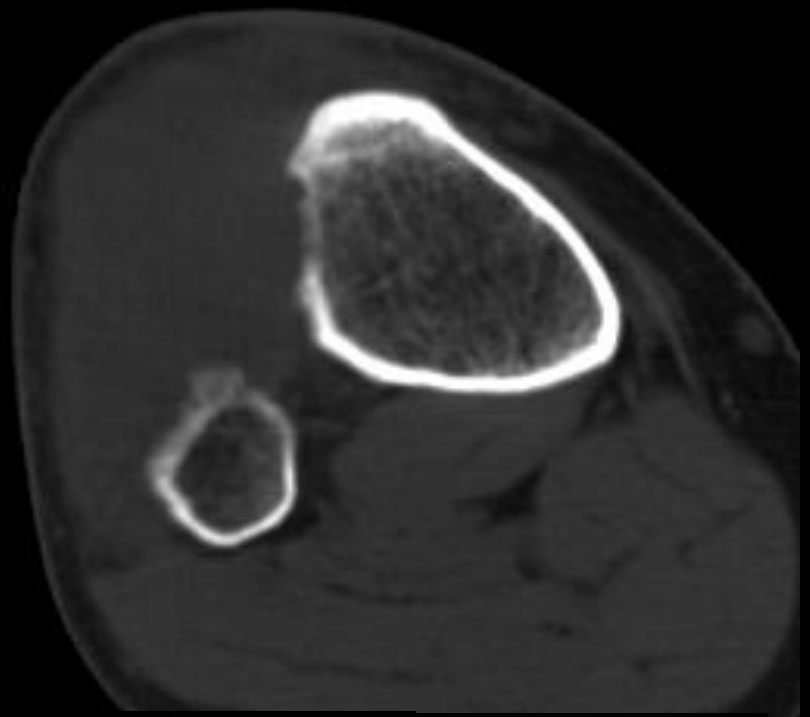


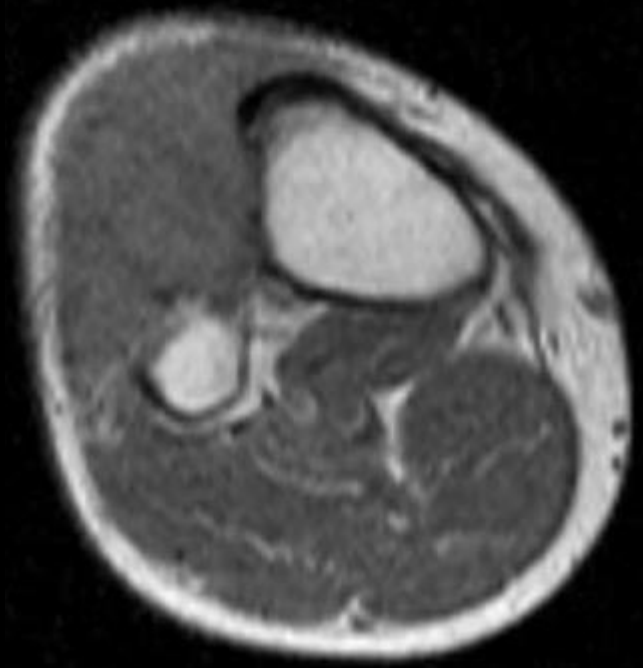
Extra-compartmental lesion
How many compartments are involved?

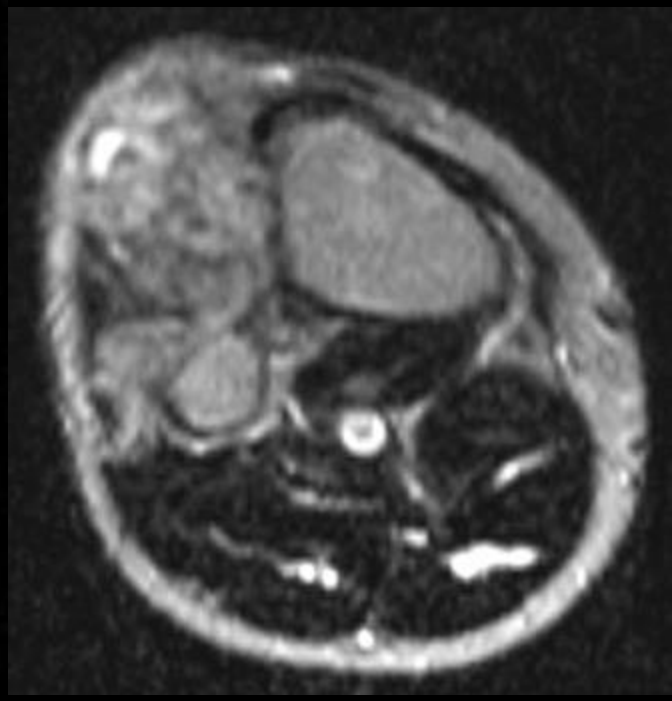


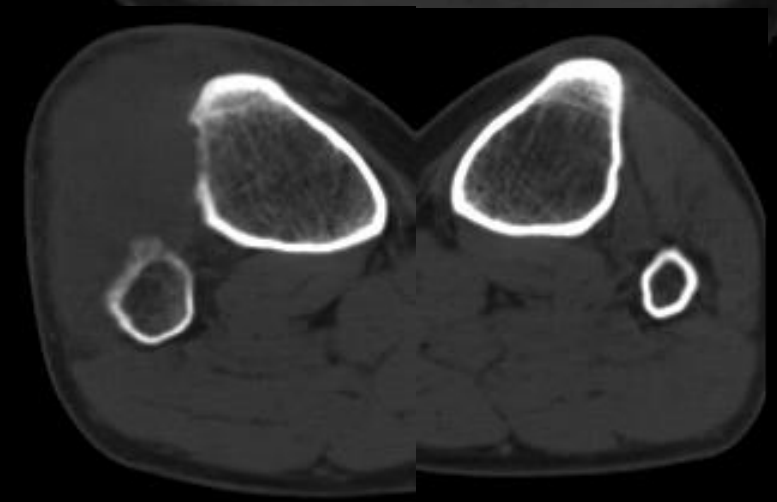


Cortical bone involment not always easy to assess on MR !









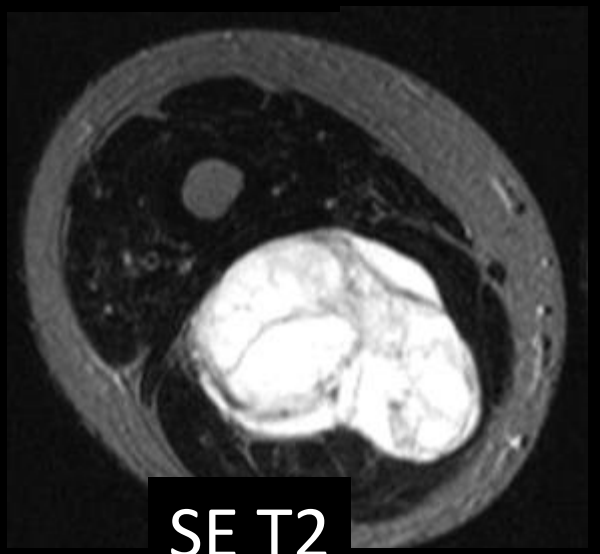
CT > IRM

Medullary bone involment easier to assess on MR !

Transverse images best display

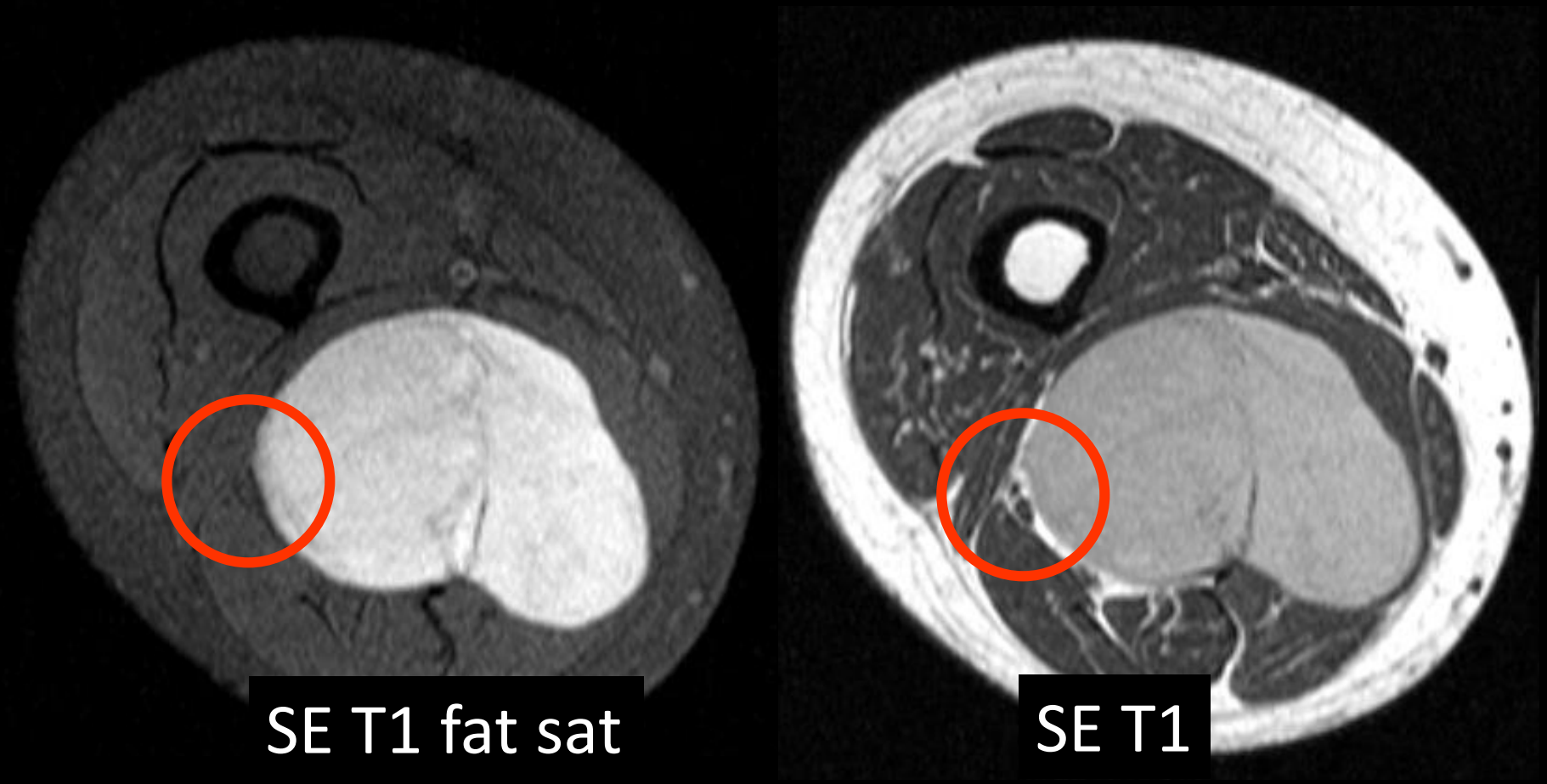
Compartmental anatomy

Relationships with neurovascular bundles



Fat is helpul to assess relationships with nerves & vessels !

Obtain at least one transverse fat-sensitive sequence !



Imaging features of

Bone lesions

1. Location
2. Structural bone changes
3. Margins
4. Mineralized matrix

Soft tissue mass

1. Location
2. ~~Structural bone changes~~
3. Margins are misleading
4. ~~Matrix~~

Do not trust margins of ST lesions!
Benign-looking nodules can be malignant !

Small subcutaneous lesion
well-delimited and homogeneous

malignant tumor (pleiomorphic sarcoma)

Do not trust margins of ST lesions!
Benign-looking nodules can be malignant !

Small subcutaneous lesion
well-delimited and homogeneous
Malignant tumor (Liposarcoma)

Rules when facing a soft tissue lesion

- Rule #1 : Location is critical.
  Superficial *vs* deep

- Rule #2 : Criteria useful for bone lesion do not apply to STT.
  Small, well-delimited ST lesion can be malignant.
  X-ray/CT are generally not contributive.

ESSR guidelines for ST mass imaging

- US criteria for benign lesions
- Indication for F/U ultrasound
- Criteria for proceeding to MRI
- Criteria for MRI as front-line imaging

- Criteria for referal to sarcoma group

Soft Tissue Tumors in Adults: ESSR-Approved Guidelines for Diagnostic Imaging

Iris M. Noebauer-Huhmann et al Seminars in musculoskeletal imaging 2015; 19: 475-482

ESSR guidelines for ST mass imaging

- US is first-stage triage imaging method
  - Mass: yes or not ?
  - Superficial or deep ?
  - Definite lipoma/cyst or not ?

- MRI is first-stage imaging method
  - Large, deep-seated, firm lesion
  - After previous treatment of a ST tumor

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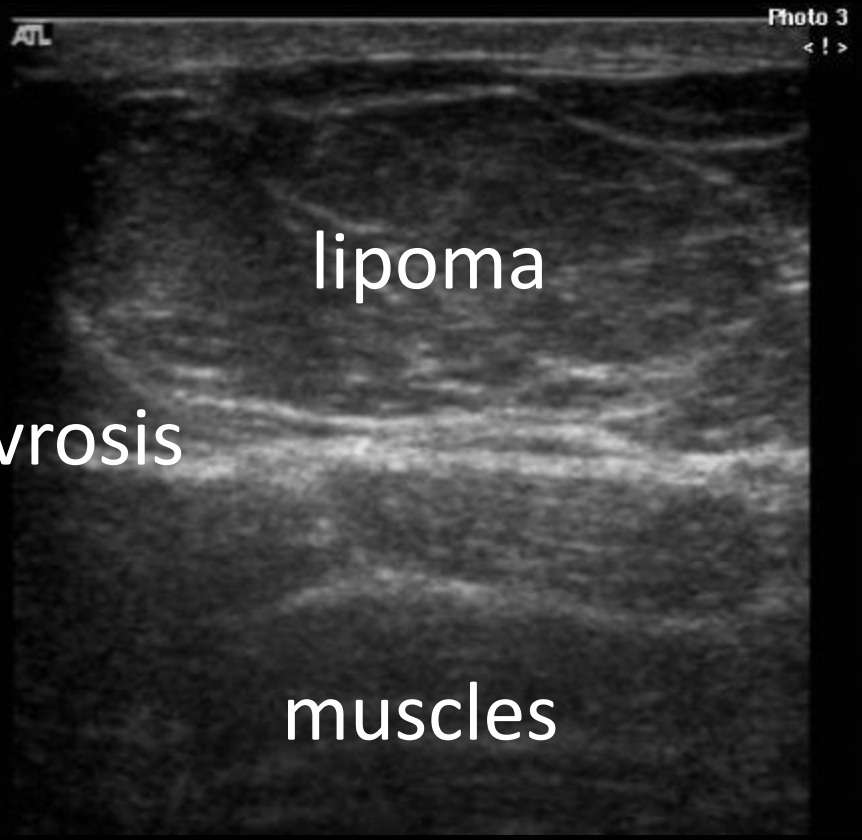
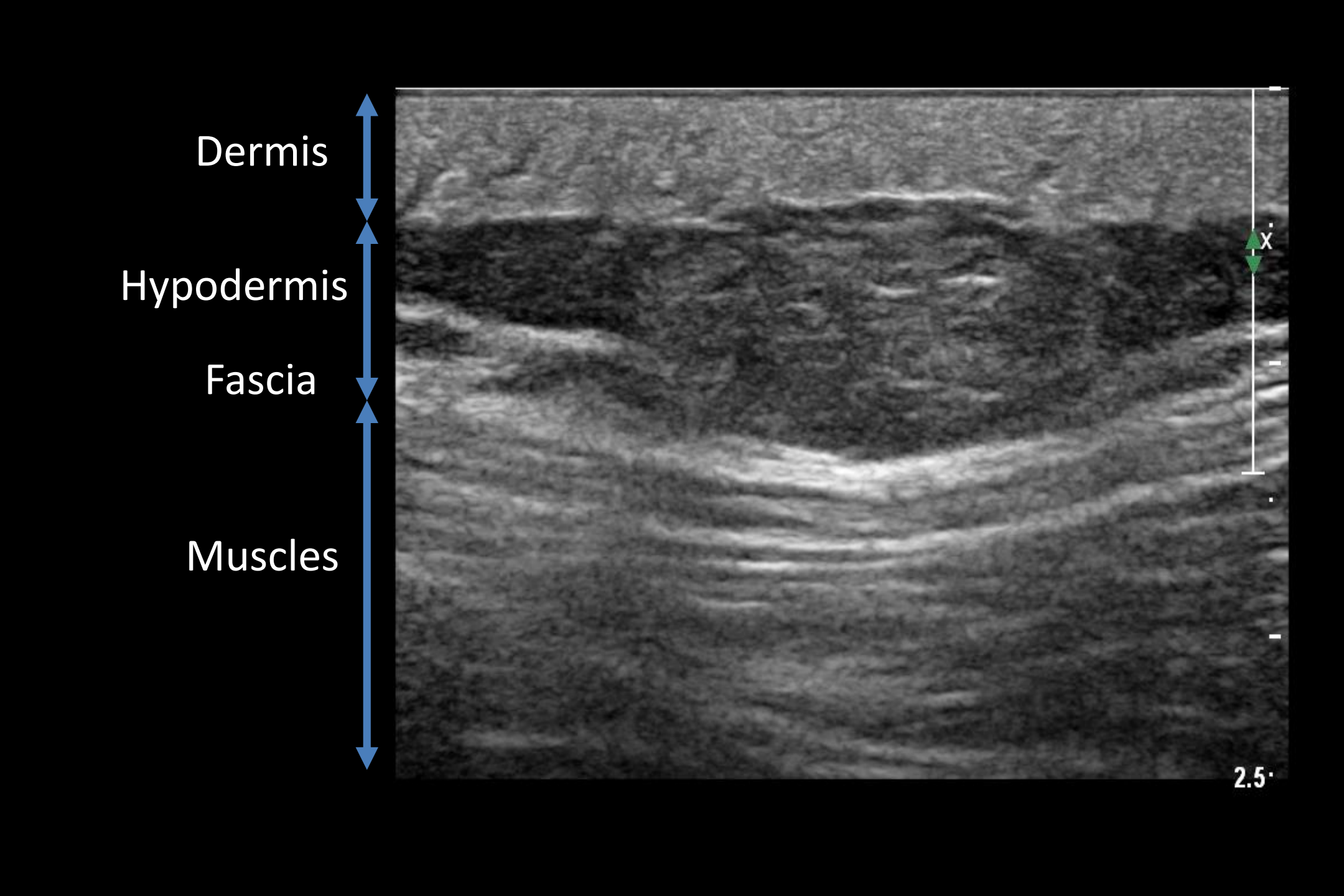
If superficial, ultrasound may be enough.
If deep, MR




Dermis
Hypodermis
Fascia
Muscles
x
2.5

US criteria for benign lesions in adults

- Simple cyst, bursa, synovial/ganglion cyst:

purely cystic well-defined lesion without any solid component, anechoic, with posterior acoustic enhancement and no vascularity.

– Superficial lipoma:

homogeneous well defined, encapsulated, and compressible with no clinical concern and documented stability on US (at least 6 moF/U).

– varia:

Vascular malformation with no clinical concern / – Foreign body "granuloma" with a compatible history / Superficial fibromatosis / muscle hernia/ Morton neuroma / Epidermoid cyst

Soft Tissue Tumors in Adults: ESSR-Approved Guidelines for Diagnostic Imaging

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Criteria for Proceeding to a Subsequent MRI

– Any clinical or sonographic doubt.
– Any tumor that is not completely accessible by US
– Any tumor with a reasonable likelihood of being malignant.
– Size > 5 cm.
– Location: below the superficial muscle fascia, or superficial, but obtuse contact with or crossing of the superficial fascia.

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Criteria for referral to a sarcoma treatment center:

– Any patient with a 5-cm superficial tumor or with a deep-seated tumor regardless of size.

– Indeterminate US or indeterminate MRI findings, or clinical suspicion of malignancy.

– Patients should be referred before biopsy or surgery.

Soft Tissue Tumors in Adults: ESSR-Approved Guidelines for Diagnostic Imaging

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Rules when facing a soft tissue lesion

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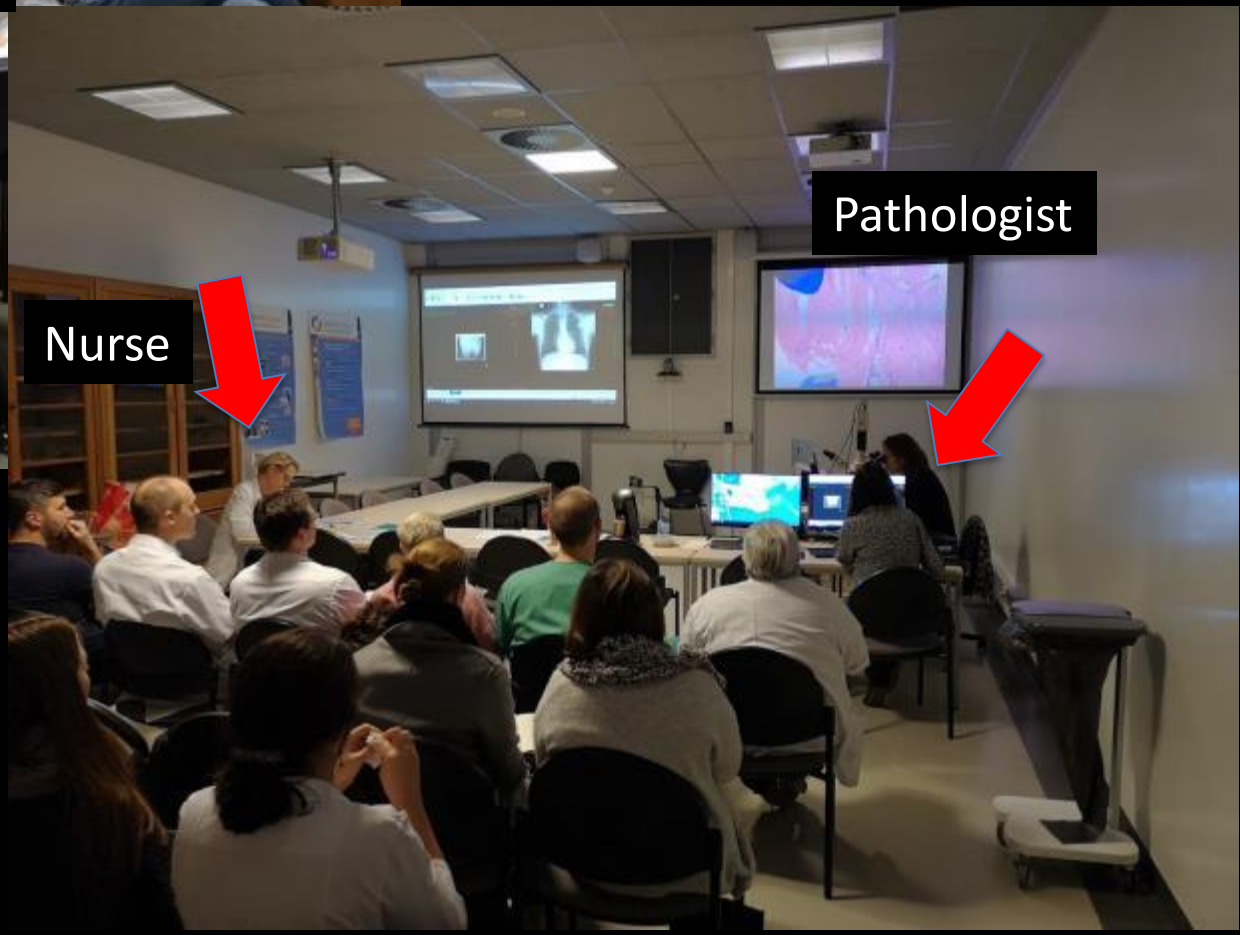
  Superficial *vs* deep

- Rule #2 : Criteria useful for bone lesion do not apply to STT.
  Small, well-delimited ST lesion can be malignant.
  X-ray/CT are generally not contributive.

- Rule #3: Do not take inappropriate initiatives (whoops surgery)
  Discuss with a sarcoma group.

Sarcoma group at UCL Brussels

Adult oncologist



Our 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.

I had promised that you would

- have a « structured » brain.
- become familiar with common no-touch bone lesions.
- be able to propose and guide imaging strategies.

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.

Rules when facing a soft tissue lesion

- Rule #1 : Location is critical.
  Superficial *vs* deep

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  Discuss with a sarcoma group.

Suggested readings and pdf of this presentation at

https://www.uclimaging.be/DESavancé/2020-2021/vendredi 30 octobre

Bone and soft tissue tumors

Cliniques universitaires
SAINT-LUC
UCL BRUSSELS

http://www.uclimaging.be/ecampus/IDKD_2019.htm