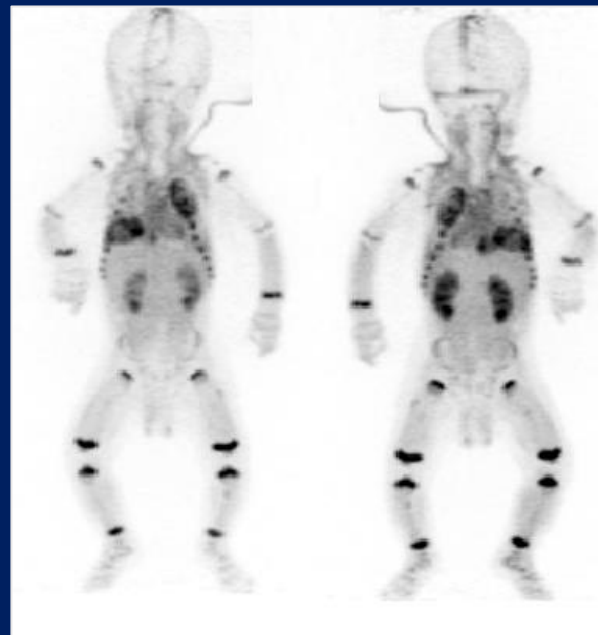
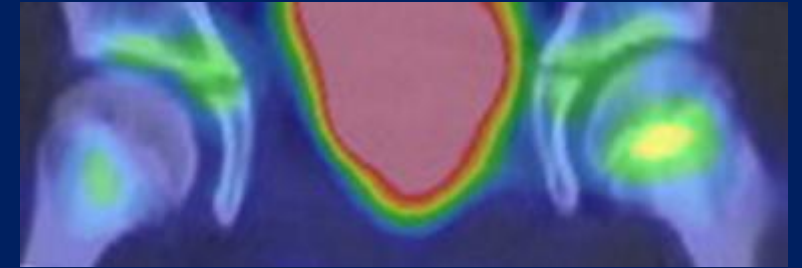




ecpr2021.org

Nuclear Medicine of the MSK system Indications & Protocols



LEARNING OBJECTIVES

- ▶ Review of the technique: nuclear medicine examinations of the MSK system
- ▶ Guidelines for the nuclear examinations of the MSK system
- ▶ Identify how and when to perform nuclear medicine examinations of the MSK system



Nuclear Medicine of the MSK system

Indications & Protocols

INDEX

- ▶ Bone physiology and pathophysiology
- ▶ Techniques
- ▶ Guideline review with examples



- ▶ Bone physiology and pathophysiology
- ▶ Techniques
- ▶ Guidelines review with examples

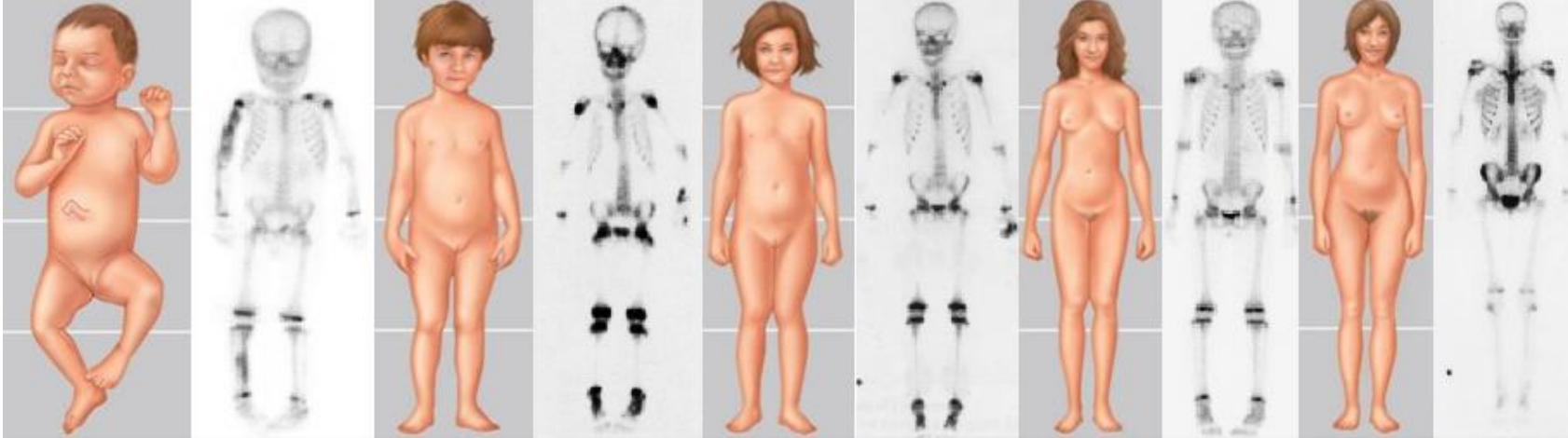
Nuclear Medicine is the medical specialty that applies radioactive isotopes to **DIAGNOSIS** and **THERAPY**



Knowledge of physiology and pathophysiology is crucial for interpreting NM scans



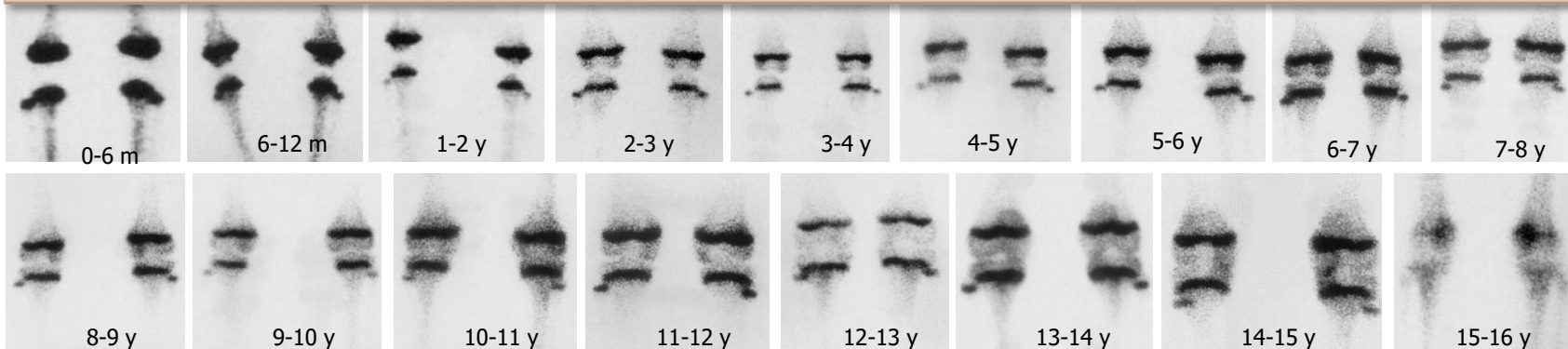
Imaging of the Developing Skeleton



ESPECIALLY IF YOU ARE A NON-PAEDIATRIC NUCLEAR MEDICINE PHYSICIAN

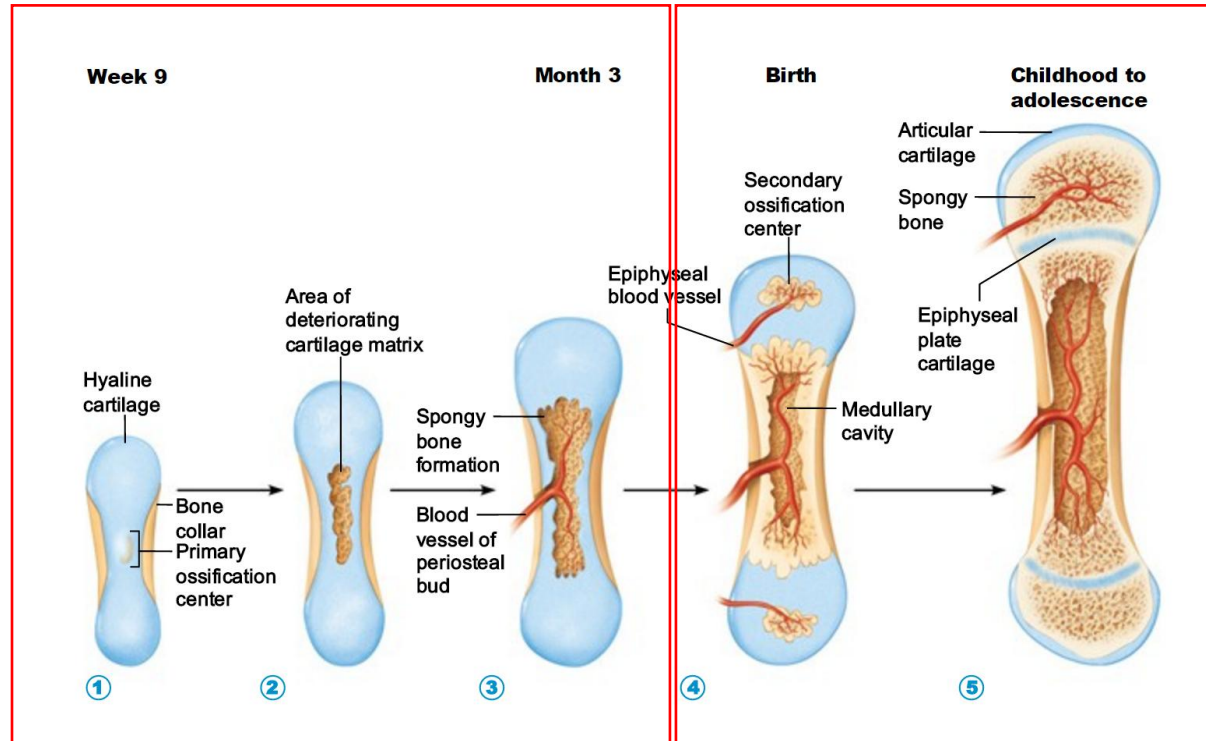
Before interpreting a bone scan in children, you need to know the NORMAL appearance of the skeleton from infancy to adulthood:

- Normal variants
- Metabolic bone changes



Bone development:

- Embryology
- Bone physiology

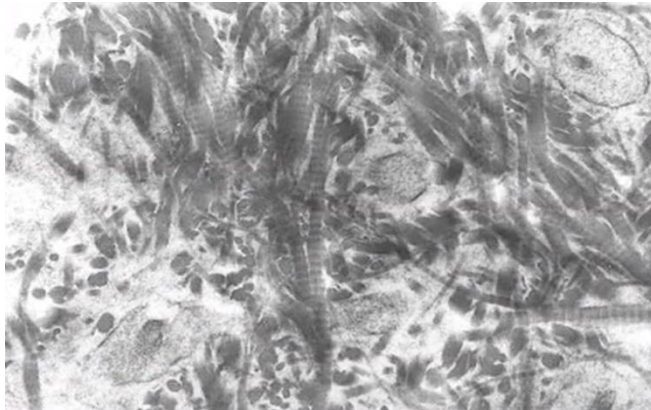


Bone Physiology

Matrix of bone

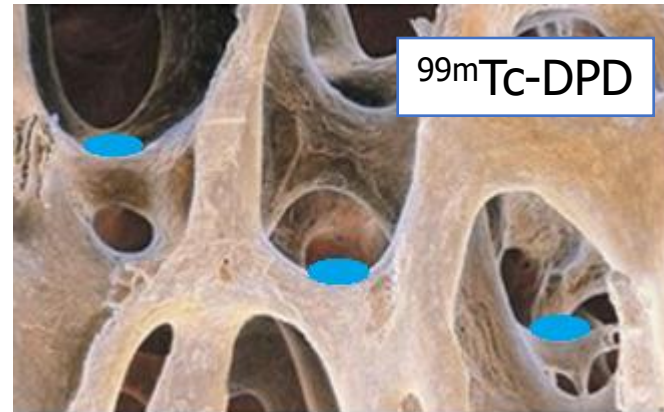
BONE'S FLEXIBILITY:

- collagen fibres

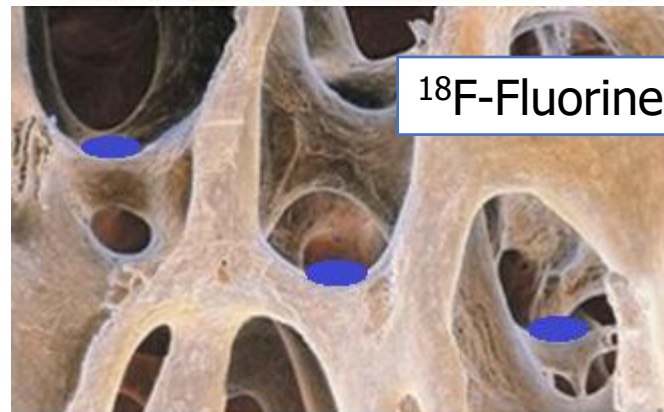


BONE'S HARDNESS: inorganic salts

- calcium phosphate
- hydroxide
- hydroxyapatite



^{99m}Tc -DPD



^{18}F -Fluorine

CALCIFICATION:

- mineral crystals deposit around collagen fibres

METABOLIC BONE IMAGING:

MECHANISM

^{99m}Tc -DIPHOSPHONATE

→ BONE SCINTIGRAPHY

^{18}F -Fluorine

→ BONE PET

- Both diphosphonates and Fluorine have a high avidity to hydroxyapatite crystals

- This is the mechanism to obtain metabolic bone images
- the uptake intensity depends on
 - vascular supply
 - osteoblastic and osteoclastic activity

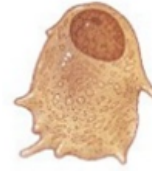
Jones AG, Francis MD, Davis MA. Bone scanning: Radionuclide reaction mechanisms. Semin Nucl Med 1976; Jan;6(1):3-16.
Grant FD, Fahey FH, Packard AB, Davis RT, Alavi A, Treves ST. Skeletal PET with ^{18}F fluoride: applying new technology to an old tracer. Clin Nucl Med. 2008 Jan;49(1):69-78.
Blau M, Nagler W, Bender MA. Fluorine-18: A new isotope for bone scanning. J Nucl Med 1967; Sep;8(9):332-4.
French RJ, McCready VR. The use of ^{18}F for bone scanning. Br J Radiol 1967; Sep;40(477):55-61.
Stansfield EC, Sheehy N, Zurakowski D, Vija AH, Fahey FH, Treves ST. Pediatric ^{99m}Tc -MDP bone SPECT with ordered subset expectation. Radiology 2011; 257:773-801.
Segall G, Delbeke D, Stabin MG, Even-Sapir E, Fair J, Sajdak R, et al. SNM practice guideline for sodium ^{18}F -fluoride PET/CT bone scans. J Nucl Med 2010; Nov;51(11):1613-20.

Bone Physiology

Cells

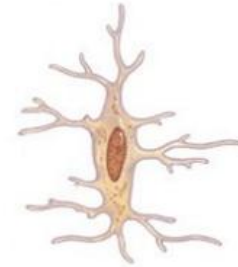
• OSTEOLASTS: bone forming cells

- mesenchymal origin
- produce bone tissue:
 - organic bone matrix
 - collagen fibres



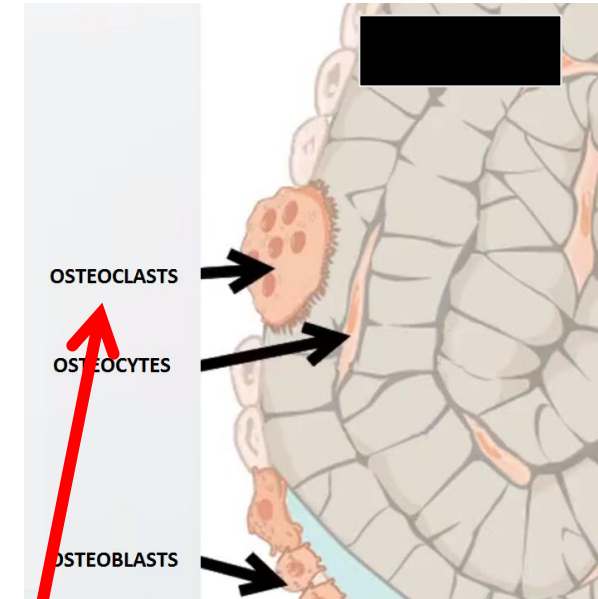
• OSTEOCYTES

- produce the inorganic matrix
- no longer secrete bone matrix
- derived from osteoblasts that have secreted bone around themselves



• OSTEOLASTS

- extremely large cells
- derived from haematopoietic system (fused monocytes)
- bone resorption = destruction of bone matrix



Bone Physiology

Bone Growing during Childhood

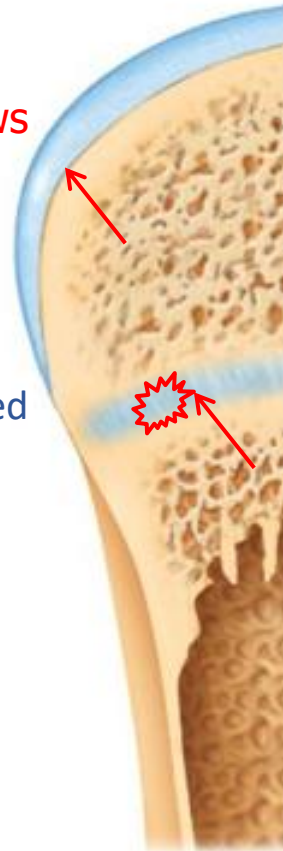
- **ARTICULAR CARTILAGE**

- grows externally
- replaced by bone internally

- **EPIPHYSEAL CARTILAGE**

- grows to the epiphysis
- replaced by bone on the diaphysis side

Cartilage grows



Cartilage replaced by bone

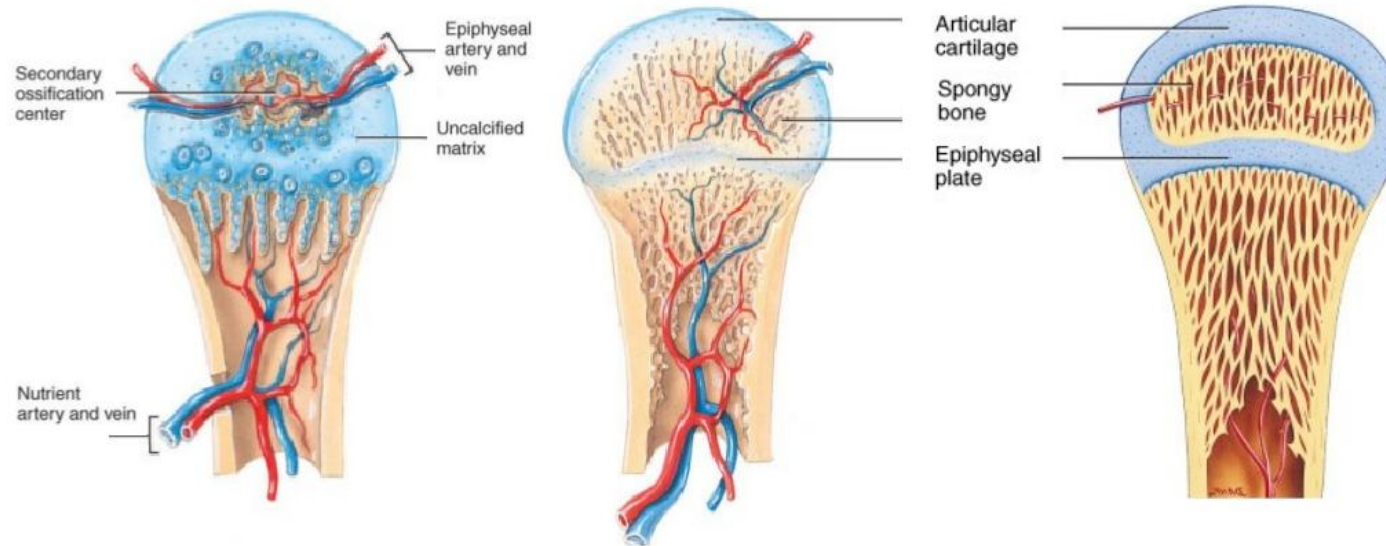
Cartilage grows



Cartilage replaced by bone

Bone Physiology

Bone Growing during Childhood



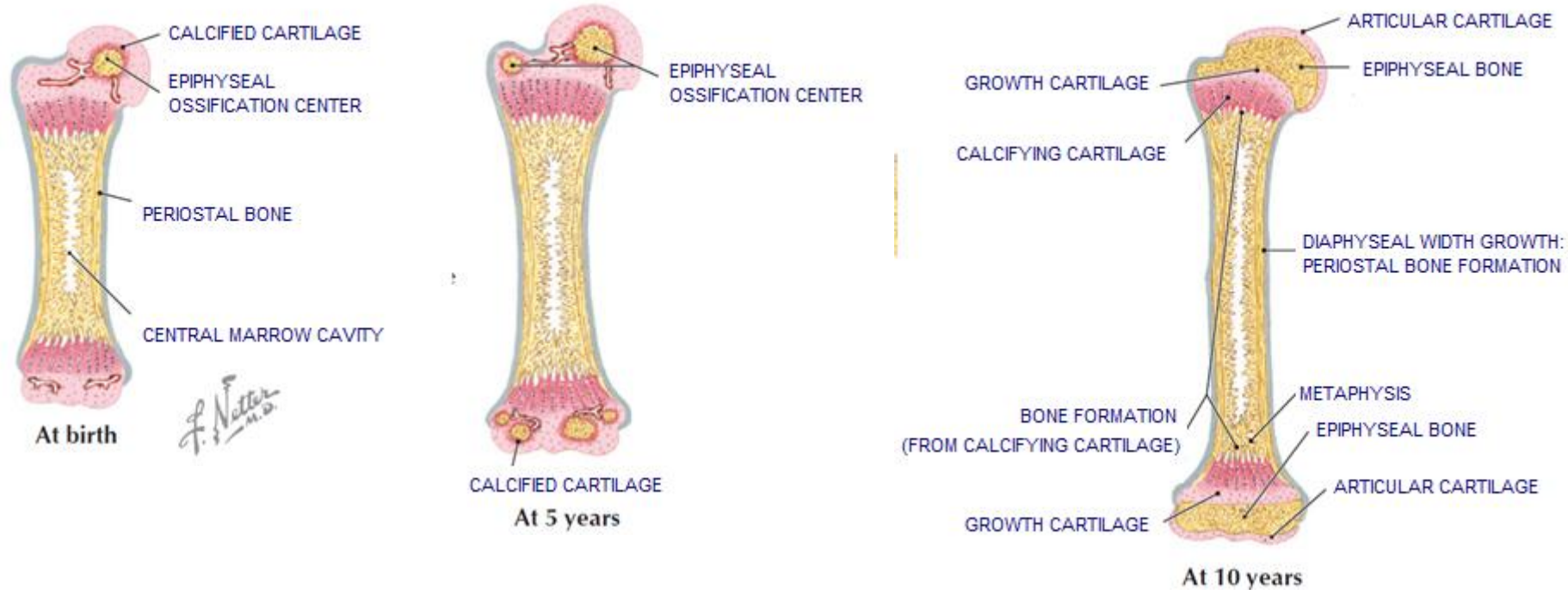
Development of a secondary ossification centre

To interpret the normal bone maturation imaging is important to know the bone growing during childhood, especially the development of the secondary ossification centres



Bone Physiology

Bone Growing during Childhood

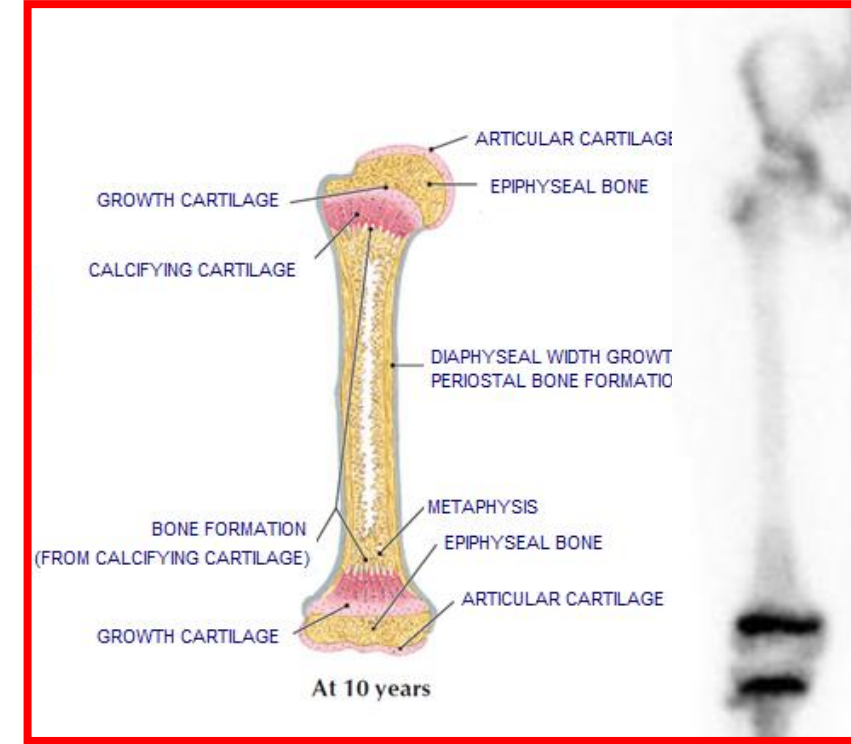
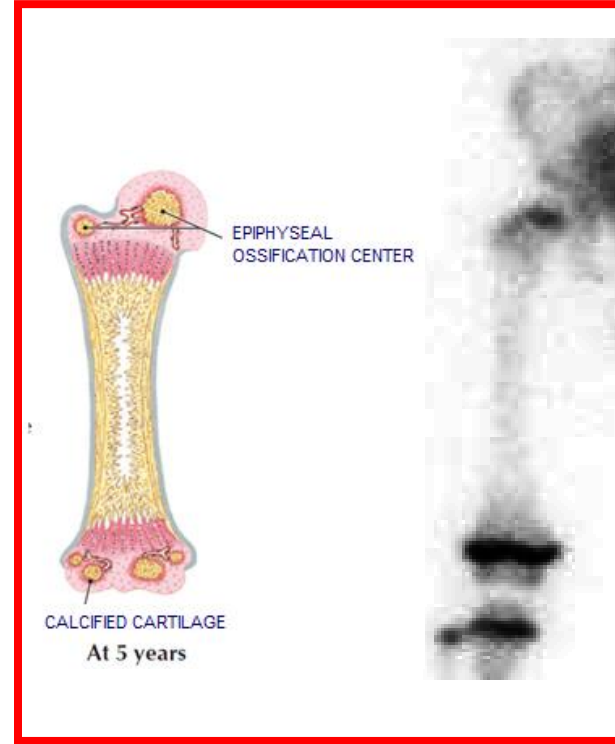
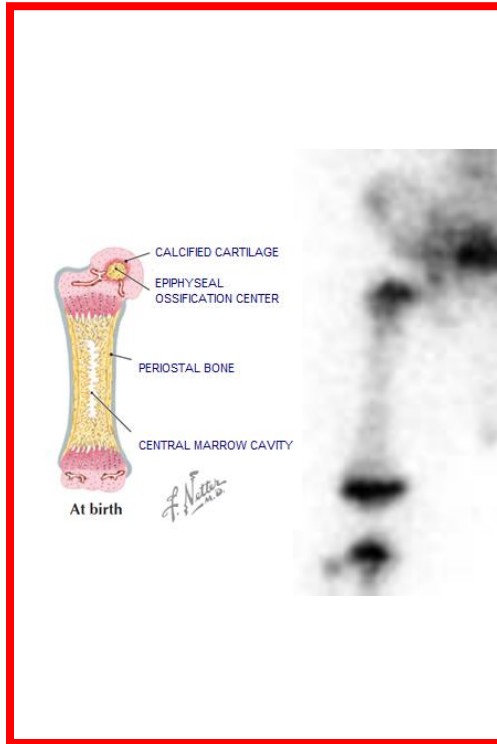


The appearance of secondary ossification centres can be misinterpreted as pathology



Bone Physiology

Bone Growing during Childhood



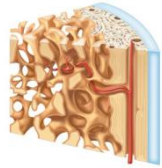
Some examples of the bone scan visualization of femoral head ossification centre during development



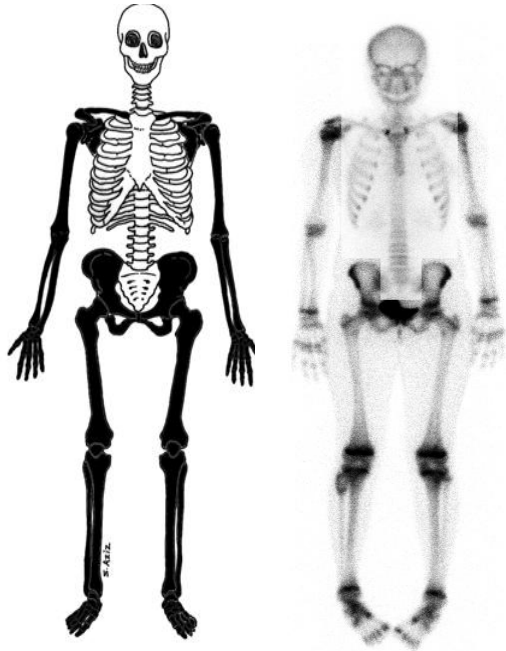
DEVELOPING SKELETON

COMPACT or CORTICAL BONE

- Cortex:
- 80% skeleton mass
- 99% calcium
- 90% phosphorus
- Medulla: spongy bone

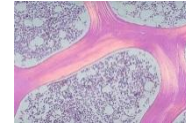


Appendicular skeleton

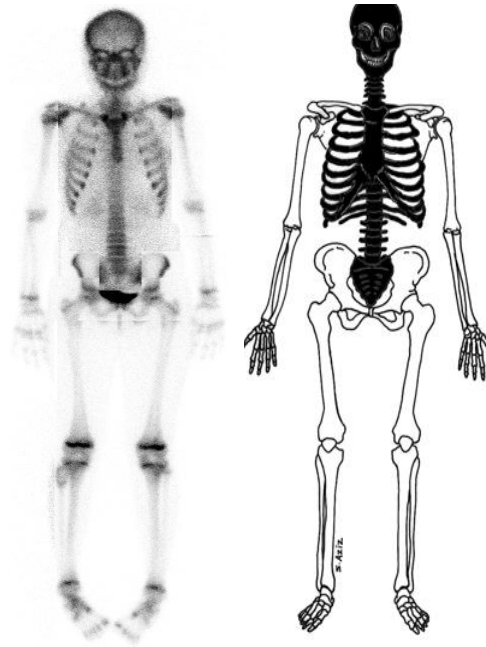


TRABECULAR or SPONGY or CANCELLOUS BONE

- High turnover rate: x8 > cortical bones
- Hosts haematopoietic and blood cells



Axial skeleton

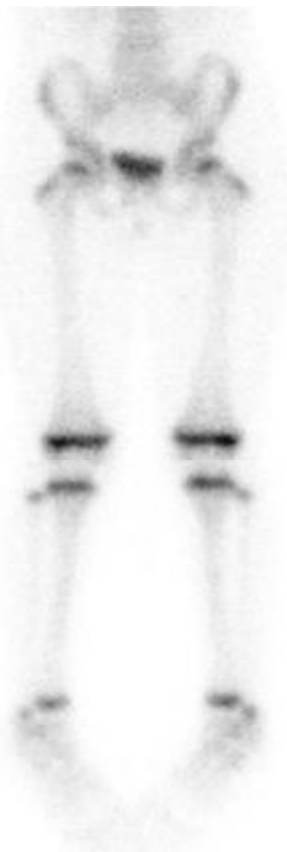


EPIPHYSEAL PLATES

- Bone Growth: mainly located at the EPIPHYSEAL PLATES of the CORTICAL and SPONGY BONES
- Paediatric skeleton is in CONSTANT GROWTH



EPIPHYSEAL PLATES



6 y



16 y

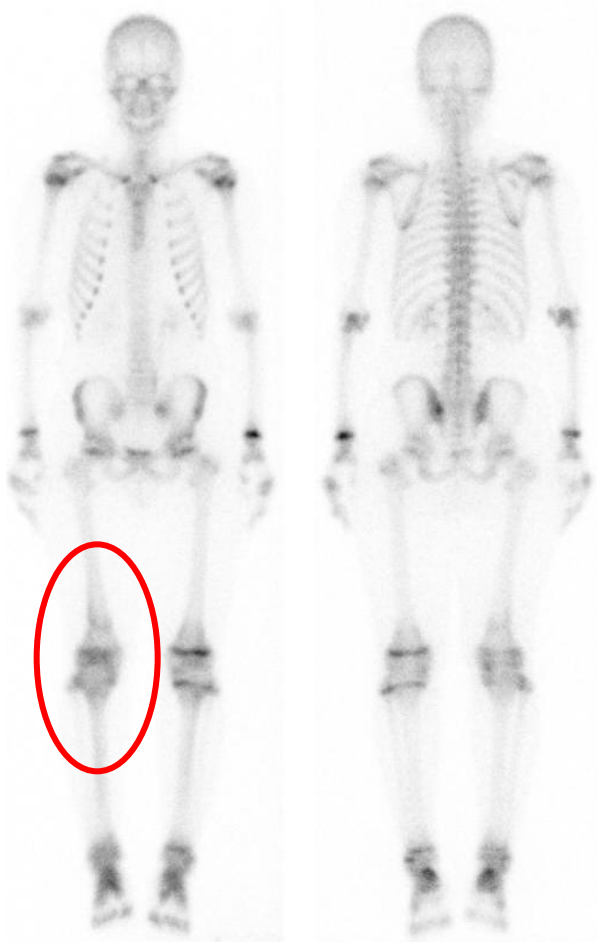
GROWTH CENTERS:

- physis of long bones
- apophysis of flat and irregular bones

Site of apophysis	Age at fusion (years)	Attached muscle
Iliac crest	17 - 18	Abdominal wall muscles
Anterior superior iliac spine	16 - 20	Sartorius muscle
Anterior inferior iliac spine	25	Rectus femoris muscle
Symphysis pubis	20 - 25	Adductor group of muscles
Ischial tuberosity	20 - 25	Hamstring muscle
Lesser trochanter	18 - 19	Iliopsoas muscle
Greater trochanter	18 - 19	External rotators
Olecranon	18	Triceps
Distal radius	18	Brachioradialis



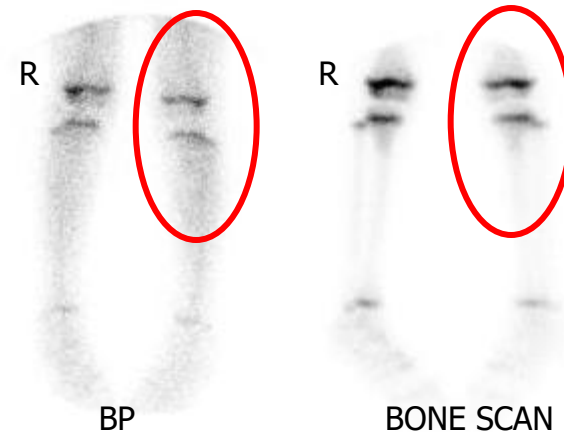
GROWTH CENTRES: EFFECT OF IMMOBILIZATION



> 50% BONE ACTIVITY in case of:
• no movement of a limb for more than 24 hours (PAIN)

DIFFUSE WHOLE BODY HYPOACTIVITY of the bone and the growth plates in case of:

- SICK CHILDREN
- diminished physical activity
- severe illness



- ▶ Bone physiology and pathophysiology
- ▶ Techniques
- ▶ Guidelines review with examples

MSK IMAGING:

TECHNIQUES IN PAEDIATRIC NUCLEAR MEDICINE

- BONE SCINTIGRAPHY
 - WHOLE BODY
 - FOCAL = SPOT
 - PIN-HOLE
 - SPECT
 - SPECT-CT
- PET ¹⁸F
 - WITH CT
 - WITHOUT CT

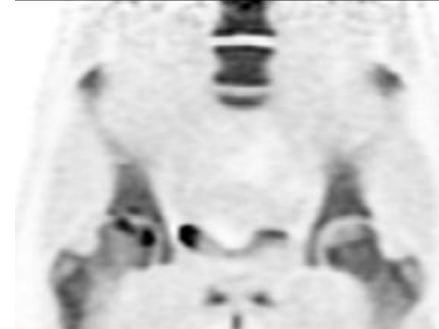
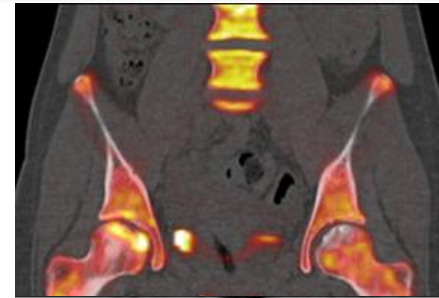
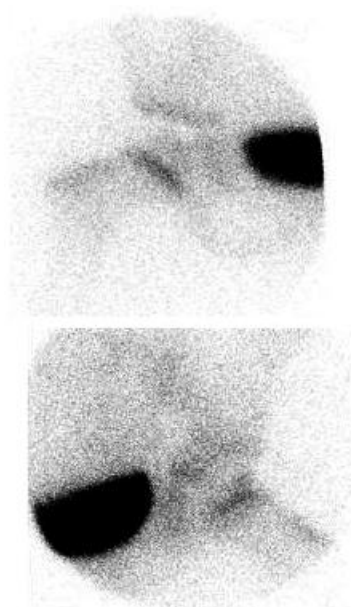
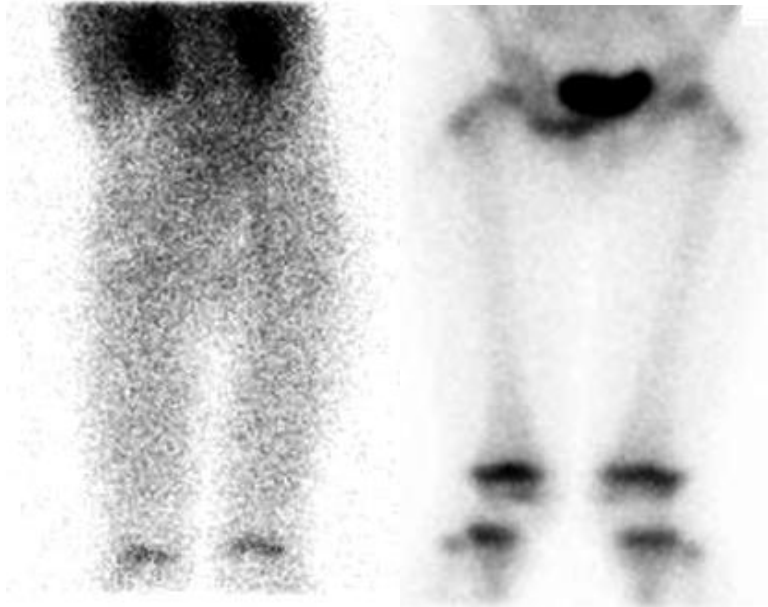


Bone scintigraphy

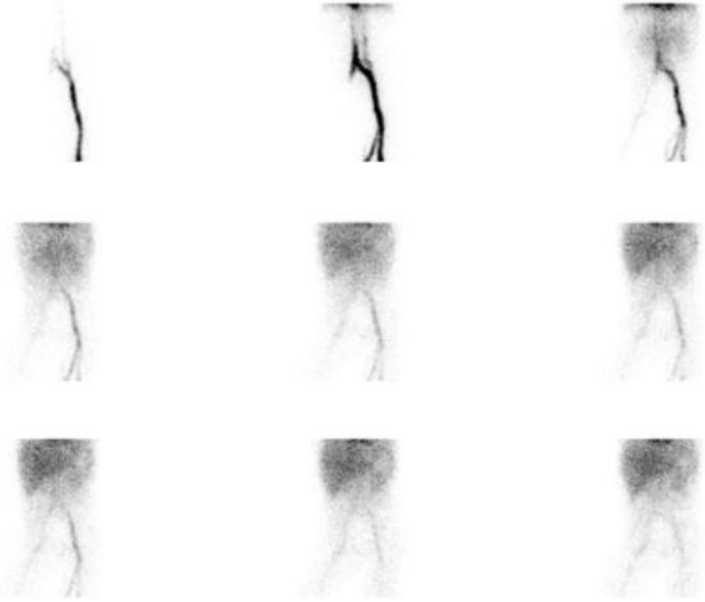
- IV ^{99m}Tc -diphosphonates

Imaging

- Vascular and blood pool phases
- planar
- pin-hole
- SPECT or SPECT-CT



3-phases BONE SCINTIGRAPHY



VASCULAR PHASE

Dynamic images to value the lesion vascularization.

Imaging value the arterial and the venous perfusion of the lesion or the limb.

BLOOD POOL

Images of the blood pool, focal or whole body, are obtained 2-5 minutes after tracer injection.

These images detect INFLAMMATION. Quick bone metabolism in children can mask quickly the blood pool activity.

BONE IMAGES

IMAGE RESOLUTION is the cornerstone of images in children: Important technique

- Focal imaging have higher resolution than WB imaging
- Child positioning: as close as possible to the collimator



HYBRID
images
like
SPECT-CT
and
PET-CT
are the
EMERGING
TECHNIQUES

- BONE SCINTIGRAPHY
 - WHOLE BODY
 - FOCAL = SPOT
 - PIN-HOLE
 - SPECT
 - SPECT-CT
- PET ¹⁸F
 - WITH CT
 - WITHOUT CT



Bone Scintigraphy

IN YOUNG CHILDREN IT IS EASIER TO OBTAIN

- SPOT frames than WB
- SPOT images: higher QUALITY than WB images

- body closer to detector
- avoid movement
- improve collaboration

- very low dose
- small structures
- increased detection time ? !

- Same child
Same exam
- WB image
 - Focal images



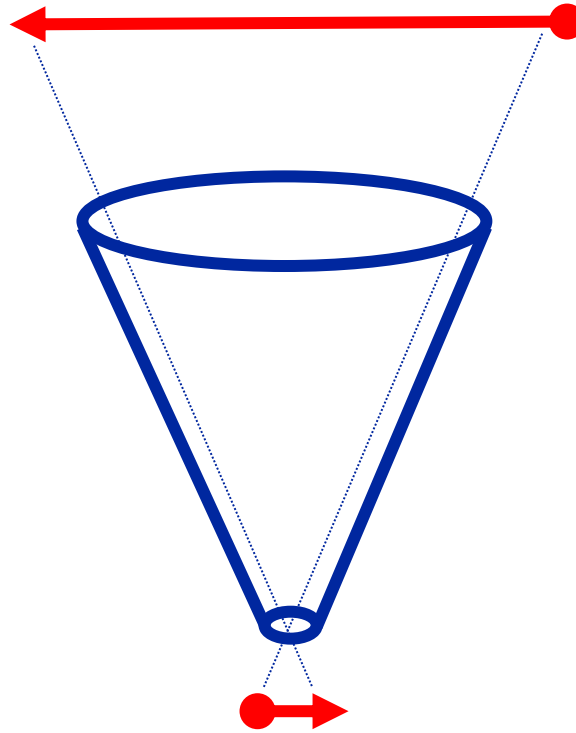
CLOSE CONTACT
CHILD-DETECTOR



Bone Scintigraphy: PINHOLE

SMALL ORGANS femoral head, kidneys in babies...

- small size hole
- close to the skin
- organ to be studied in the centre of the image





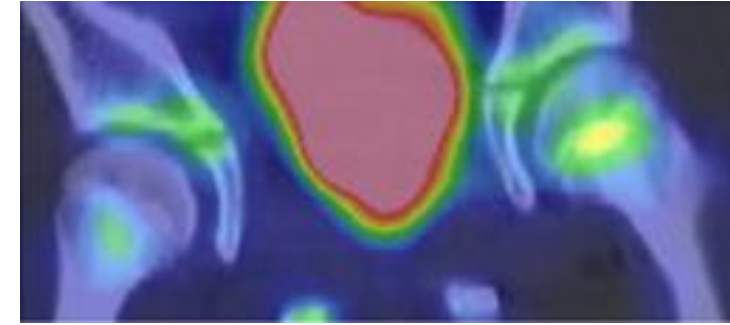
Blood Pool



Planar bone image



Pin-hole views



SPECT-TC

PIN-HOLE

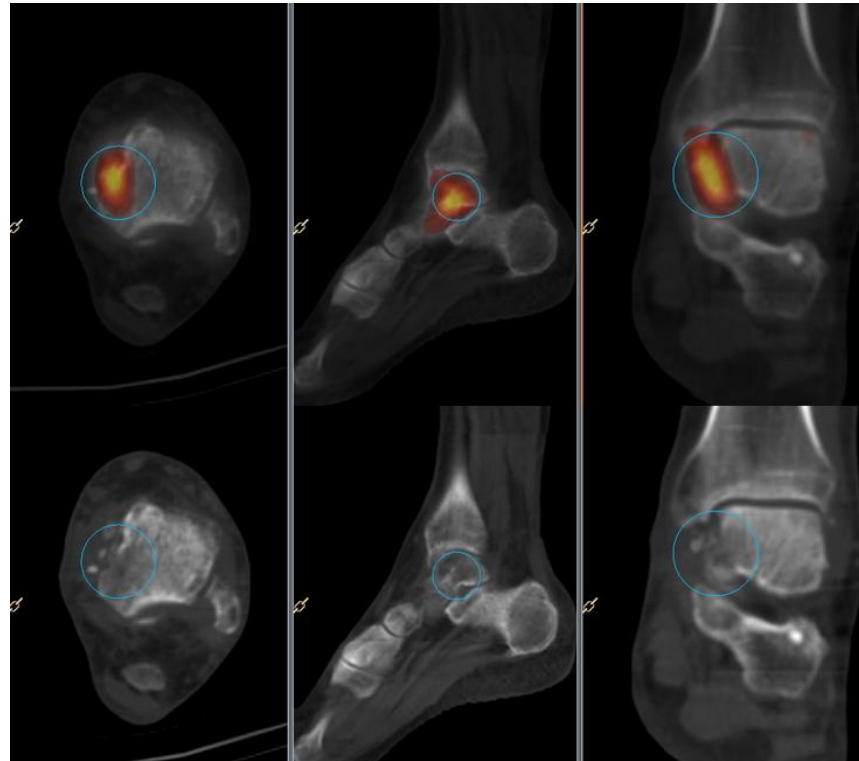
PINHOLE views have the **highest resolution** that we can obtain with a gammacamera. Much higher resolution than planar images and even SPECT.

Limitations:

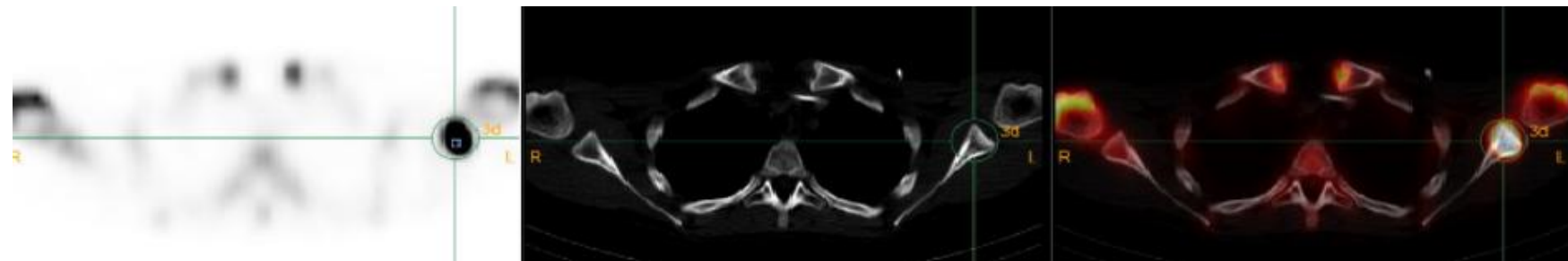
- Low availability of this kind of collimator
- Long acquisition time, requiring immobilization (5-10 min)

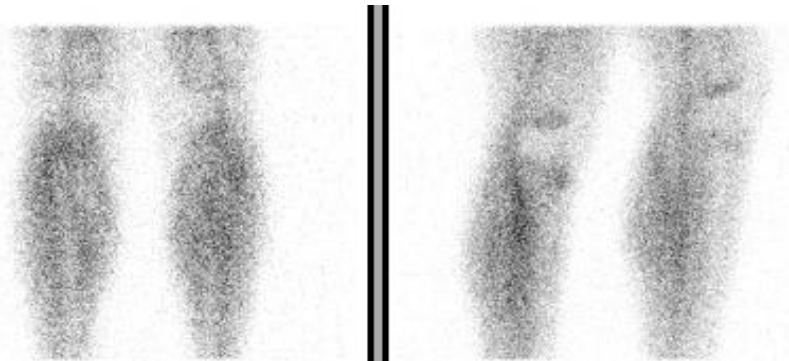


SPECT-CT Bone scintigraphy

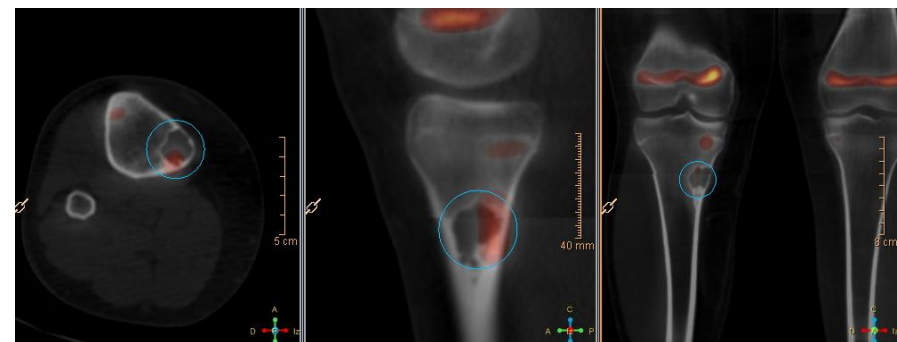
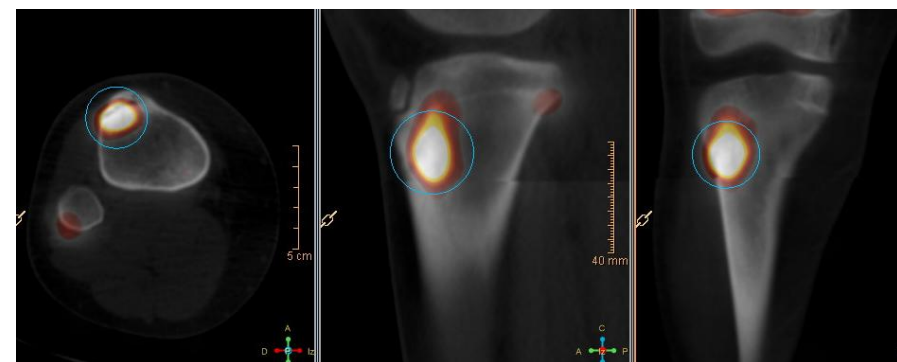


SPECT-CT Gammacamera





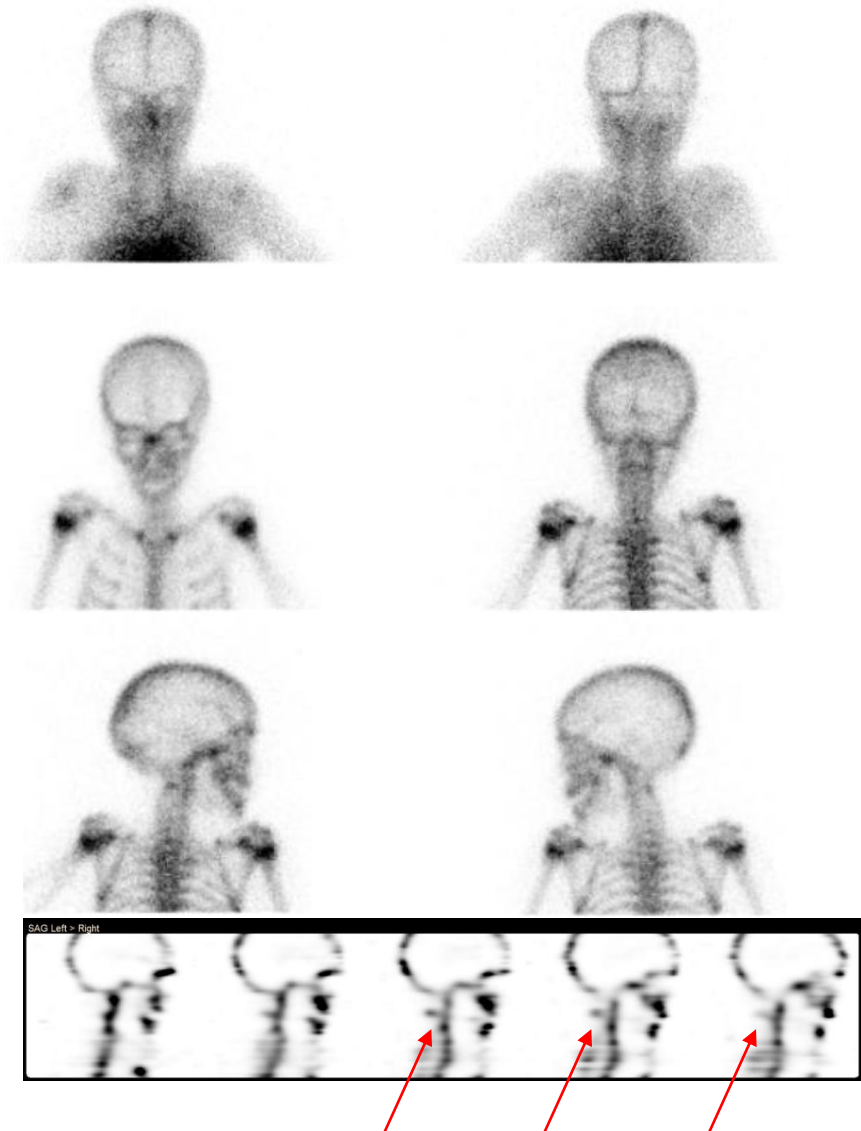
SPECT and SPECT-CT increase the diagnostic safety and allow an accurate anatomical localization of the metabolic injury



Severe Osgood-Slatter syndrome

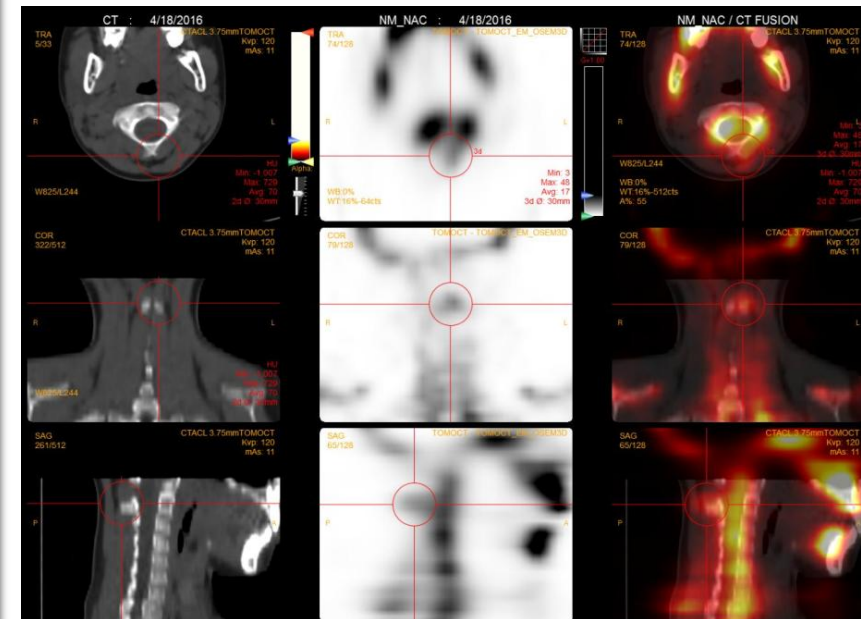
but also detect
a fissure of
an osseous bone cyst





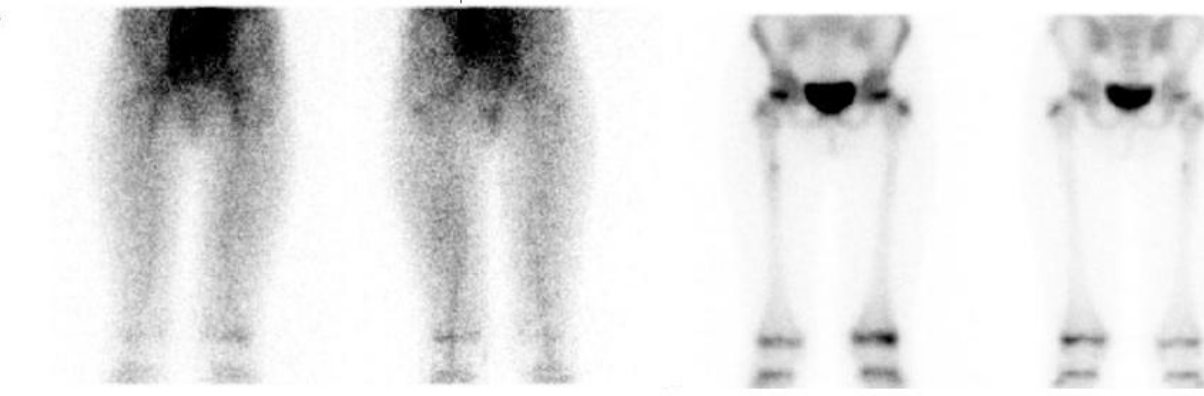
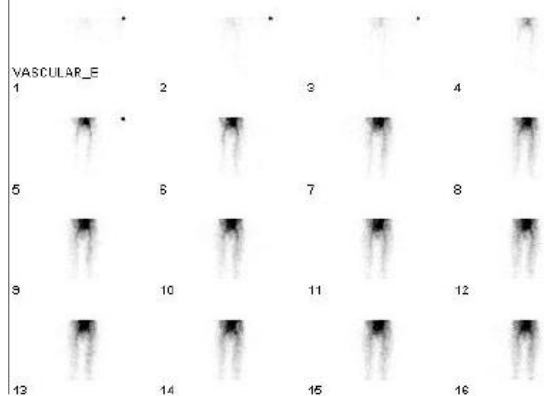
SPECT and SPECT-CT

- SPECT is a complementary tomographic technique to planar images
- SPECT and SPECT-CT are replacing pin-hole collimator in most departments
- high sensitivity to detect vertebral lesions:
 - in children and teenagers with vertebral pain is mandatory to obtain SPECT images, even if planar images are normal!



Cervical
Vertebral
Fracture

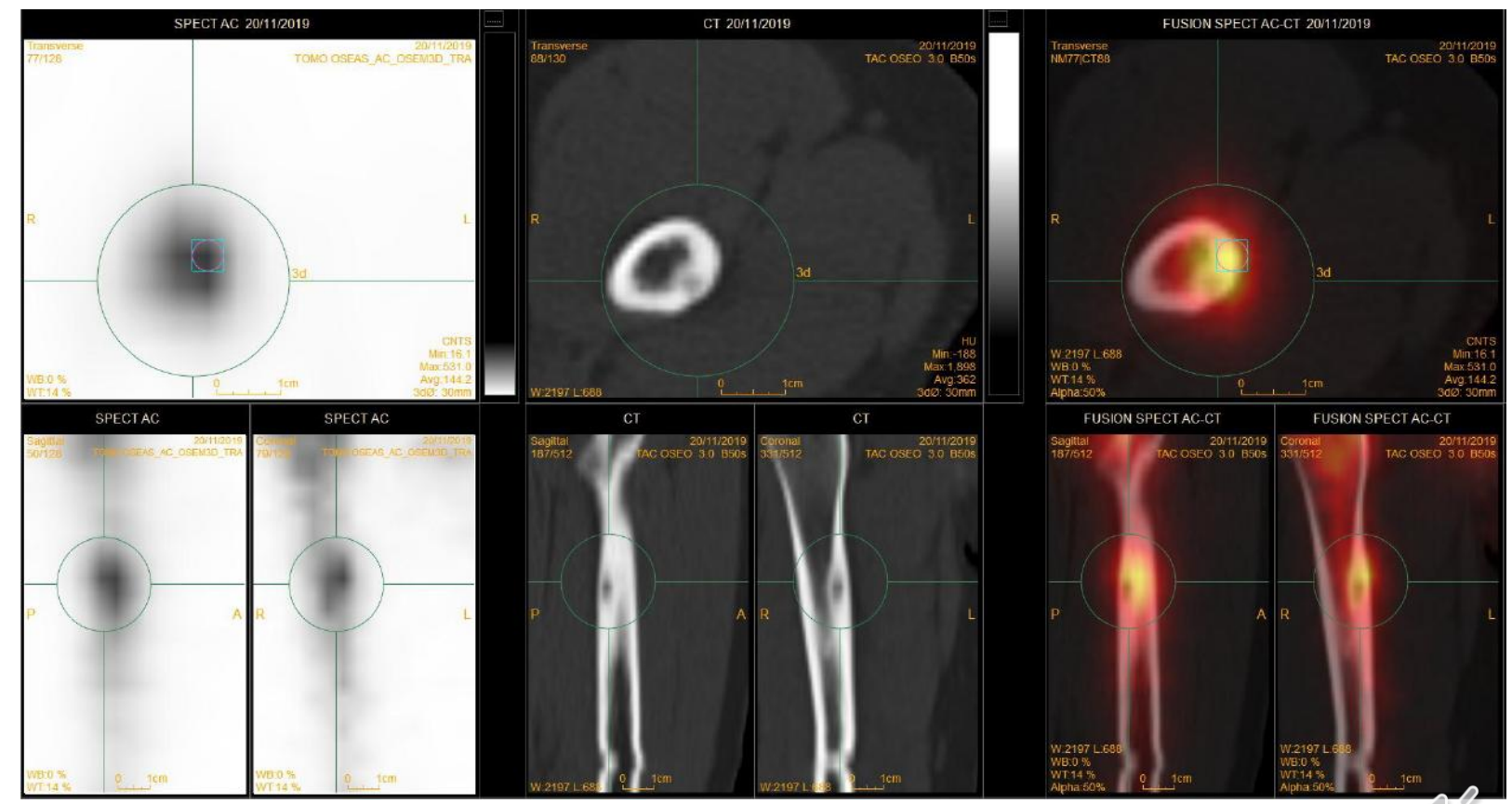




Pseudoarthrosis

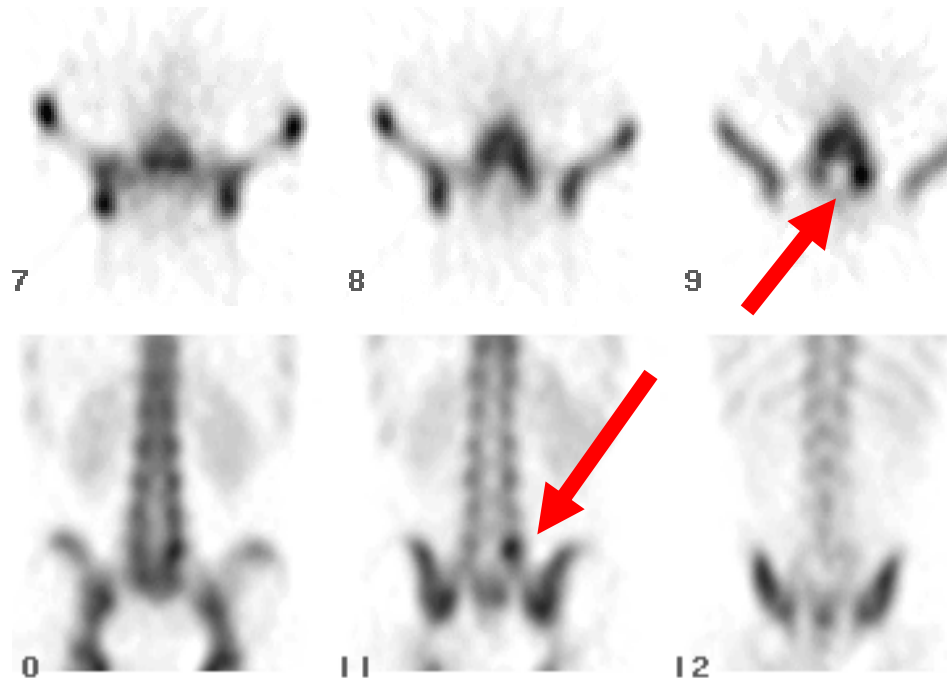
SPECT and SPECT-CT INDICATIONS

- Perform a SPECT-CT only to localize a bone metabolic lesion.
- DO NOT PERFORM a SPECT-CT if SPECT is normal.
- Perform a low dose CT, just to localize the lesion.
- SPECT-CT in children:
 - Limited use due to the CT dosimetry.



Bone Scintigraphy: SPECT and SPECT-CT

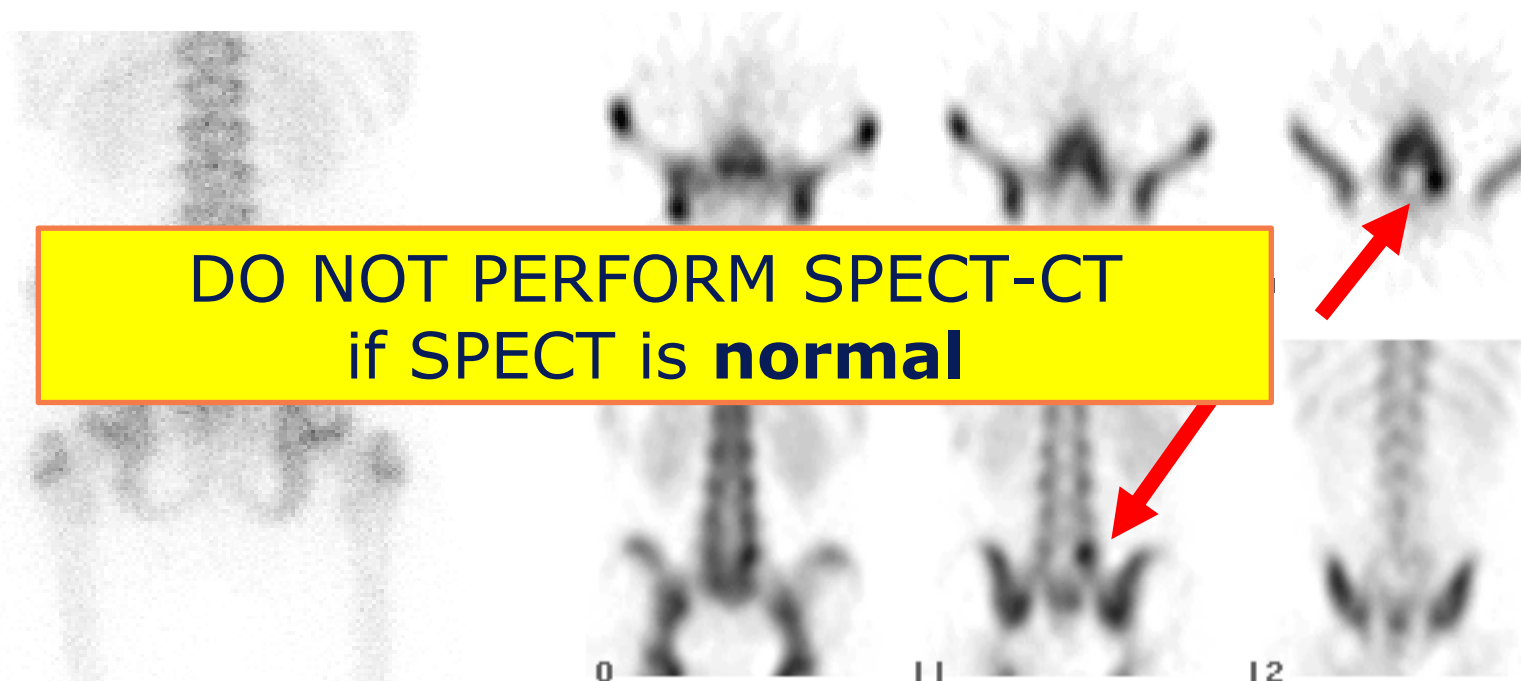
In some pathologies, like vertebral lesions, bone SPECT has higher SENSITIVITY to detect lesions than planar images



Bone Scintigraphy: SPECT and SPECT-CT

When it is advisable
to perform **a SPECT or SPECT-CT?**

In some pathologies, like vertebral lesions, bone SPECT has higher SENSITIVITY to detect lesions than planar images



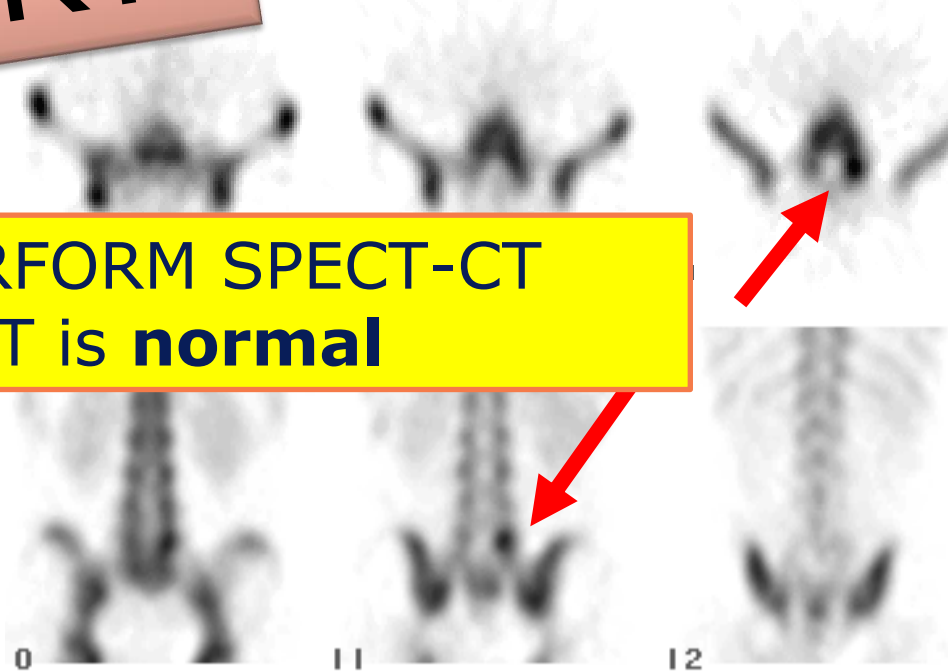
Bone Scintigraphy: SPECT and SPECT-CT

When it is advisable
to perform **a SPECT or SPECT-CT?**

In some pathologies, like vertebral lesions, bone SPECT has higher SENSITIVITY than planar images

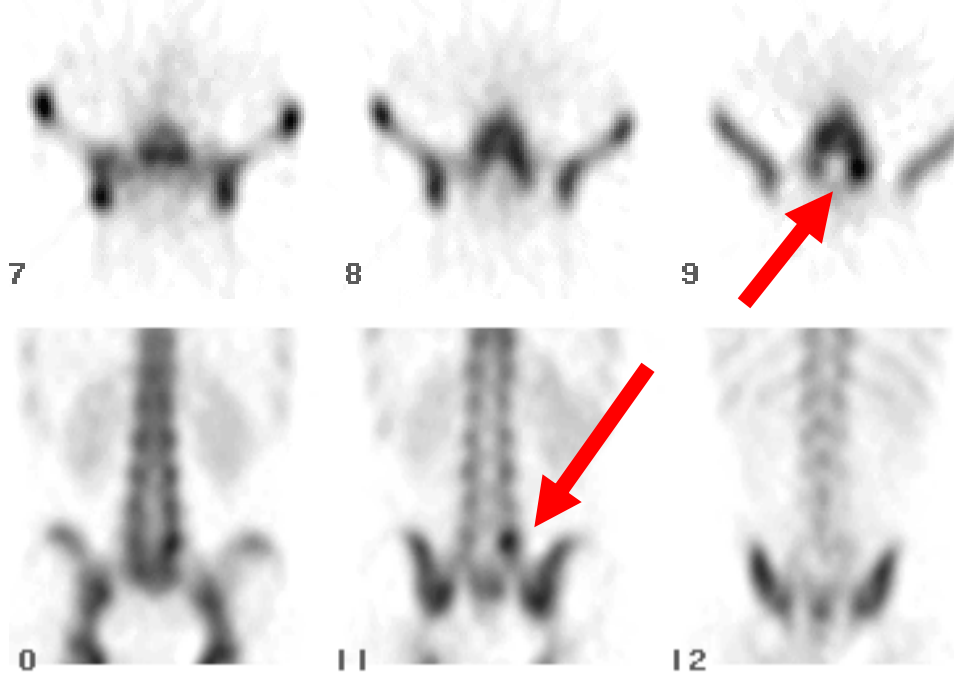
CT DOSIMETRY!

**DO NOT PERFORM SPECT-CT
if SPECT is **normal****





COMPARE THE DIFFERENT MODALITY IMAGES and AVOID TO PERFORM AN UNNECESSARY CT

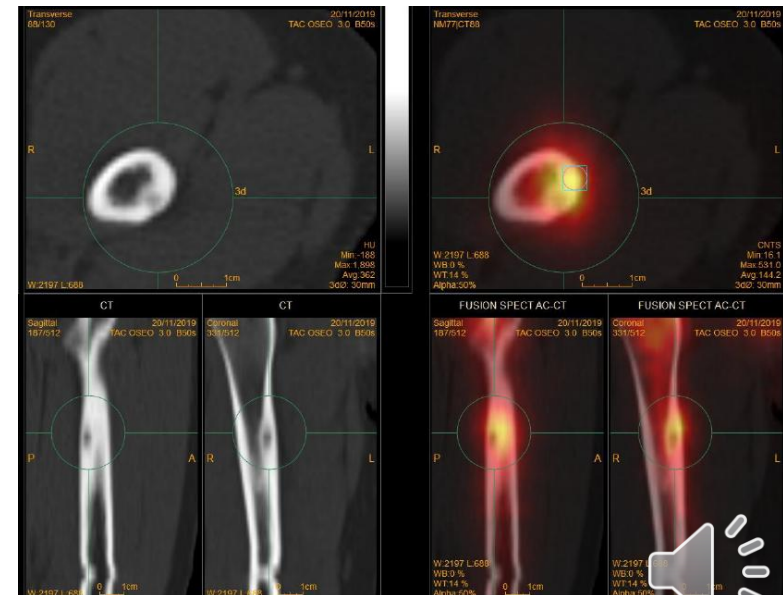
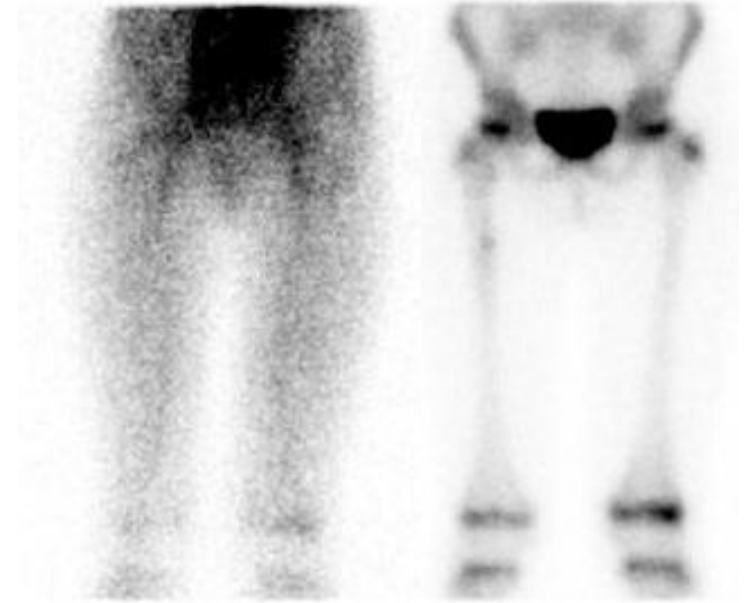


Football player
Back pain



SPECT-CT

- TOMOGRAPHIC IMAGING
 - HYBRID IMAGING SCINTIGRAPHY-CT
 - COMPLEMENTARY TO BONE PLANAR IMAGES
-
- **SPECT**
 - HIGHER SENSITIVITY THAN PLANAR IMAGES TO DETECT LESIONS
 - ESPECIALLY IN VERTEBRAL COLUMN
 - MANDATORY IN CASE OF BACK OR VERTEBRAL PAIN
-
- **SPECT - CT**
 - PRECISE ANATOMIC LOCATION OF THE METABOLIC LESION



5 años, osteoma osteoide

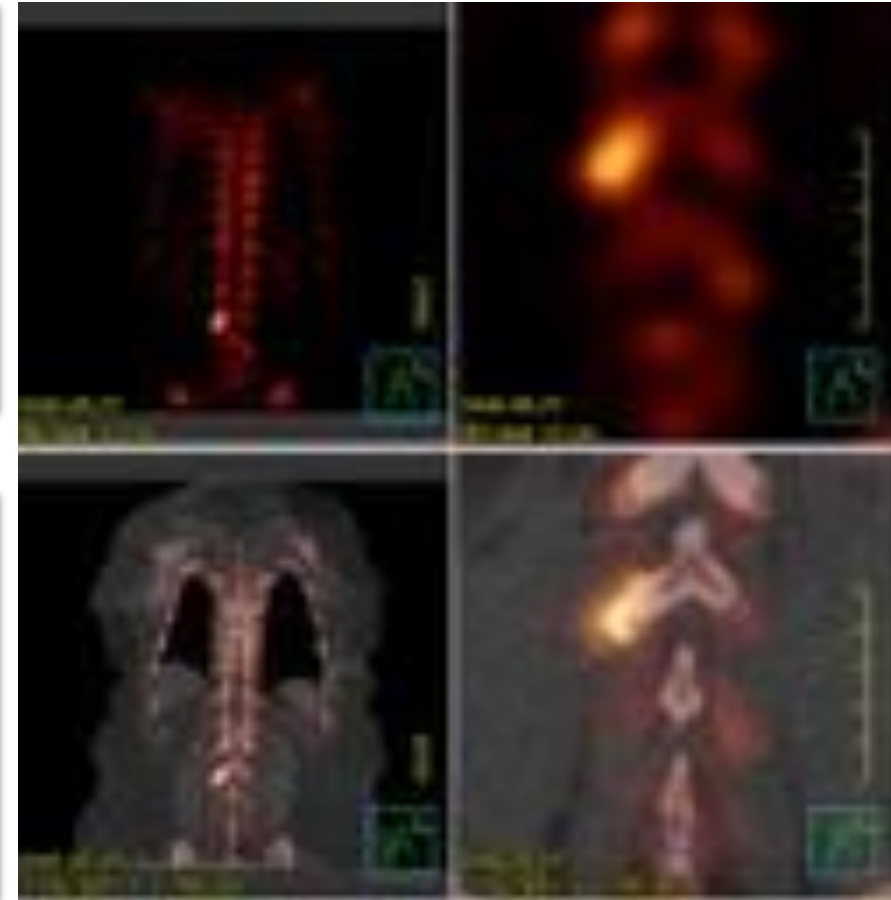
SPECT-CT

- CT ALLOWS:

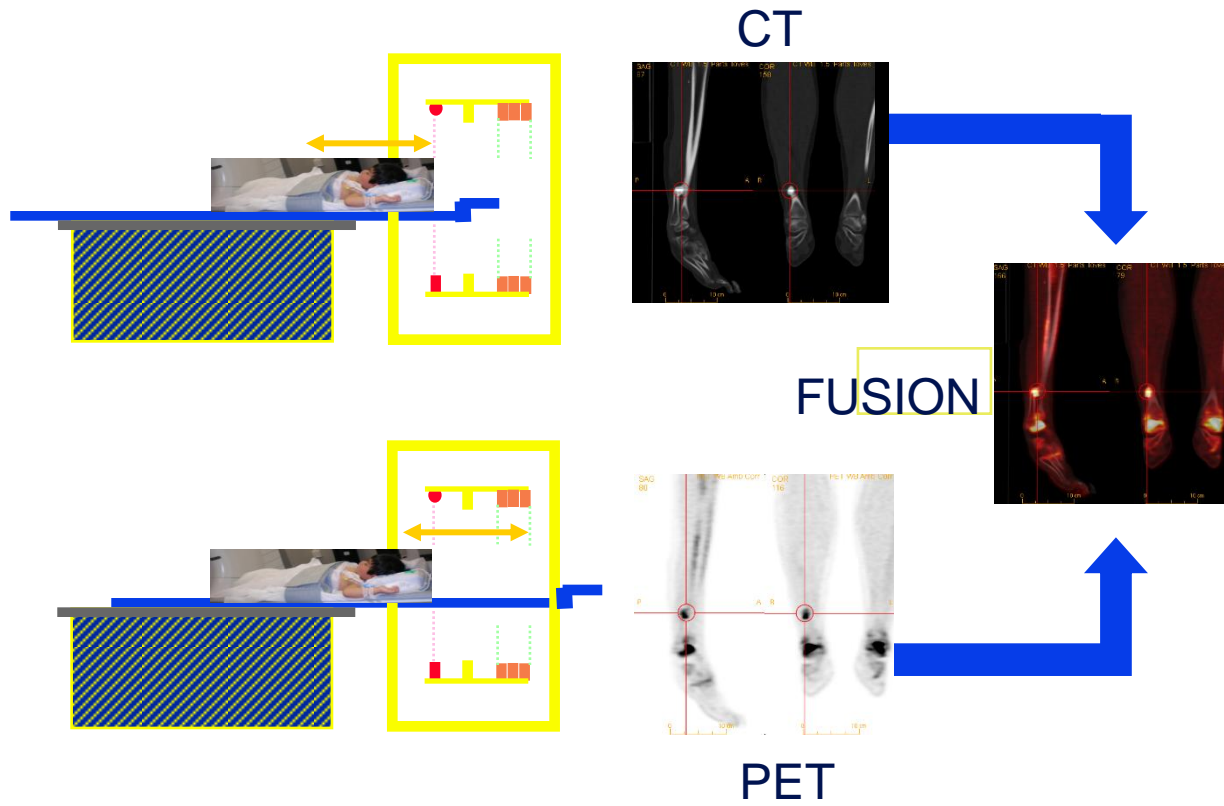
- LOCALIZATION OF METABOLIC LESIONS DETECTED BY THE SCINTIGRAPHY
- ATTENUATION CORRECTION OF SPECT (DEEP STRUCTURES)

- CT

- ADVISABLE / MANDATORY USE OF LOW DOSE CT
- CT only if necessary
- **NO CT IN CASE OF NORMAL SPECT!!!!!!!!!!**
- DOSIMETRY CT: much higher than bone scintigraphy



18F PET



- much higher image resolution than bone scan
- with or without CT



- ▶ Bone physiology and pathophysiology
- ▶ Techniques
- ▶ Guidelines review with examples



SNMMI Procedure Standard for Bone Scintigraphy 4.0

Twyla B. Bartel (Chair)¹, Manohar Kuruva², Gopinath Gnanasegaran³, Mohsen Beheshti⁴, Erica J. Cohen⁵, Alan F. Weissman⁶, and Tracy L. Yarbrough¹

¹Global Advanced Imaging, PLLC, Little Rock, Arkansas; ²University of Arkansas for Medical Sciences, Little Rock, Arkansas; ³Royal Free London NHS Foundation Trust, London, United Kingdom; ⁴PET-CT Center Linz, St. Vincent's Hospital, Linz, Austria; ⁵Edward Hines, Jr., VA Hospital, Hines, Illinois; and ⁶Desert Radiologists, Las Vegas, Nevada

Eur J Nucl Med Mol Imaging (2010) 37:1621–1628
DOI 10.1007/s00259-010-1492-3

GUIDELINES

Guidelines for paediatric bone scanning with ^{99m}Tc-labelled radiopharmaceuticals and ¹⁸F-fluoride

Jan Stauss • Klaus Hahn • Mike Mann • Diego De Palma

Eur J Nucl Med Mol Imaging (2016) 43:1723–1738
DOI 10.1007/s00259-016-3415-4

GUIDELINES

The EANM practice guidelines for bone scintigraphy

T. Van den Wyngaert^{1,2} • K. Strobel³ • W. U. Kampen⁴ • T. Kuwert⁵ •
W. van der Bruggen⁶ • H. K. Mohan⁷ • G. Gnanasegaran⁸ •
R. Delgado-Bolton⁹ • W. A. Weber¹⁰ • M. Beheshti¹¹ •
W. Langsteger¹¹ • F. Giammarile¹² • F. M. Mottaghy^{13,14} • F. Paycha¹⁵ •
On behalf of the EANM Bone & Joint Committee and the Oncology Committee.



ECPR
June 21-23, 2021
virtual

EUROPEAN COURSE
PAEDIATRIC RADIOLOGY
Musculoskeletal Imaging



SNM Practice Guideline for Sodium ^{18}F -Fluoride PET/CT Bone Scans 1.0*

George Segall¹, Dominique Delbeke², Michael G. Stabin², Einat Even-Sapir³, Joanna Fair⁴, Rebecca Sajdak⁵, and Gary T. Smith⁶

¹VA Palo Alto Health Care System, Palo Alto, California; ²Vanderbilt University Medical Center, Nashville, Tennessee; ³Tel Aviv Sourasky Medical Center, Tel Aviv, Israel; ⁴Mallinckrodt Institute of Radiology, St. Louis, Missouri; ⁵Loyola University Medical Center, Chicago, Illinois; and ⁶Tennessee Valley Veterans Administration Medical Center, Nashville, Tennessee

Eur J Nucl Med Mol Imaging (2015) 42:1767–1777
DOI 10.1007/s00259-015-3138-y



GUIDELINES

^{18}F -NaF PET/CT: EANM procedure guidelines for bone imaging

M. Beheshti¹ • F. M. Mottaghy^{2,3} • F. Payche⁴ • F. F. F. Behrendt² •
T. Van den Wyngaert⁵ • I. Fogelman⁶ • K. Strobel⁷ • M. Celli⁸ • S. Fanti⁸ •
F. Giammarile⁹ • B. Krause¹⁰ • W. Langsteger¹



ECPR
June 21-23, 2021
virtual

EUROPEAN COURSE
PAEDIATRIC RADIOLOGY
Musculoskeletal Imaging



Nuclear Medicine of the MSK system

Indications

- Inflammation
- Bone and joint infections
- Trauma
- Mandibular condylar hyperplasia
- Bone infarction
- Osteonechrosis
- Benign bone tumors
- Malignant Bone diseases



BONE SCANS INTERPRETATION

BONE DISEASES may have different patterns during childhood

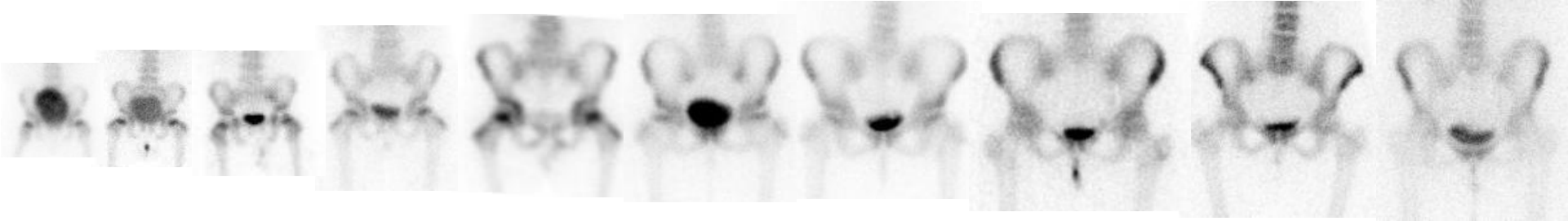
- maturity and development patterns affect the image interpretation
- In some bone diseases the location and morphology of the lesions differ
 - during childhood
 - vary in adults and in children



HIP

Bone Growing during Childhood

Planar



Pinhole

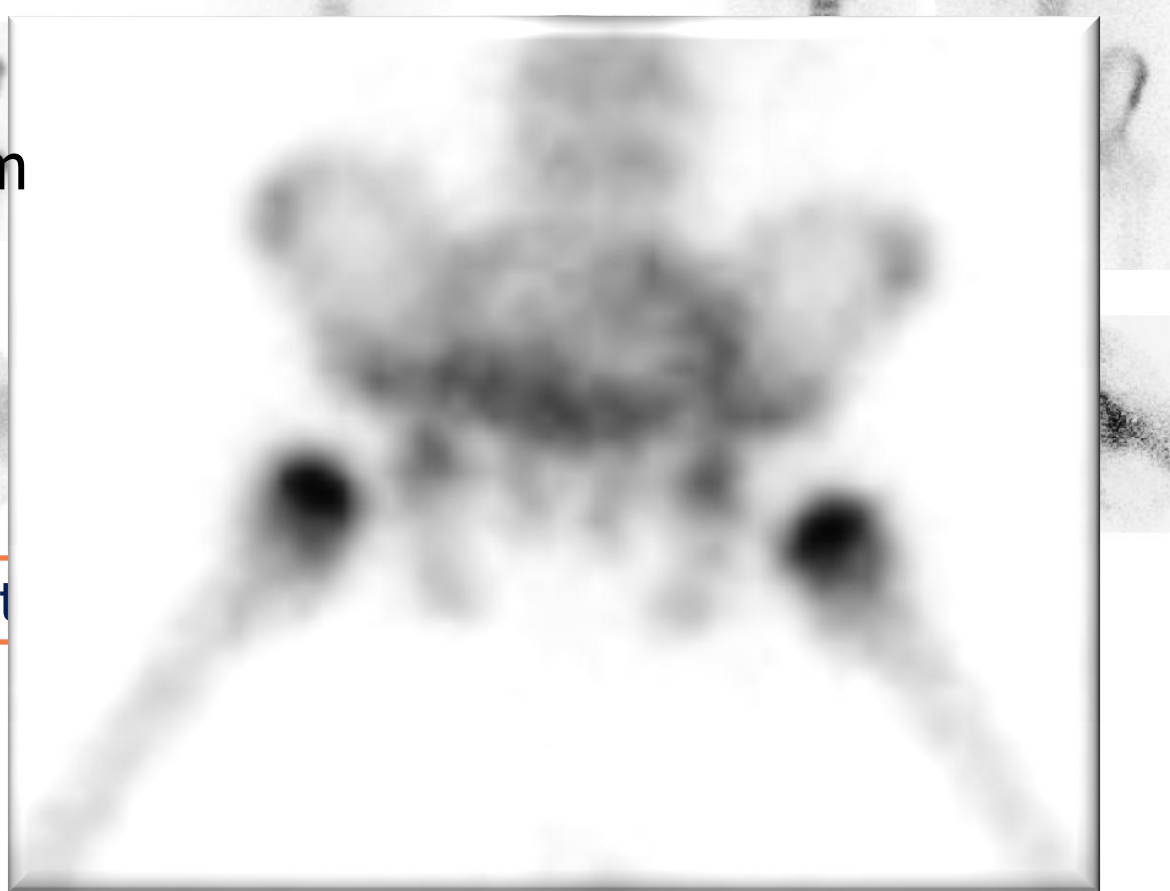


Ossification of the femoral head: 2-7 months



HIP

- Planar image
- Pin-hole
- SPECT
- SPECT-CT
- ^{18}F -PET



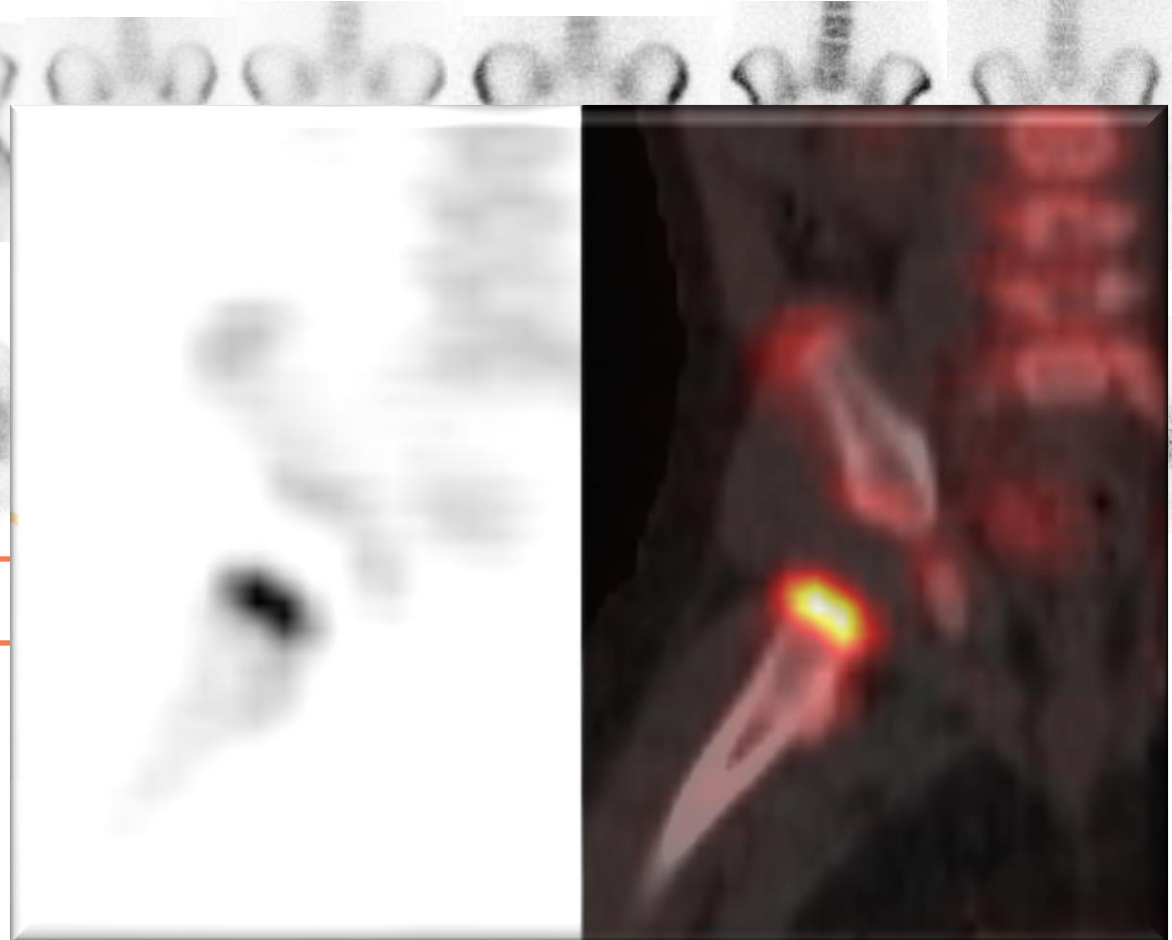
HIP

- Planar image
- Pin-hole
- SPECT
- SPECT-CT
- ^{18}F -PET



HIP

- Planar image
- Pin-hole
- SPECT
- SPECT-CT
- ^{18}F -PET



HIP

- Planar image
- Pin-hole
- SPECT
- SPECT-CT
- ^{18}F -PET



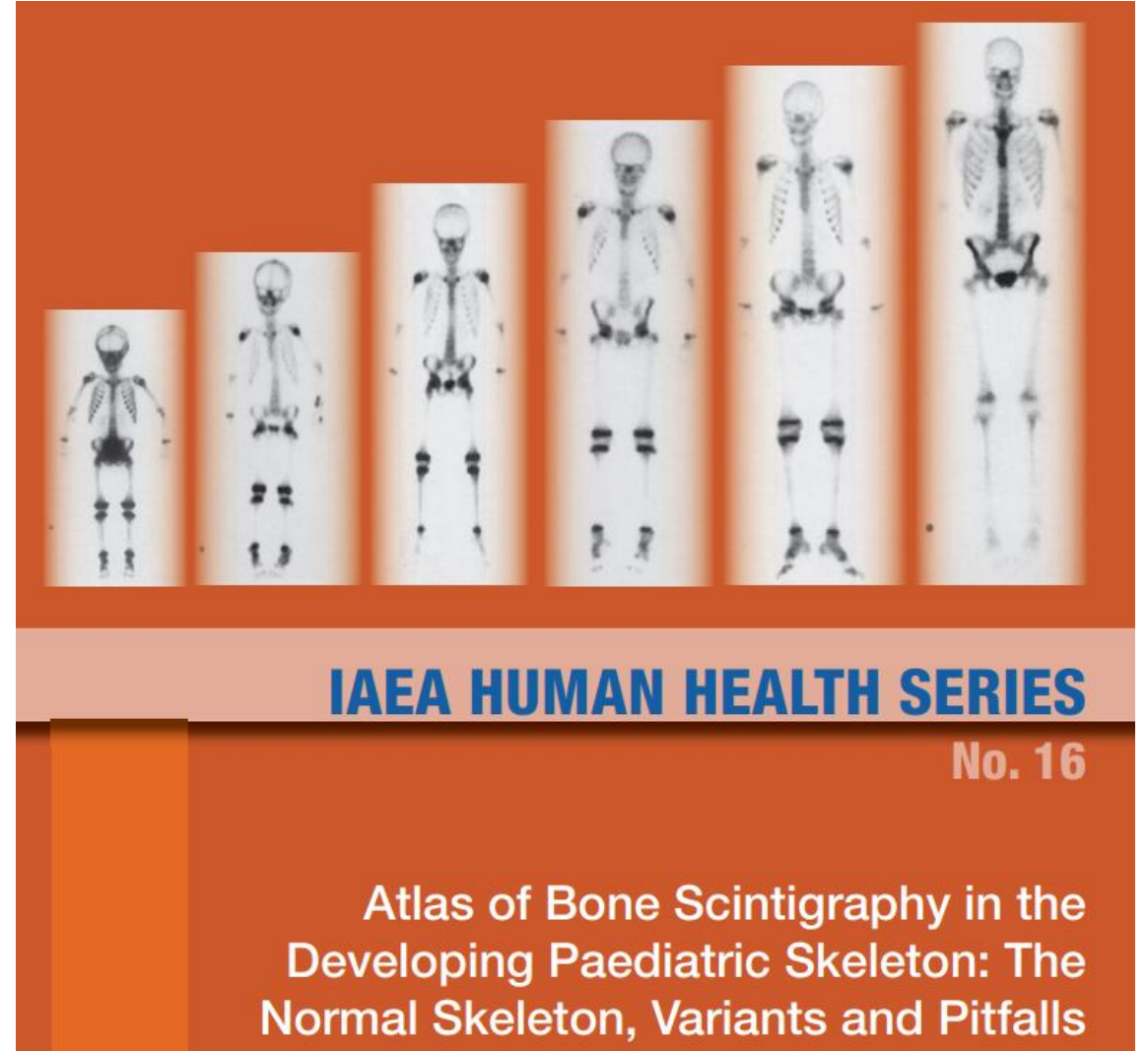
months

in the developing paediatric skeleton:
the normal skeleton, variants and pitfalls



https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1491_web.pdf

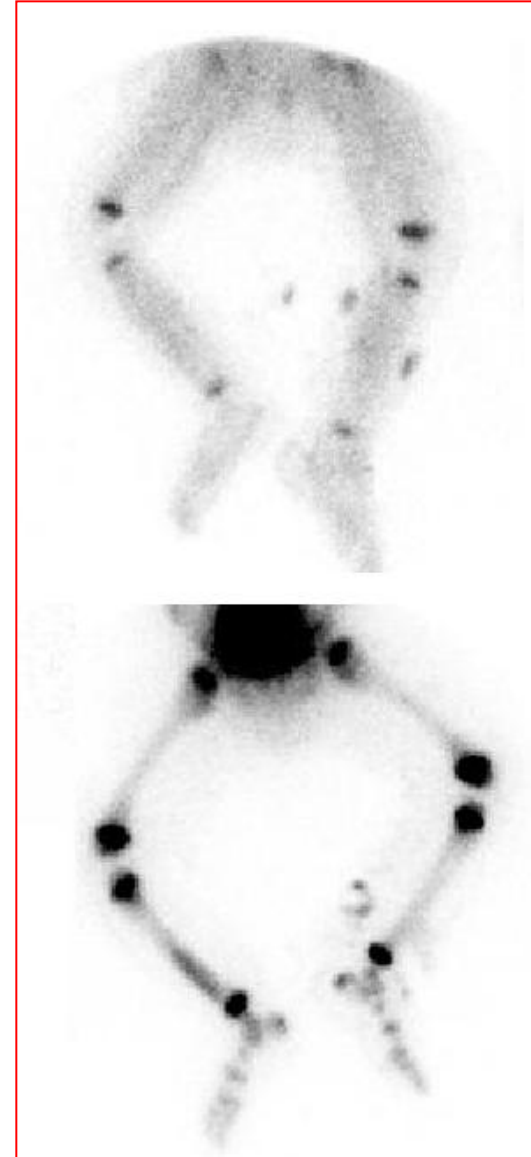
Atlas of bone scintigraphy in the developing
paediatric skeleton:
the normal skeleton, variants and pitfalls



BONE DISEASES: different patterns in childhood

Bone fractures in babies

- Pandyaphyseal
- Usually not transverse
- Submetaphyseal



Blood
pool +

Bone
uptake +

6 m
Tibia fracture



BONE DISEASES: different patterns in childhood

Blood
pool +



Bone
uptake +



2 y
Tibia fracture

Bone fractures

- Pandiaphyseal
- Usually not transverse
- Submetaphyseal



BONE DISEASES: different patterns in childhood

Bone fractures

- Pandyaphyseal
- Usually not transverse
- Submetaphyseal

8 y
Humerus fracture



Blood
pool +

Bone
uptake +



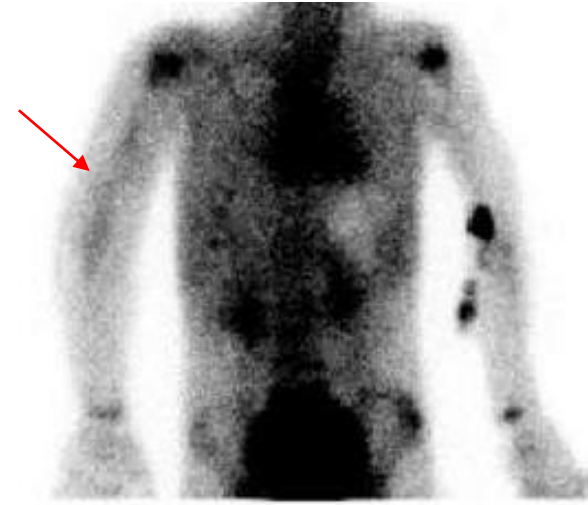
CHILD ABUSE BATTERED CHILD Non-accidental fractures

Occult
fractures

≠ new
≠ old

Bone Scintigraphy

- Blood Pool: usefull
 - +++
 - inflammation
- Bone uptake
 - +++/++
 - image resolution +/-
- New bone fractures
 - Blood pool +
 - Bone uptake +
- Old fractures:
 - Blood pool neg
 - Bone uptake +



CHILD ABUSE - BATTERED CHILD - NAF

PET with Fluorine ^{18}F

- Detects bone fractures with
 - High sensitivity
 - Good image resolution
- Dosimetry: low
 - low dose ^{18}F
 - Babies 0,5 mCi
 - No CT
 - Only CT or Xray of the area with ^{18}F hypermetabolism
- Whole Body imaging
- Shorter exam 45-60 min

- Blood Pool: useful
 - +++
 - inflammation
- Bone uptake
 - +++/++
 - image resolution +/-
- New bone fractures
 - Blood pool +
 - Bone uptake +
- Old fractures:
 - Blood pool neg
 - Bone uptake +

- Same interpretation than the bone scan
- Much higher image quality, resolution and sensitivity



ALL IN ONE !!!!!



CHILD ABUSE - BATTERED CHILD - NAF

PET ^{18}F

BONE SCAN



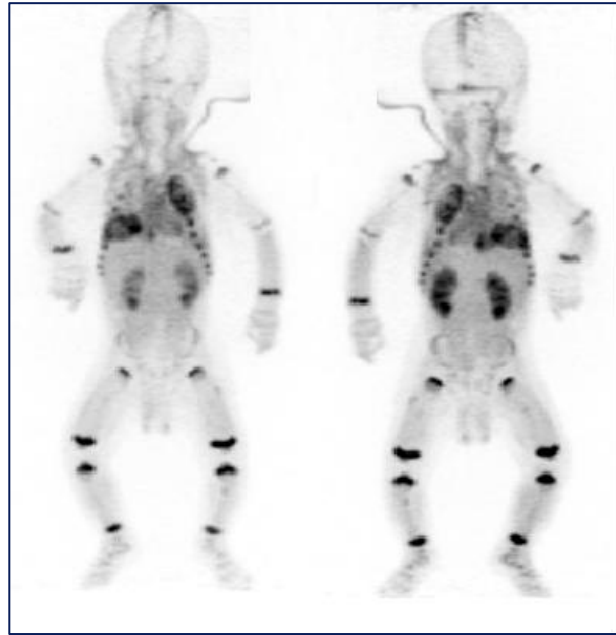
COMPARE THE QUALITY OF THE IMAGE OF BOTH TECHNIQUES...



CHILD ABUSE - BATTERED CHILD - NAF

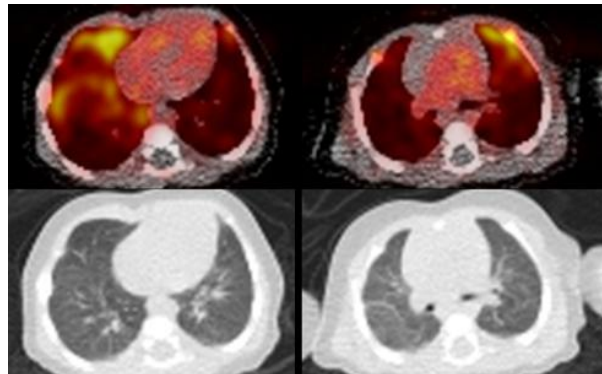
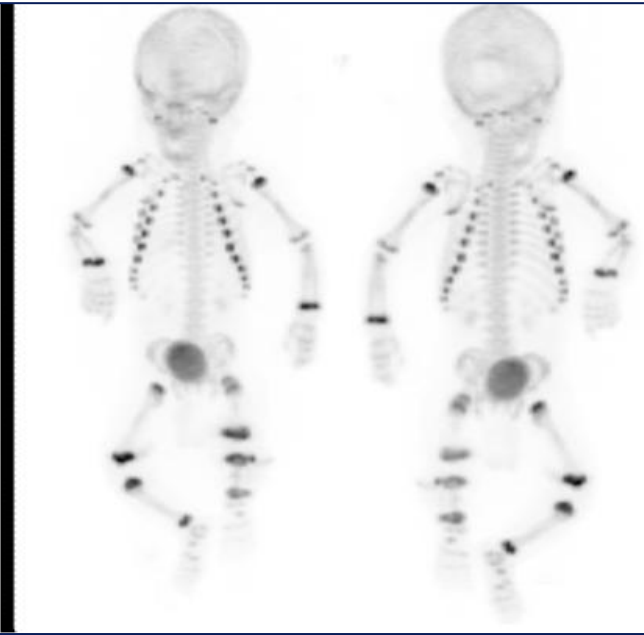
PET ^{18}F

- Blood pool, WB
Lung trauma
bilateral



PET ^{18}F

- Bone uptake, WB
Multiple costal fractures,
bilateral



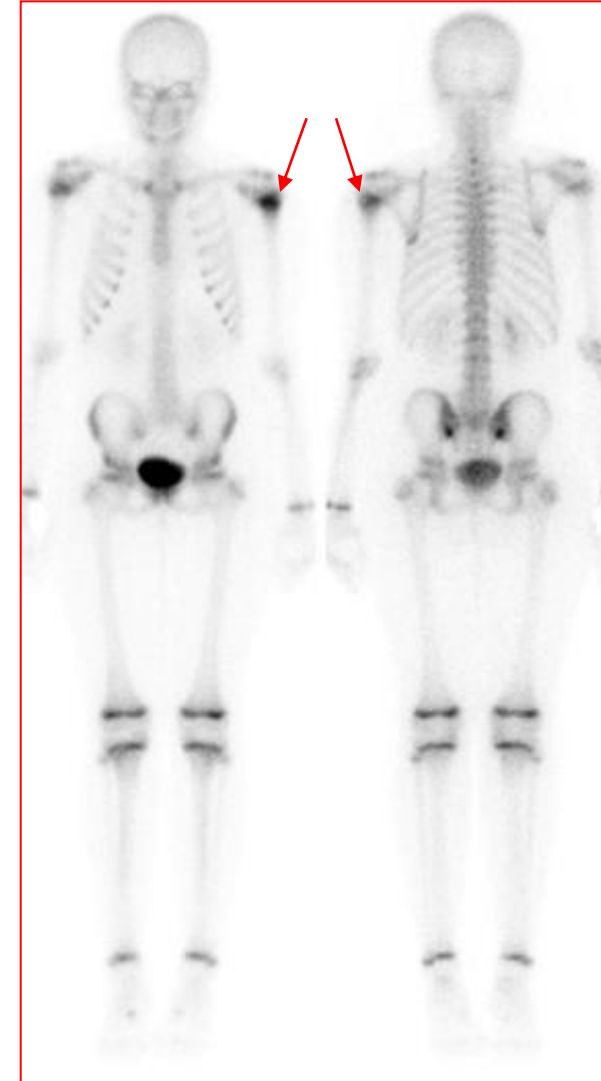
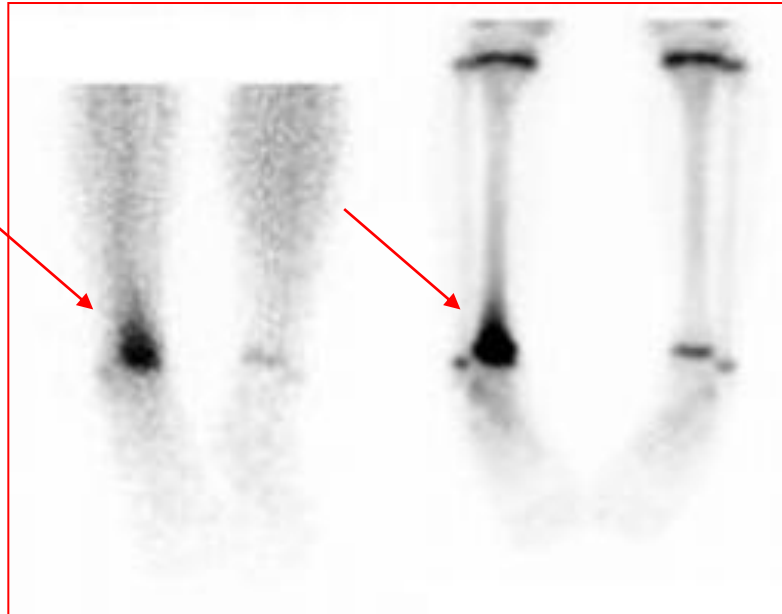
BONE DISEASES: different patterns in childhood

Osteomyelitis

in babies and children

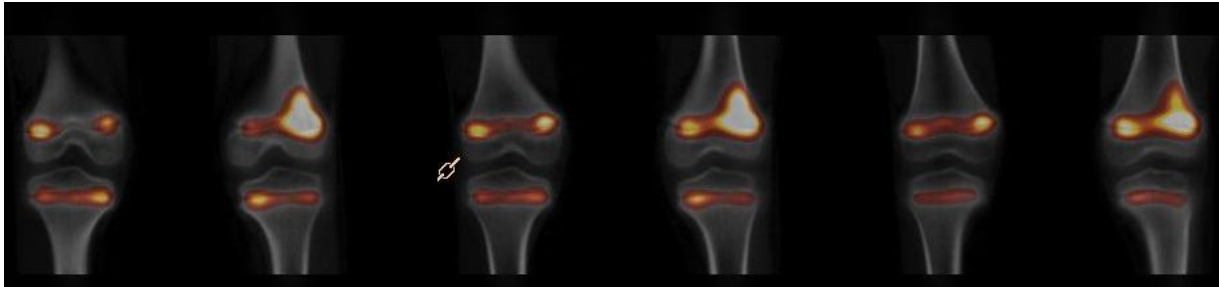
Foci are mostly:

- in long bones
- in submetaphyseal areas

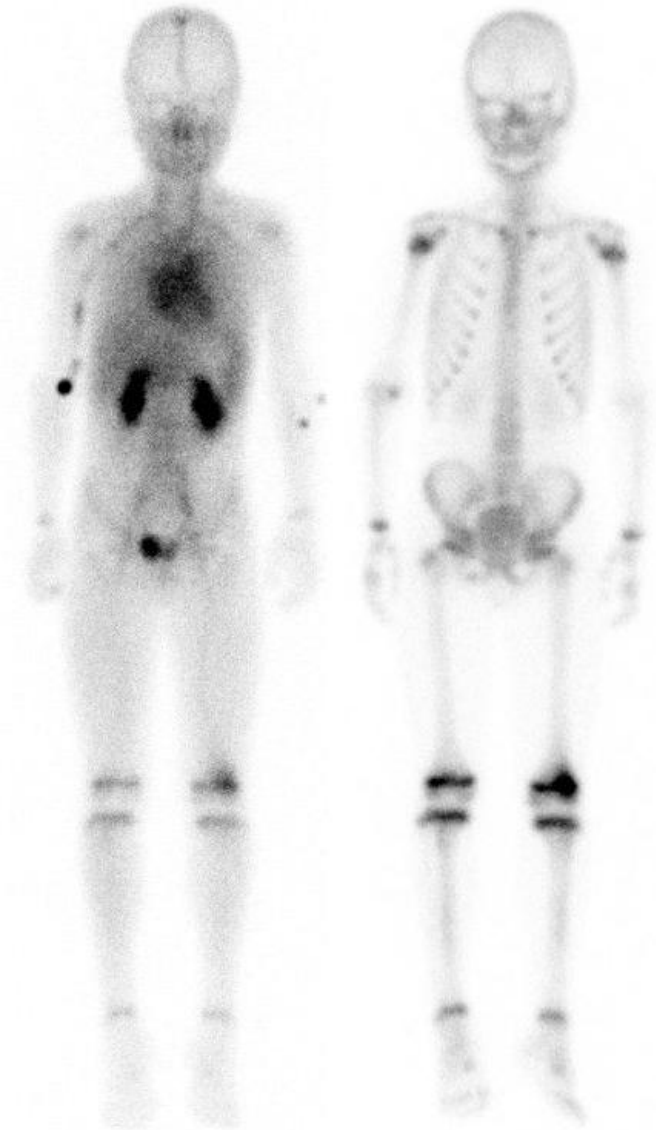


OSTEOMYELITIS

- Blood pool +
- Increased focal bone uptake
- In children: typically sub metaphyseal area of long bones
 - distal vascularization of the diaphysary artery

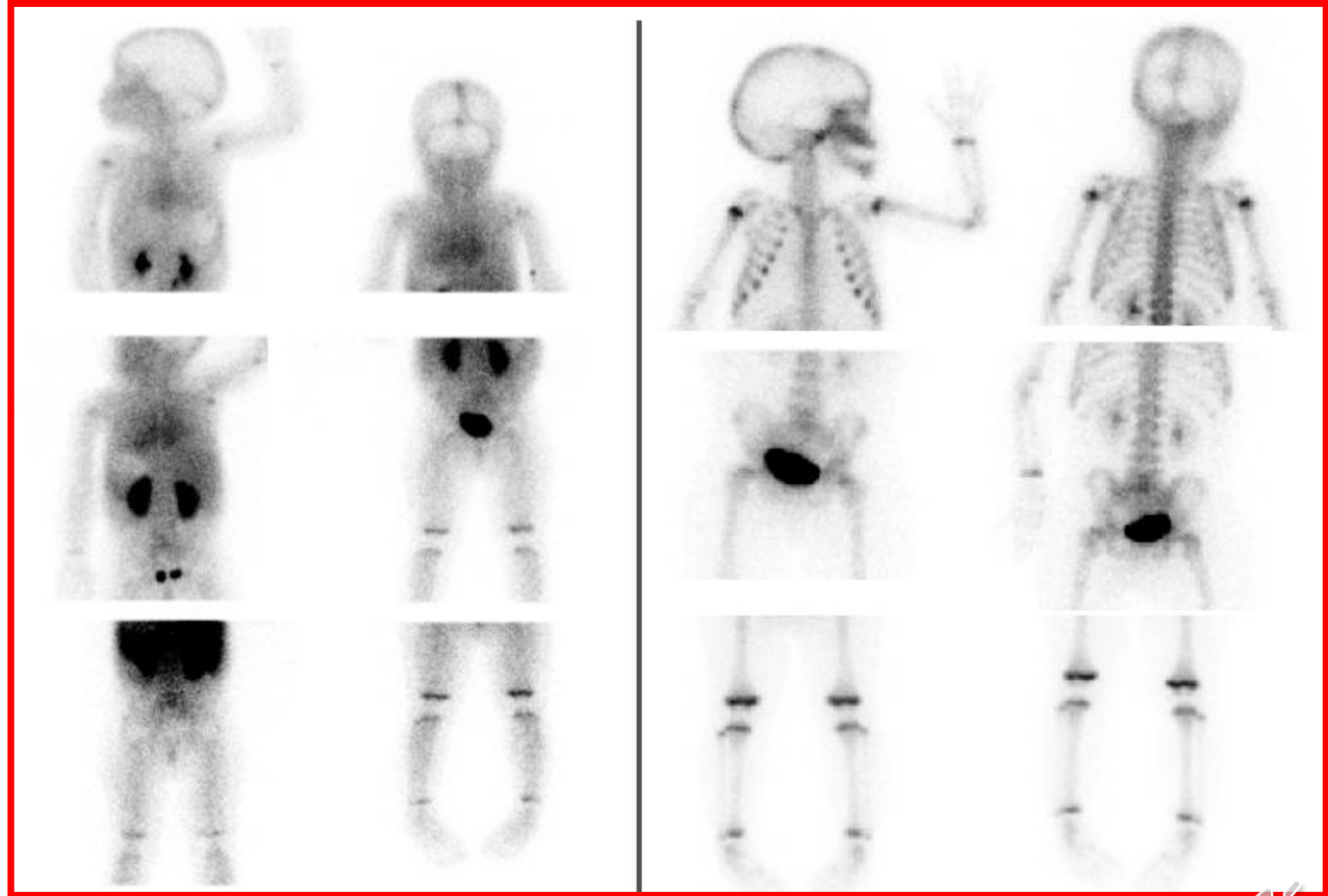
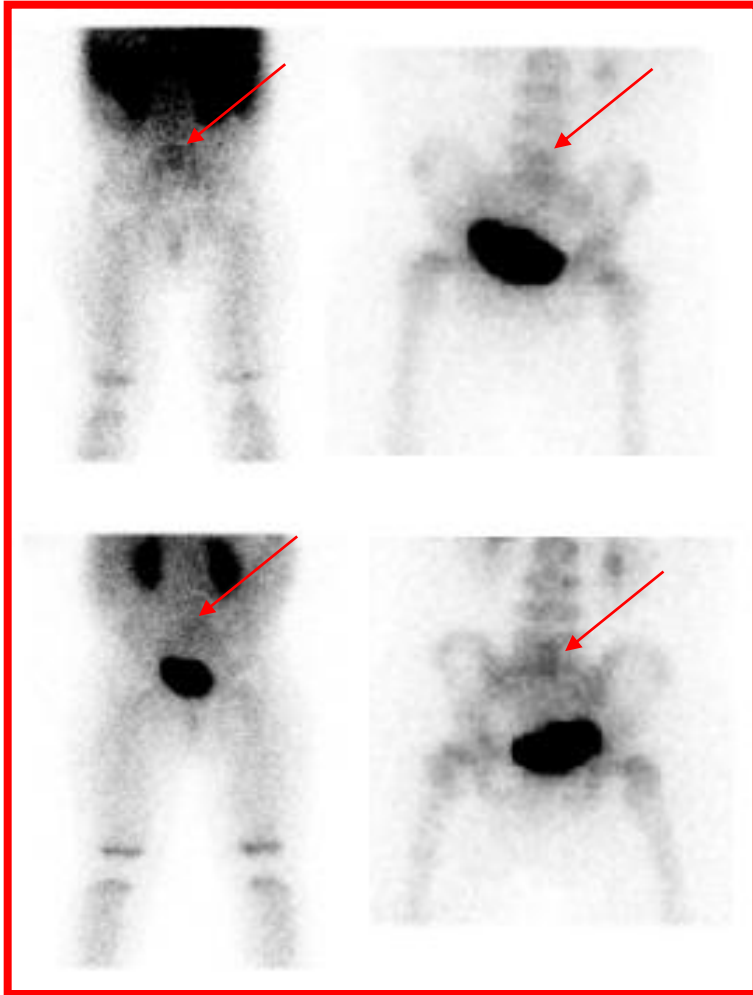


7 y, left femoral osteomyelitis

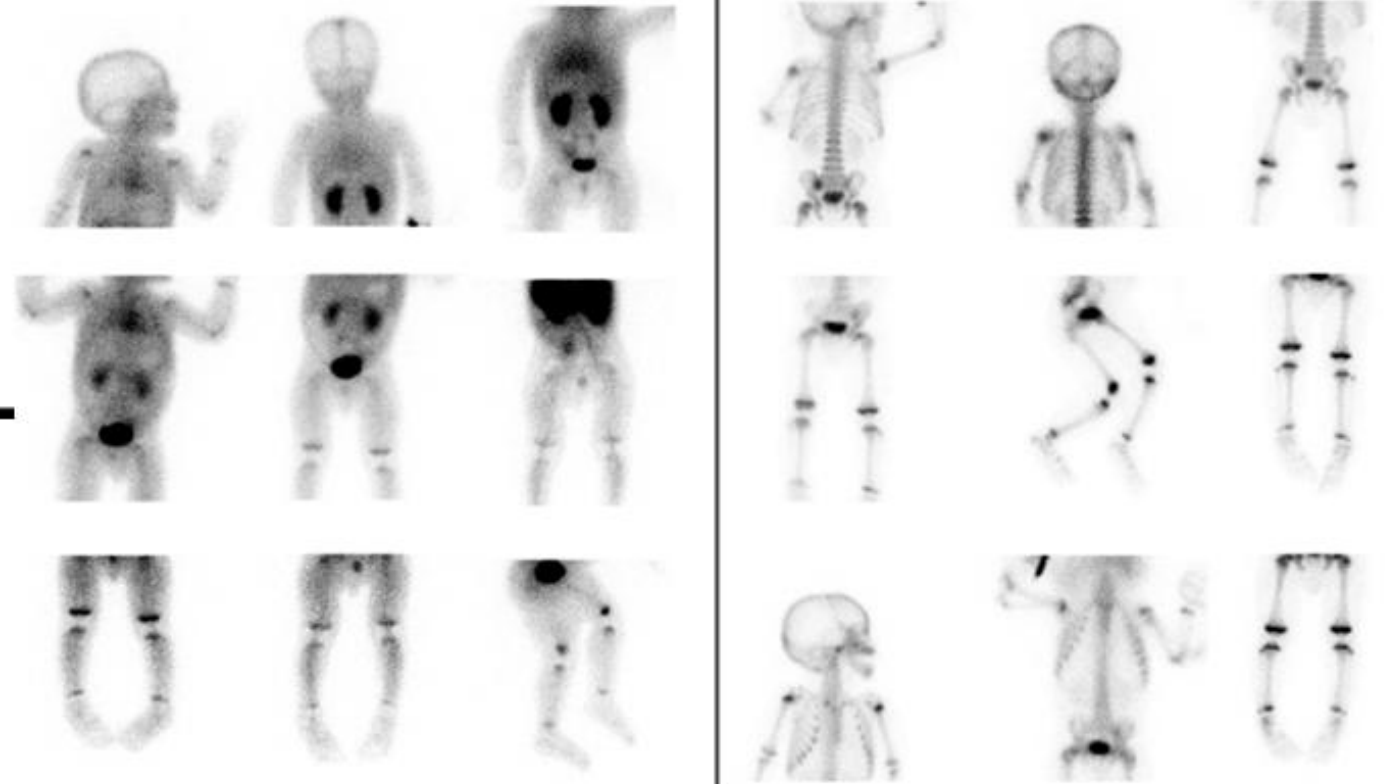
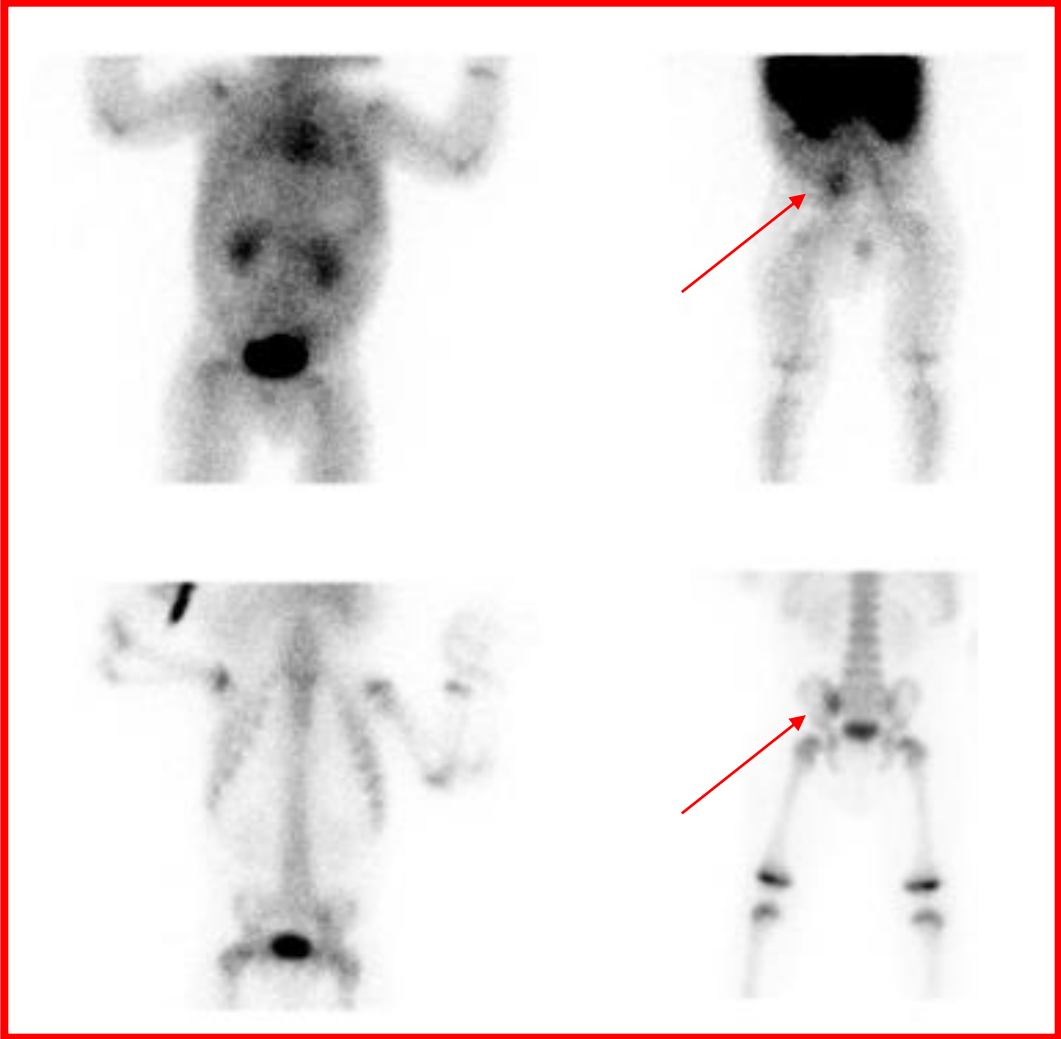


Discitis

Discitis are often diagnosed on bone scan in case of babies and infants with fever and who refuse to walk.



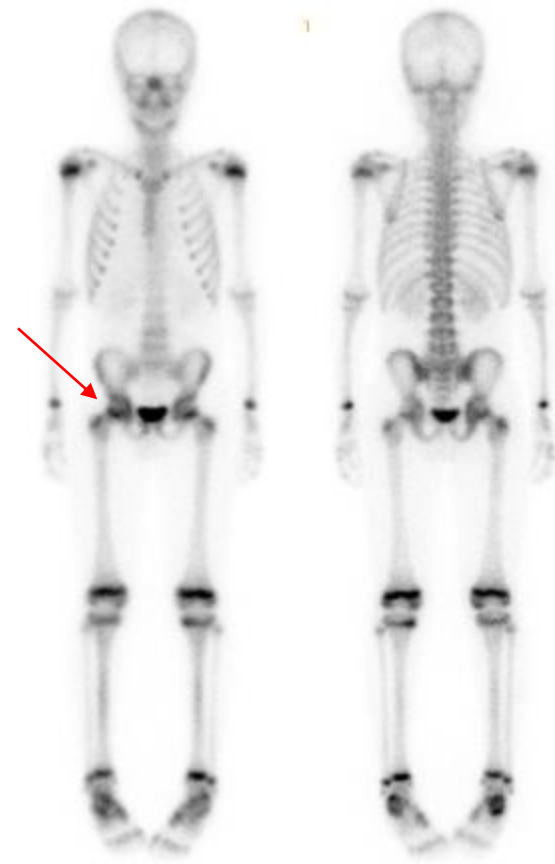
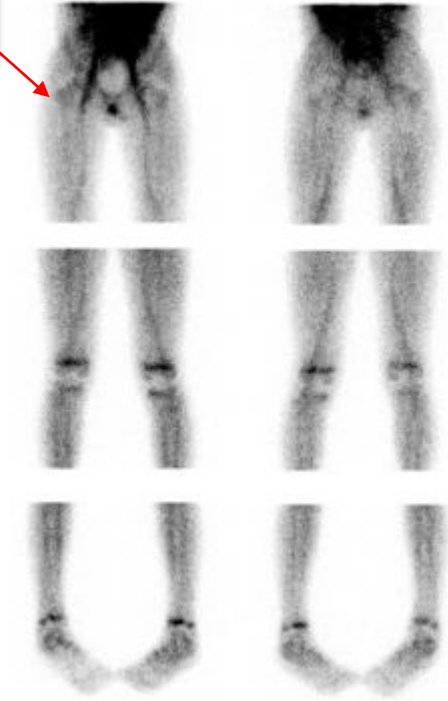
Sacroileitis



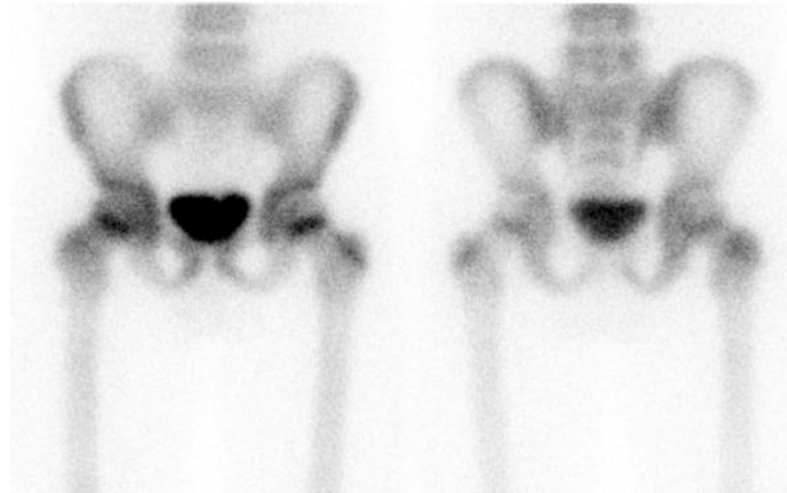
ARTHRITIS

HIP ARTHRITIS, non complicated:

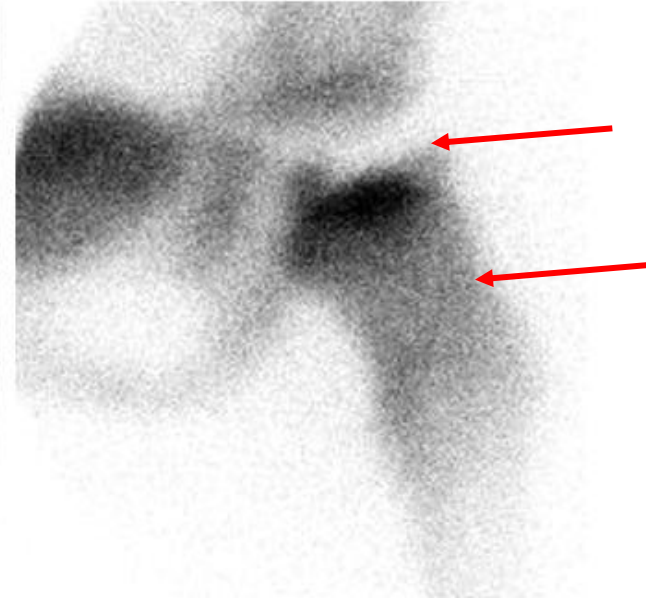
- Blood pool +
- Bone uptake + diffuse
- Pin-hole images are crucial to detect vascular involvement of the femoral head



7 y
Right hip arthritis



BONE DISEASES: different patterns in childhood



Femoral head
cold area

Femoral neck
osteomyelitis

Osteomyelitis and Arthritis

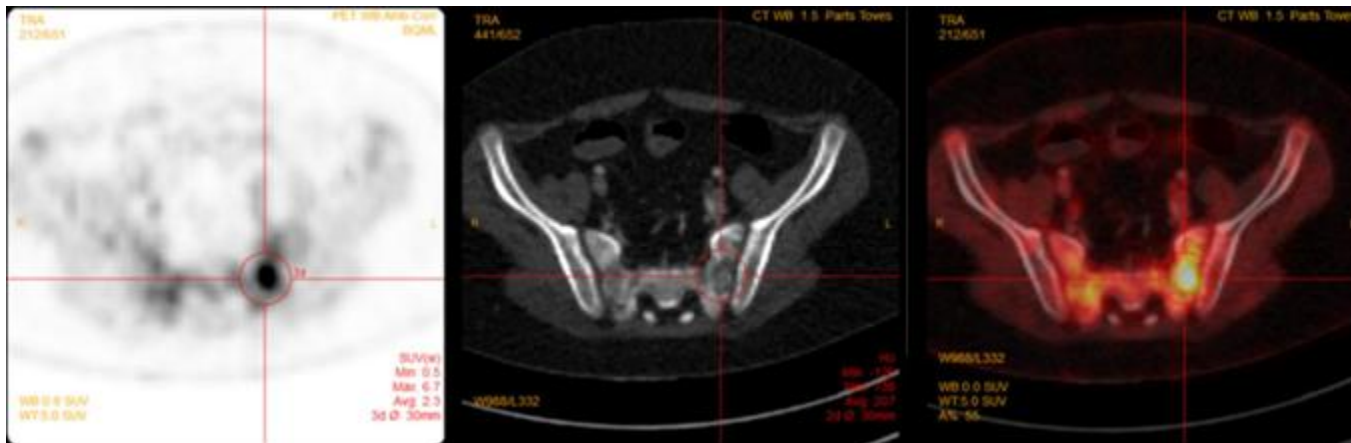
in babies and children

- Value the epiphyseal perfusion
- Value submetaphyseal areas



Sacrum Osteomyelitis with Brodie abscess

- Blood Pool +
- Planar bone images difficult to interpret
- SPECT-CT crucial



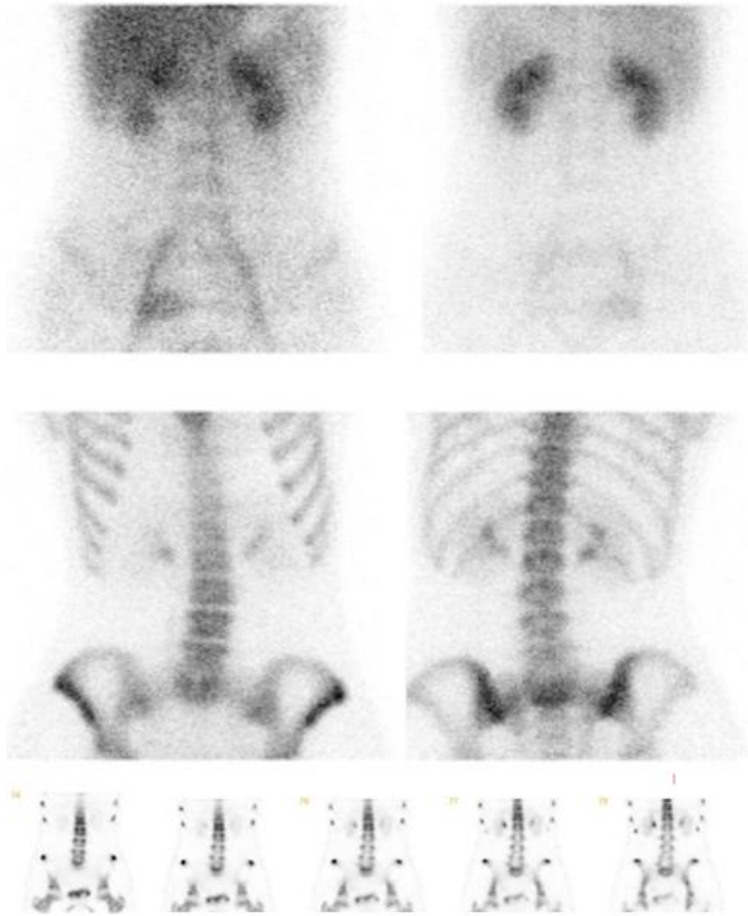
Brodie abscess on the left sacrum, with increased focal uptake



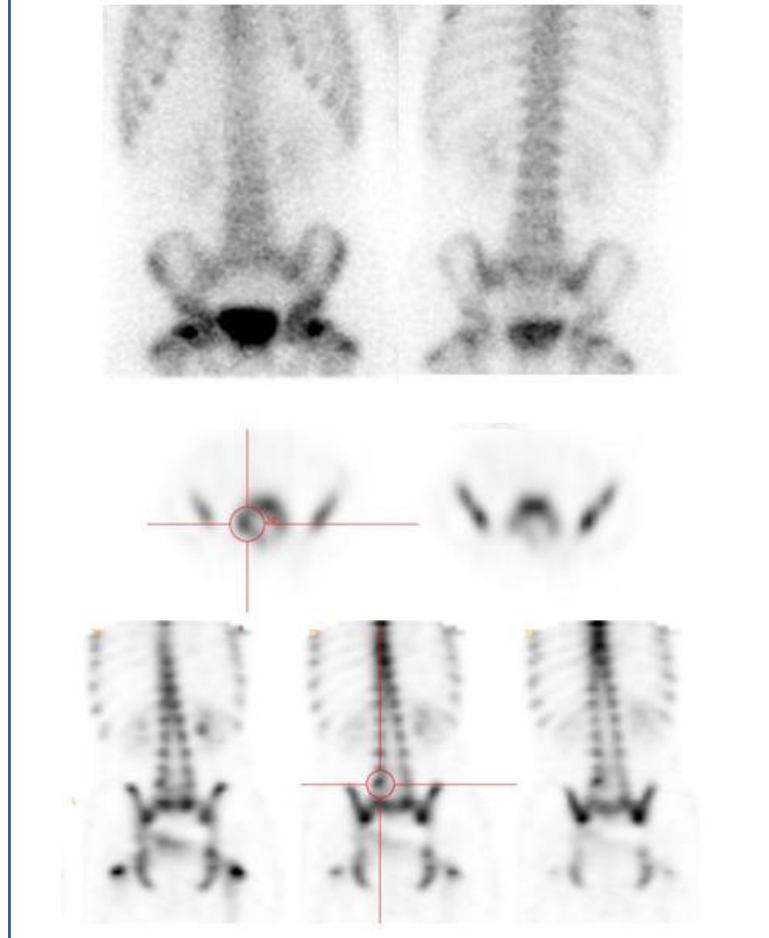
DORSAL / LUMBAR PAIN

In case of lumbar pain, bone SPECT has higher SENSITIVITY to detect lesions than planar images

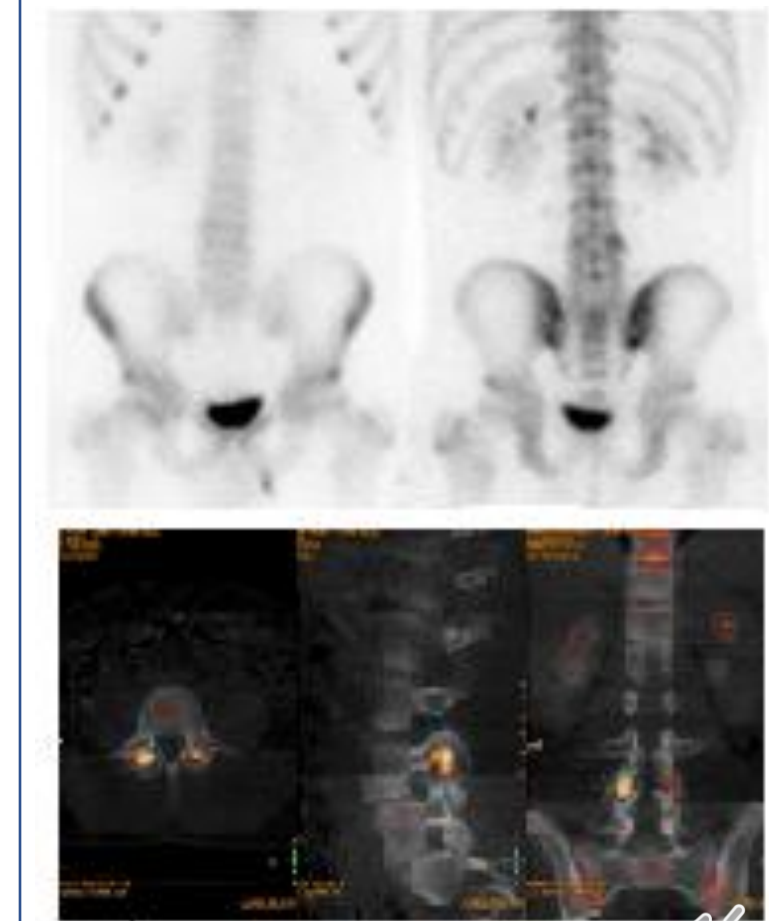
NORMAL

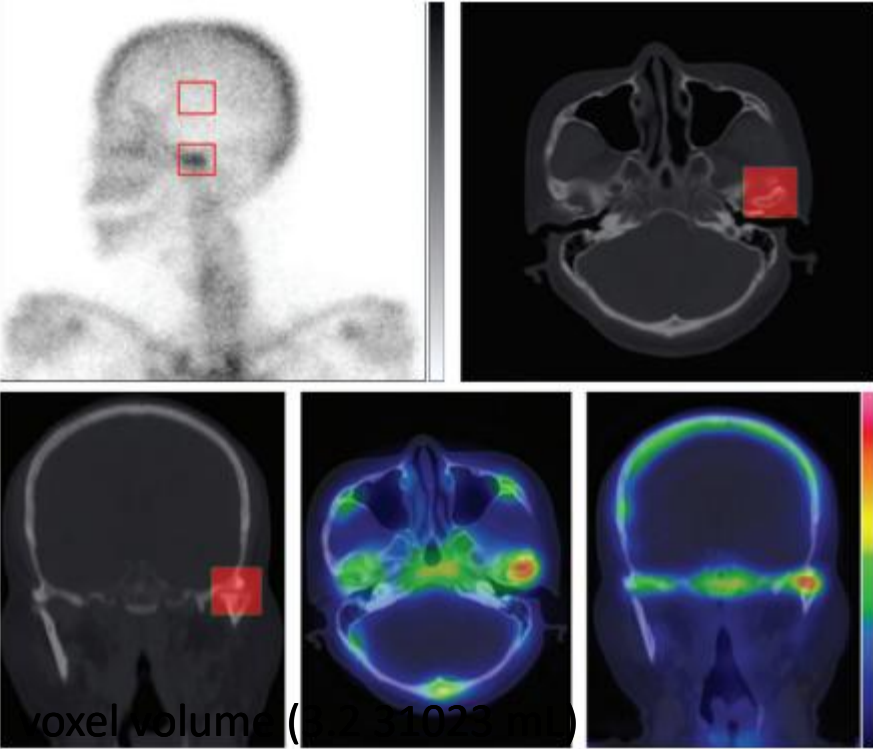


UNILATERAL SPONDYLOLYSIS



BILATERAL SPONDYLOLYSIS





VISUAL QUANTIFICATION



Normal

Mild-Moderate

Severe

ABSOLUTE QUANTIFICATION

$$RR = \frac{\text{TMJ counts}}{\text{background counts}}$$

$$SUV_{\text{mean}} = \frac{\text{total radioactivity / VOI volume}}{\text{injected radioactivity / body weight}}$$

$$SUV_{\text{max}} = \frac{\text{maximum radioactivity / voxel volume}}{\text{injected radioactivity / body weight}}$$

Voxel volume $3,2 \times 10^{-3}$ mL

Mandibular condylar
hyperplasia



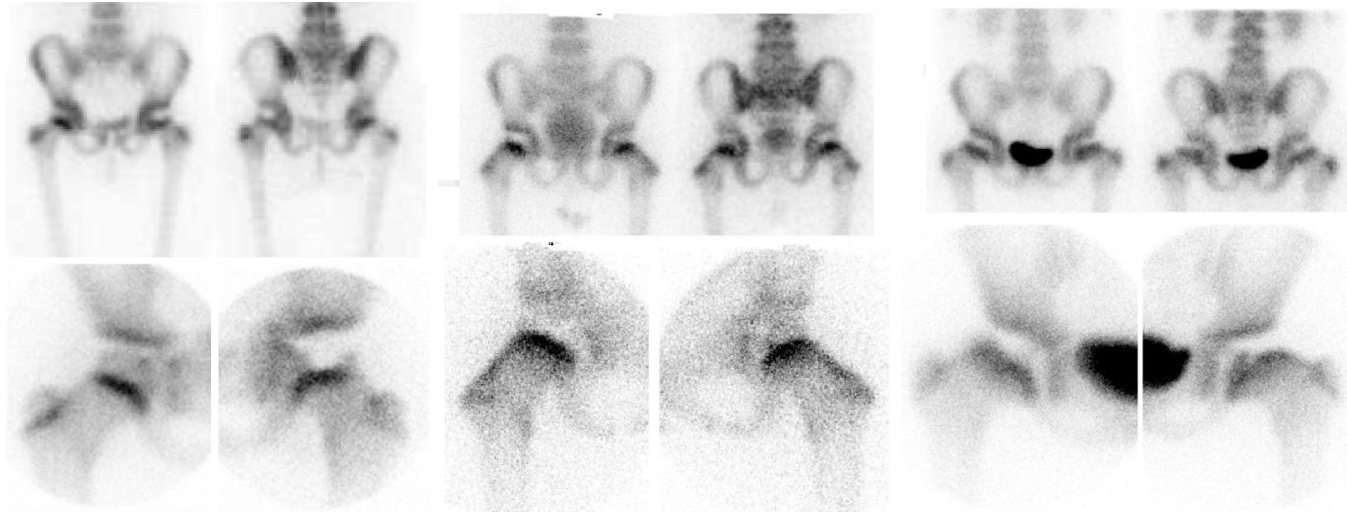
LEGG-CALVE-PERTHES DISEASE

- Pin-hole: is the best imaging to value the femoral head perfusion

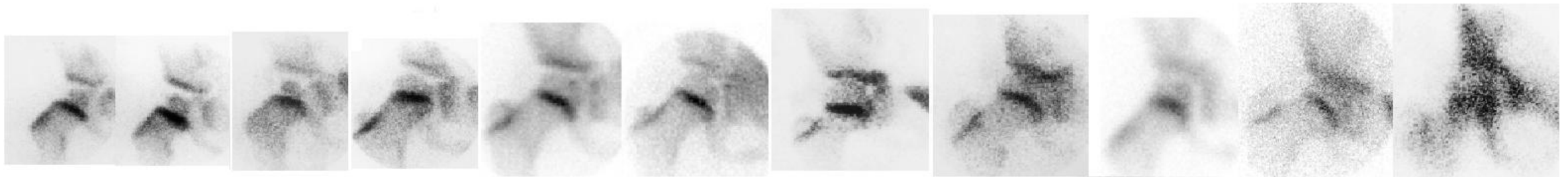
Initial diagnosis:

- lack of femoral head uptake = poor prognosis
- External pillar with uptake = good prognosis

- follow/up: perfusion of the femoral head



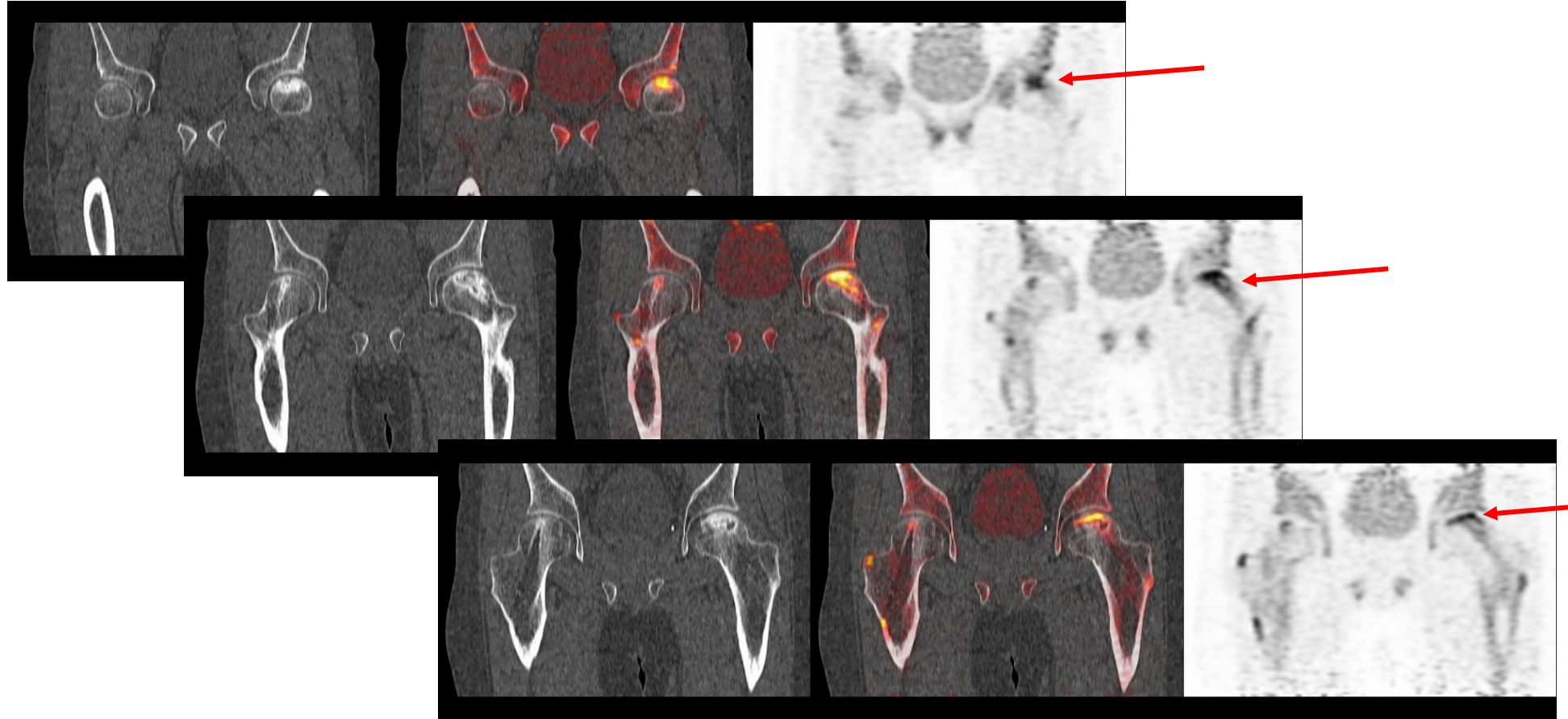
PIN-HOLE: normal imaging during growing



FEMORAL HEAD OSTONECHROSIS

Assessment of BONE VIABILITY after revascularization surgery

- Free vascularized bone graf



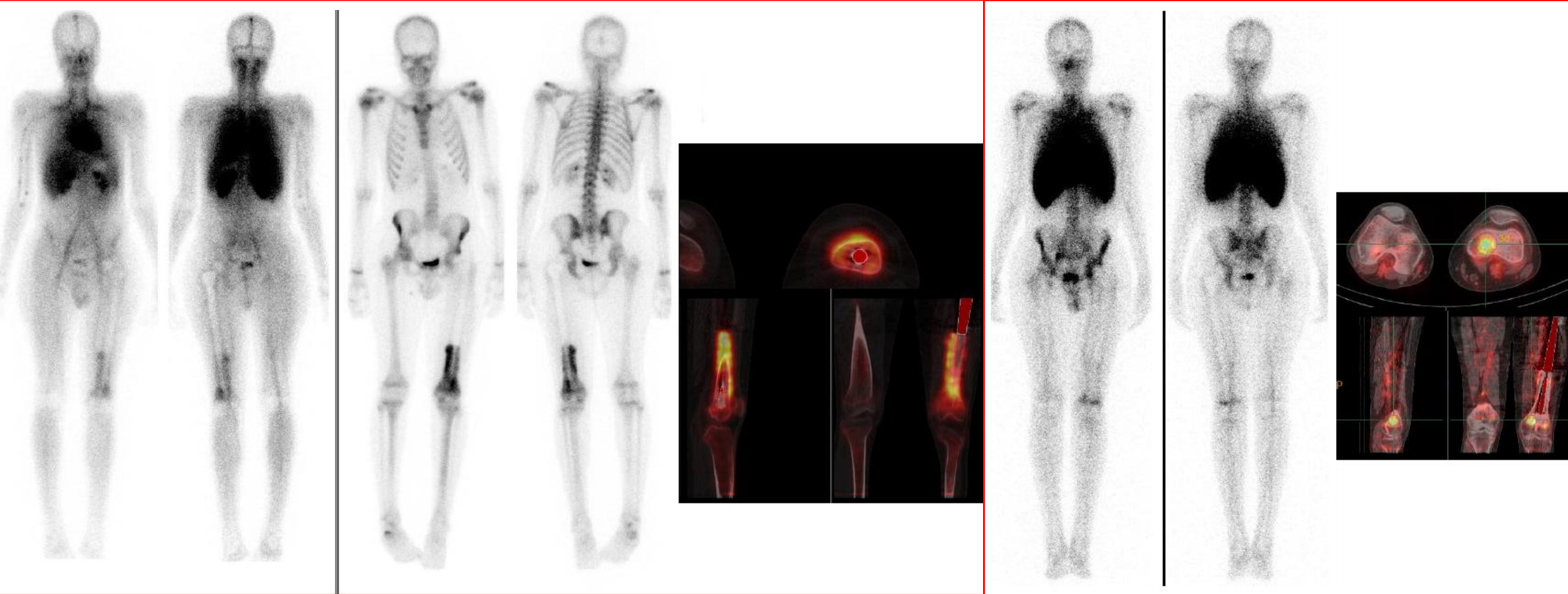
PET-CT with ^{18}F Fluorine

Detects easily

- the bone viability after the surgery and
- the bone formation during the follow-up



PSEUDOARTHROSIS FEMORAL PROTHESIS - OSTEOSARCOMA



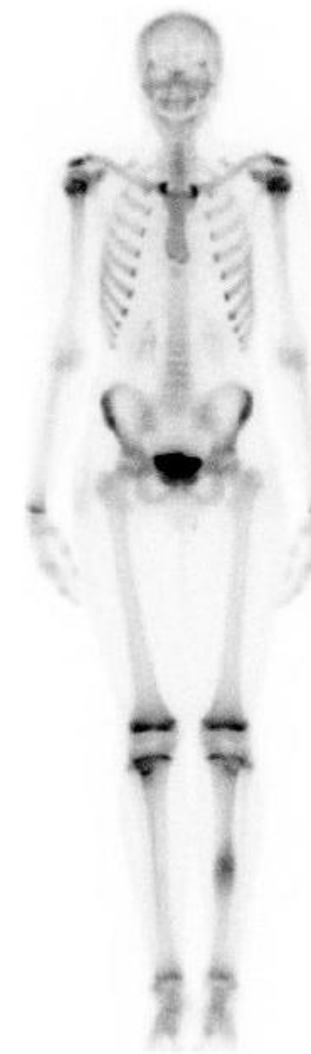
Bone scan with SPECT-CT

WBC scan with SPECT-CT

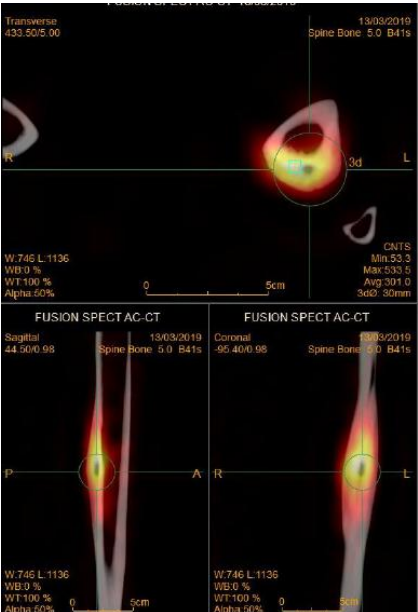


Osteoid Osteoma

- 16 year old boy
- Left tibia pain
- Periosteal reaction on planar Xr



- Blood pool +
- Bone lesion with increased uptake in the middle of the left tibial diaphysis
- Foci of high uptake in the middle of the lesion
- SPECT/CT image is diagnostic by itself!



Osteoblastoma

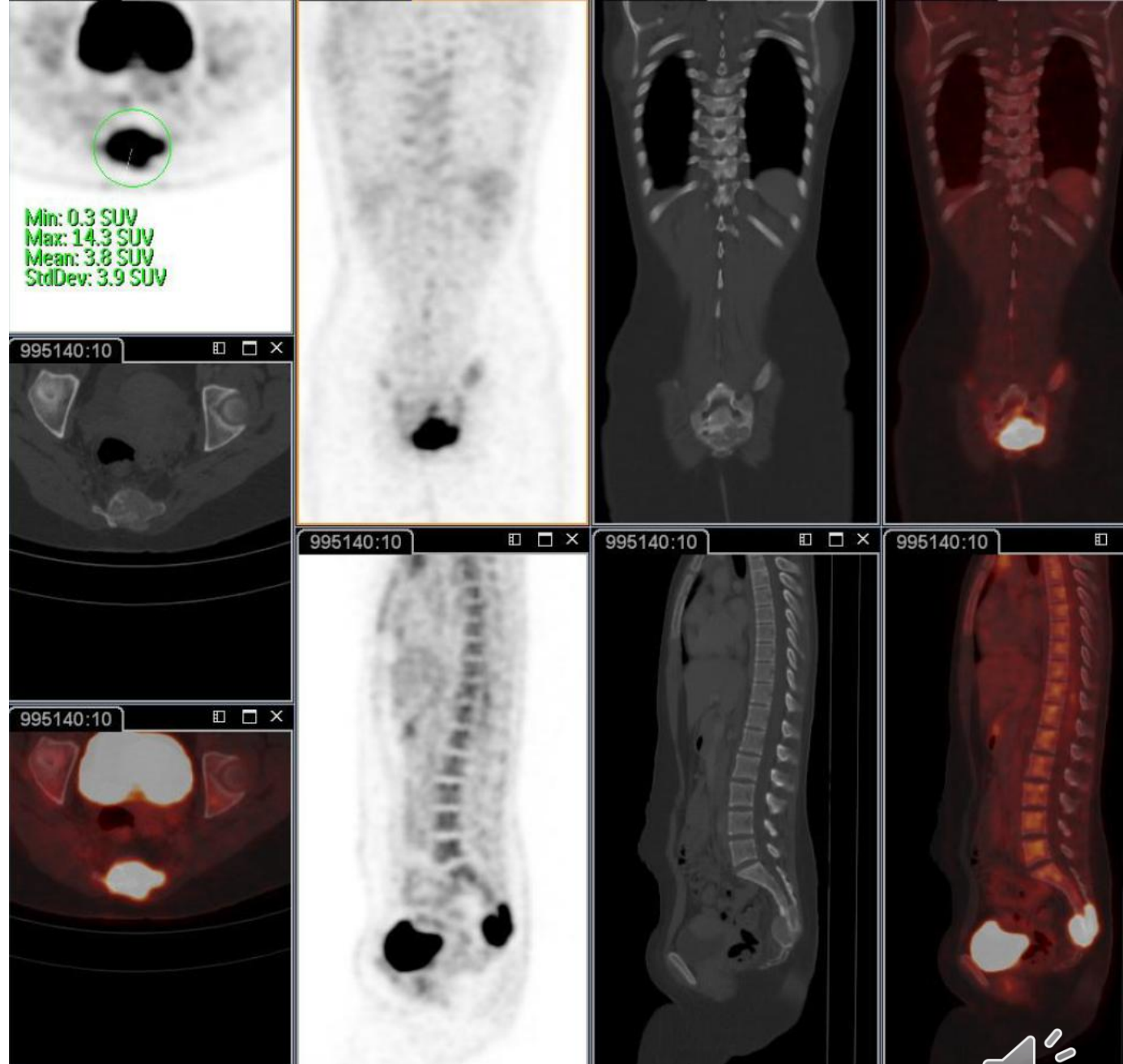
- 14 y old boy
- Sacrum tumour

MR and PET-CT:

- Suspicion of malignant tumour

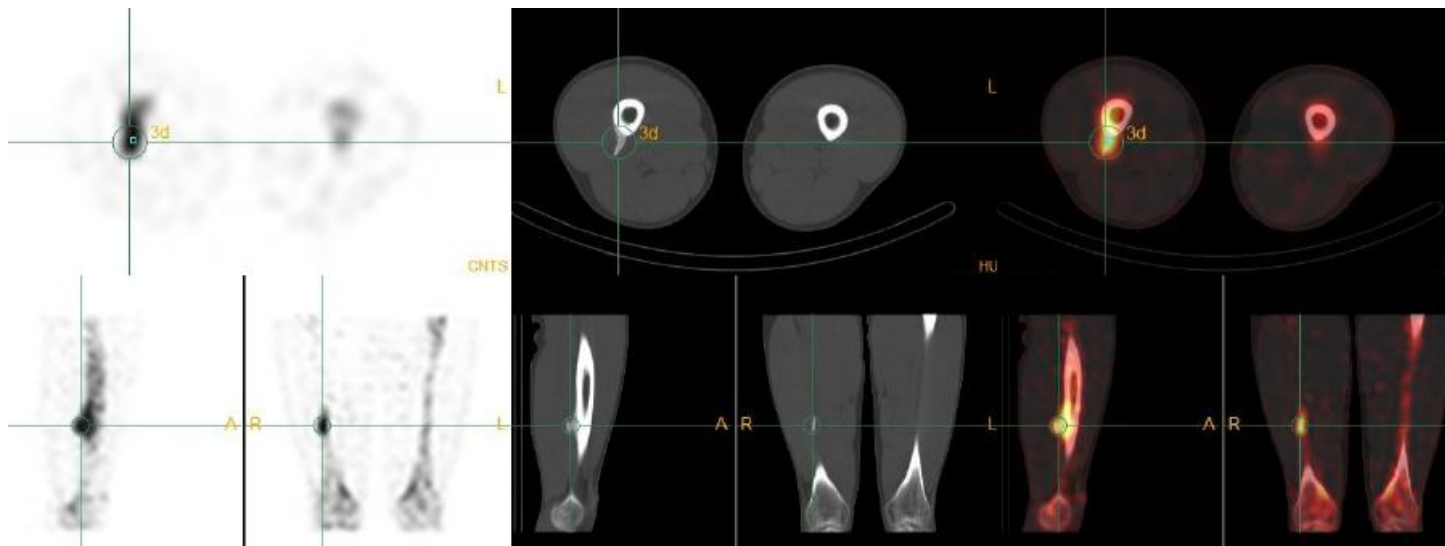
Biopsy: Osteoblastoma

Surgery: complete excision



Osteochondroma Exostosis

- 18 y, right femur tumour
- Unique exostosis:
 - Increased osteogenic activity
 - Persistent growth cartilage
 - Trauma



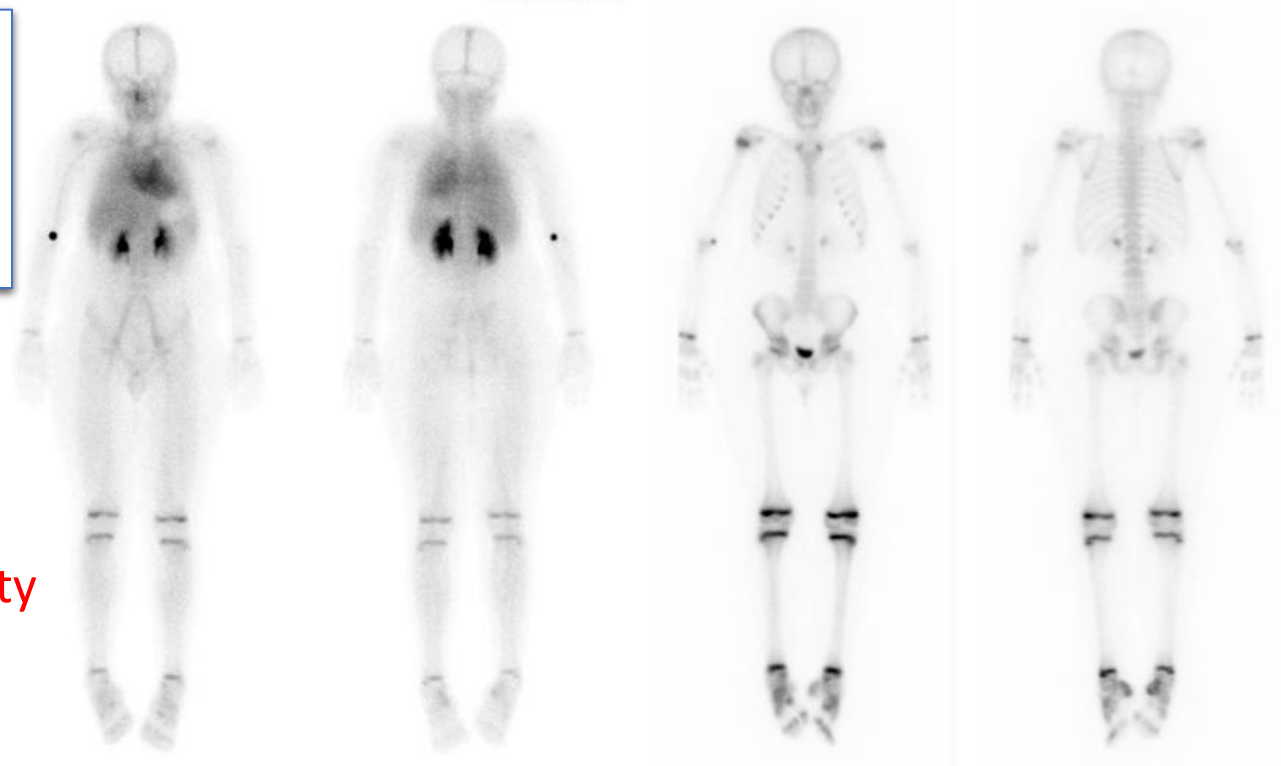
Multiple enchondromatosis

- 10 y old girl
- Ollier disease
- Bone scan for extensión

MR: multiple enchondroma left hand, signs of aggressivity

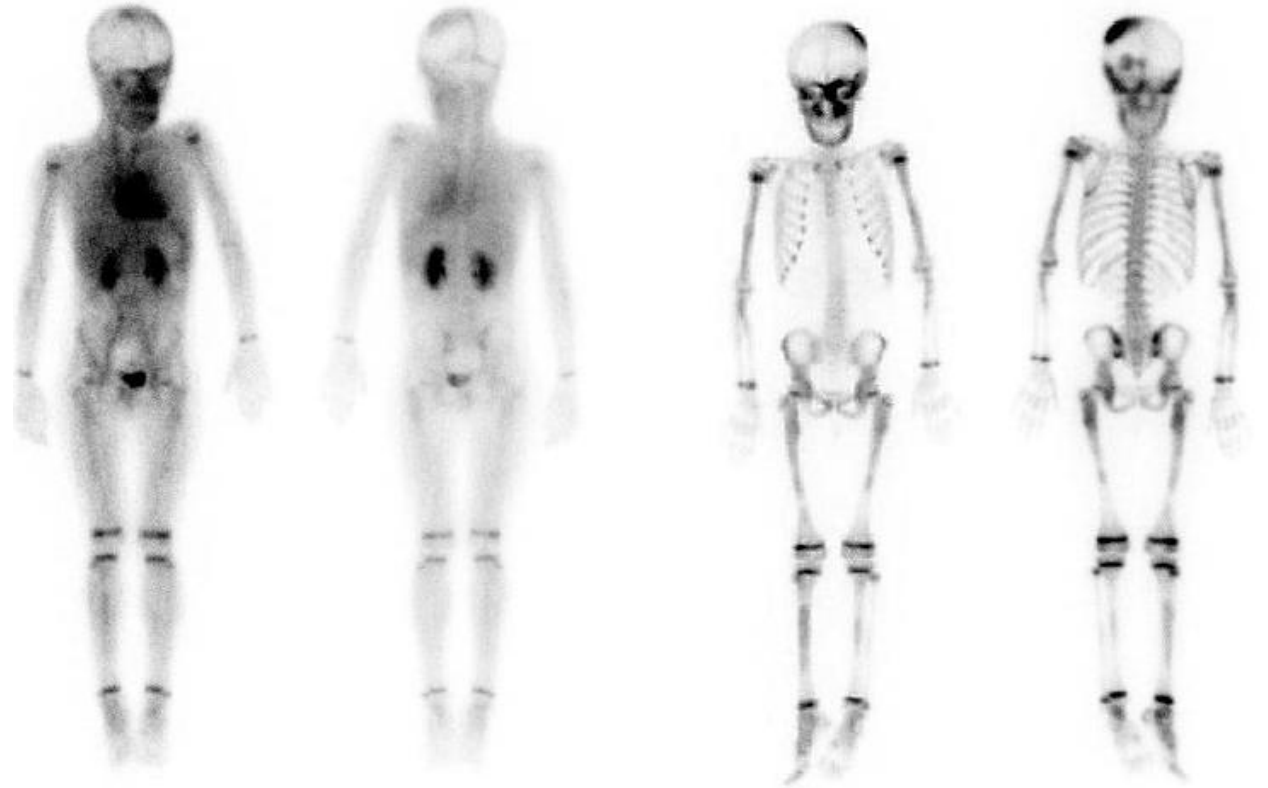
Bone scan: only left hand involvement.

- Low inflammatory compound (blood pool)
- Low osteogenic activity



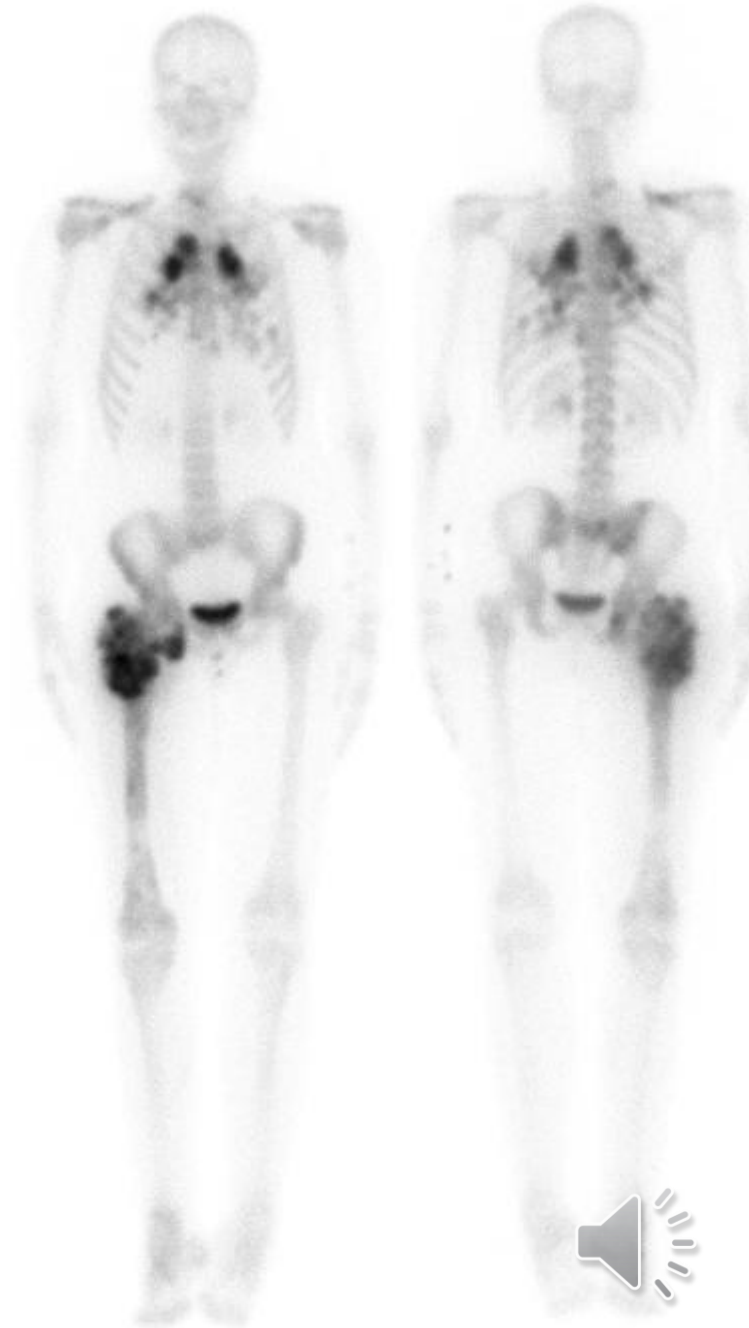
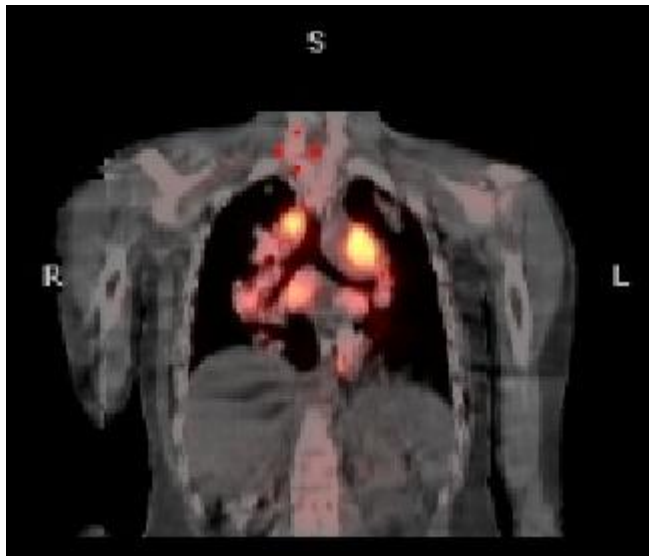
Fibrous Displasia

- 5 y, McCune-Albright síndrome
- Poliestotico involucramiento óseo
- Pool de sangre + en varias localizaciones



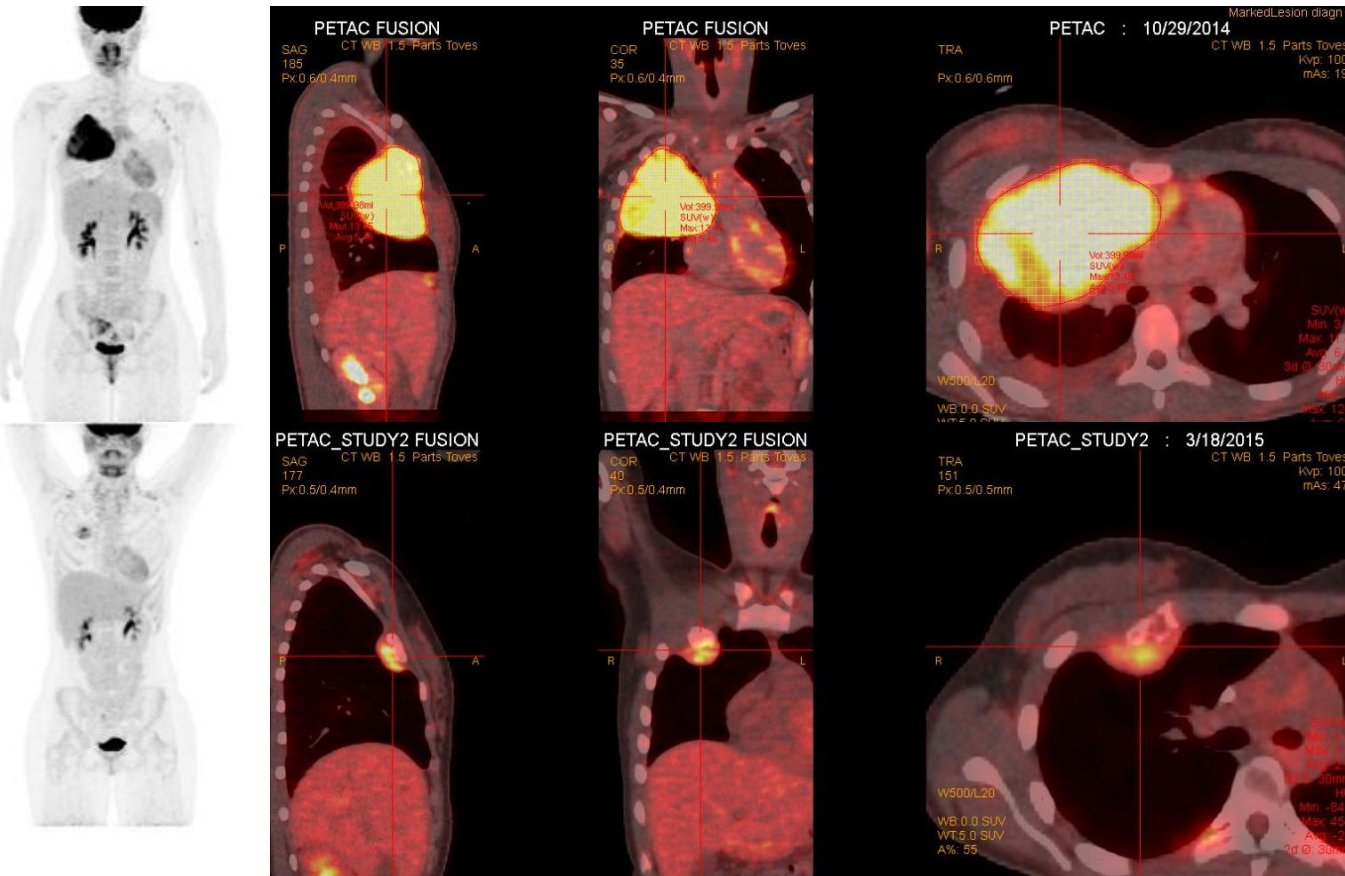
OSTEOSARCOMA

- Advanced staging at diagnosis
- Large local extension
- Multiple lung metastases



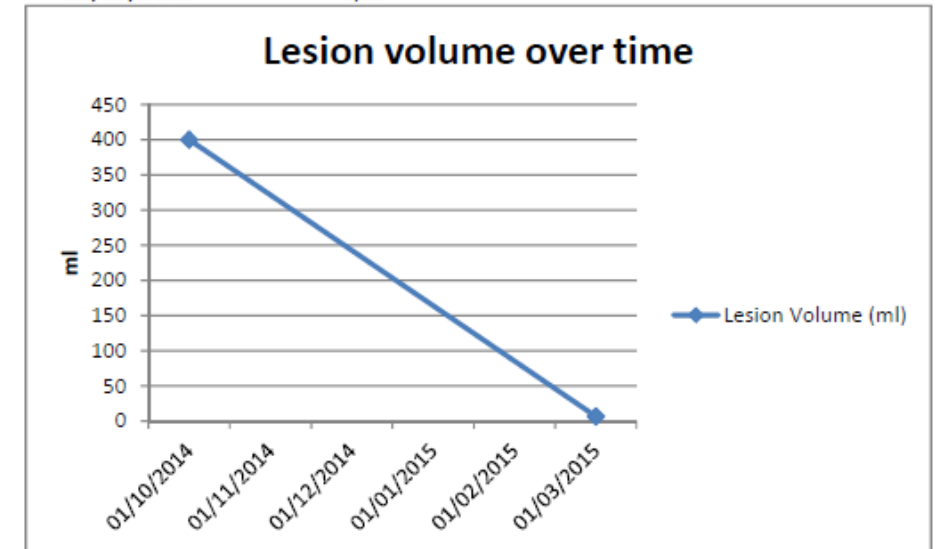
COSTAL OSTEOSARCOMA

Initial diagnosis and follow/up with quantification of the response to chemotherapy



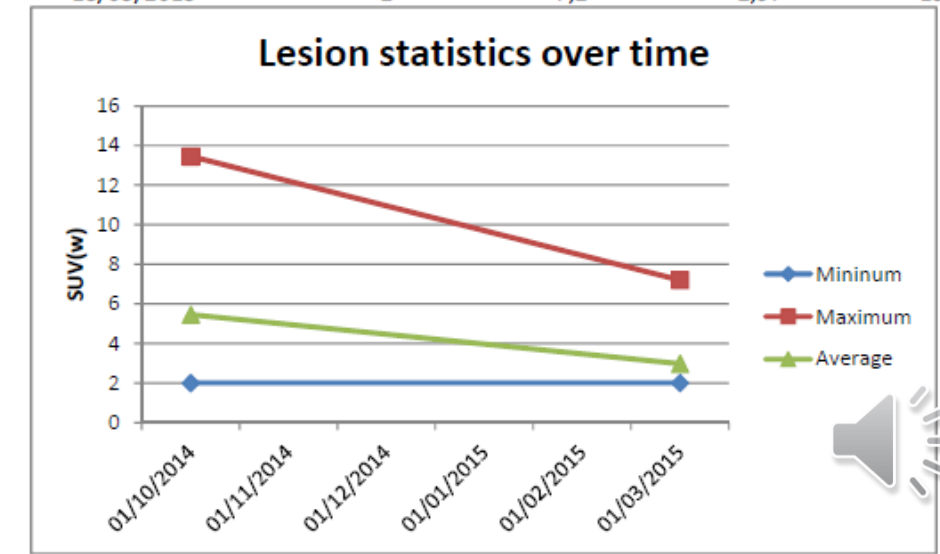
Lesion Volume:

Study Date	Lesion Volume (ml)	
29/10/2014	399,98	1,7%
18/03/2015	6,67	



Functional Statistics:

Study Date	Minimum	Maximum	Average	Total
29/10/2014	2	13,45	5,46	2.184,97
18/03/2015	2	7,2	2,97	19,81



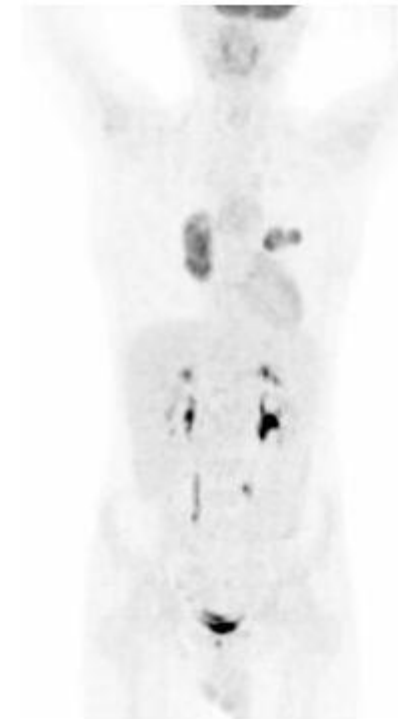
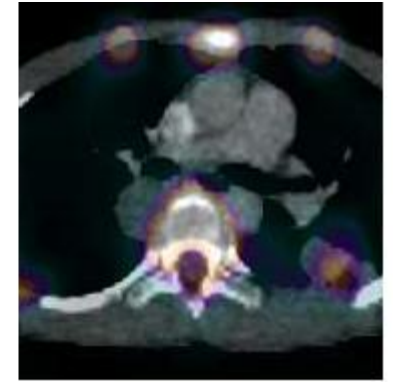
FEMORAL OSTEOSARCOMA

- Chemotherapy
- Surgery
- Follow-up:
 - Bone scintigraphy
 - PET FDG

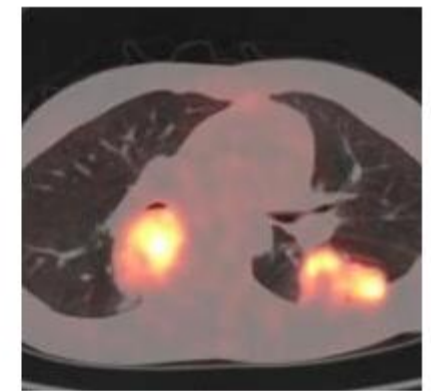
PET-FDG detects multiple lung mets

- Few bone scan + (differentiated)
- Most bone scan neg (undifferentiated)
- All FDG+

Bone scan + SPECT-CT



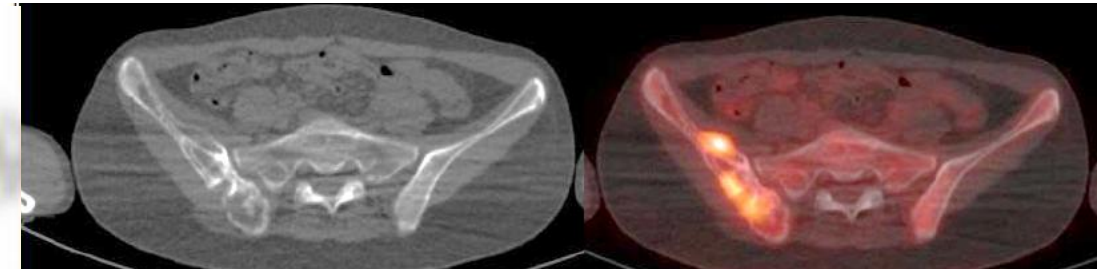
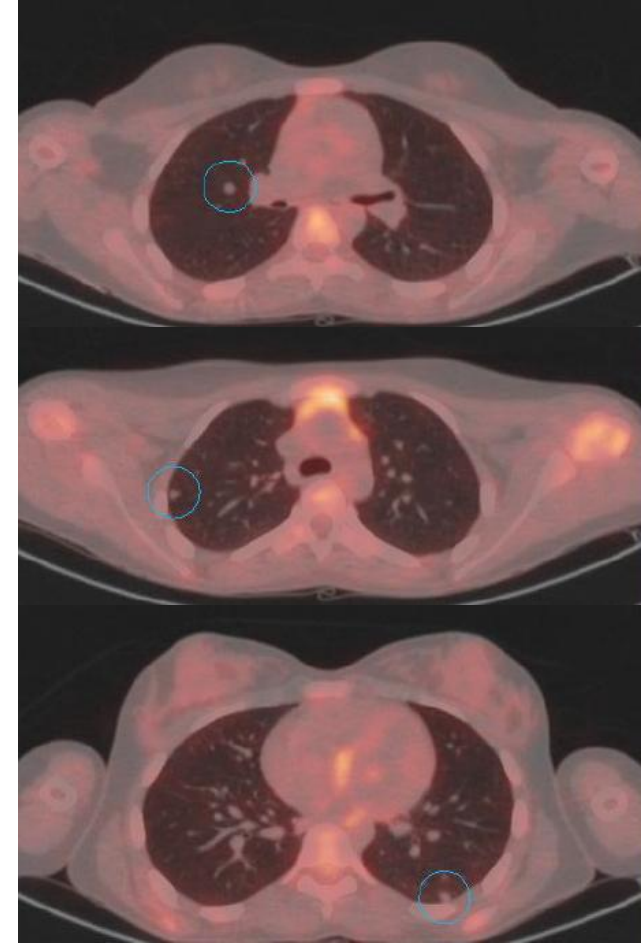
PET-CT
¹⁸F-FDG



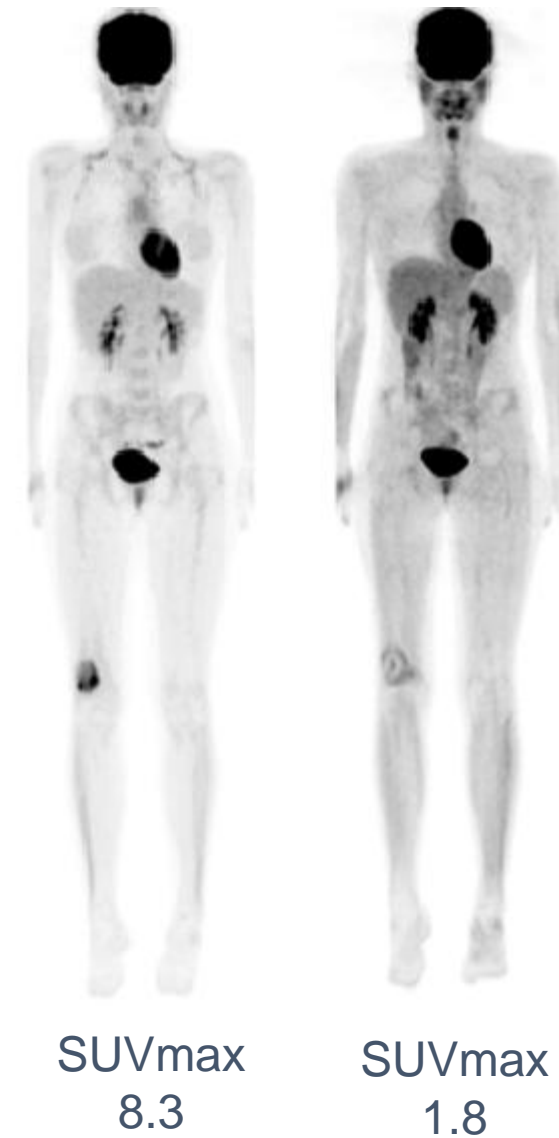
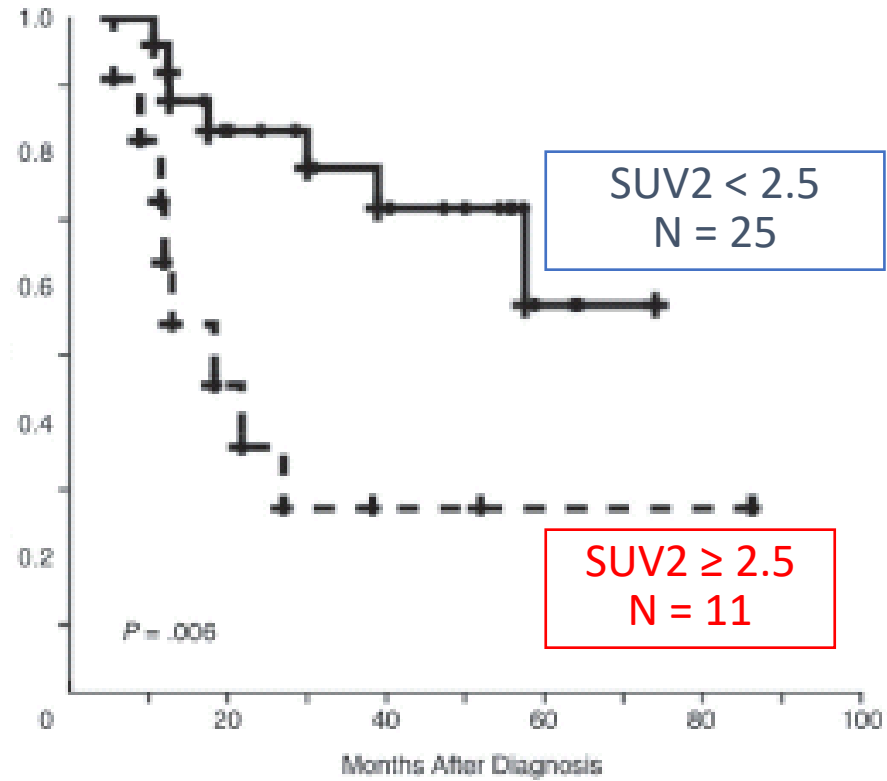
Ewing Sarcoma

- 16 y
- Initial diagnosis
- Tumour with mild metabolism FDG+
- Lung mets

Min: 0.1 SUV
Max: 5.7 SUV
Mean: 1.3 SUV
StdDev: 1.0 SUV



Metabolic Response in Ewing Sarcoma



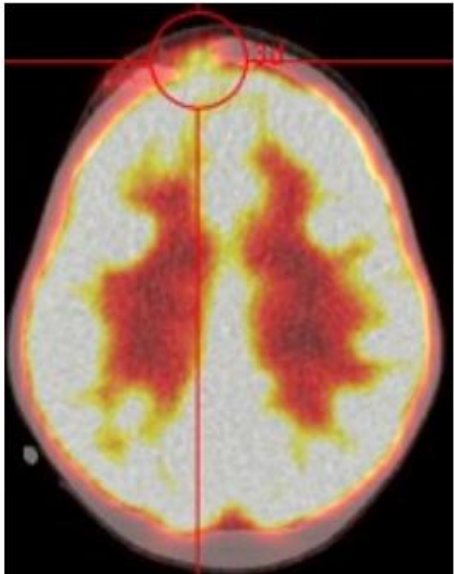
Hawkins DS, Schuetze SM, Butrynski JE, Rajendran JG, Vernon CB, Conrad EU 3rd, Eary JF. [18F]Fluorodeoxyglucose positron emission tomography predicts outcome for Ewing sarcoma family of tumors. *J Clin Oncol.* 2005 Dec 1;23(34):7828-34



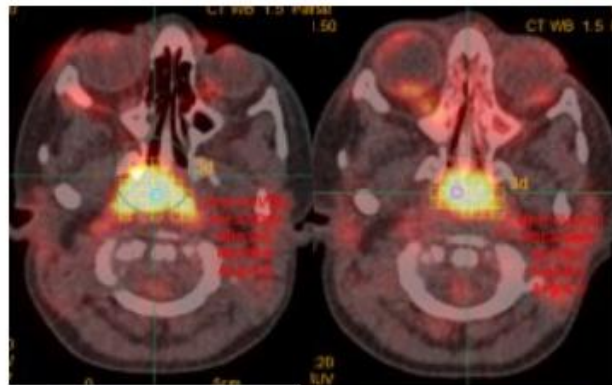
LANGERHANS CELL HISTIOCYTOSIS

Uni or Multifocal
Uni or Multisystem

Initial evaluation



After treatment
(Interim)



INITIAL

AFTER

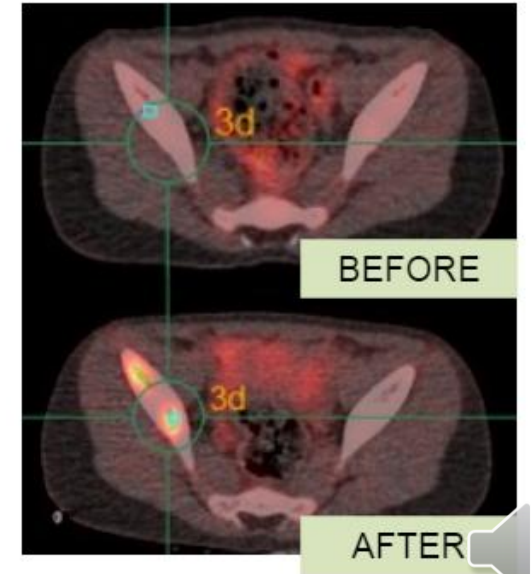
Response
assessment



INITIAL

AFTER

Recurrence
suspicion



BEFORE

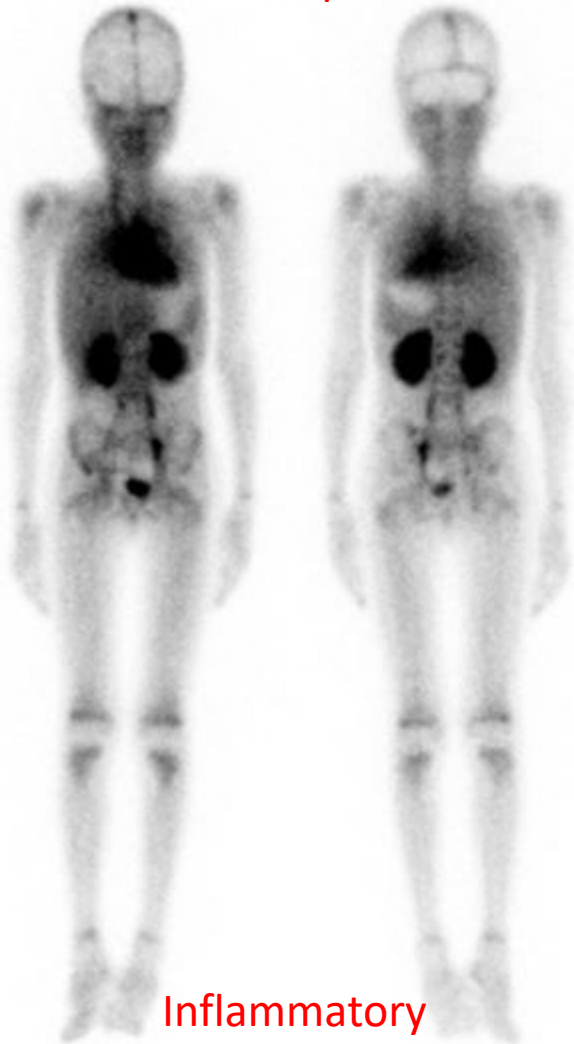
AFTER



Neuroblastoma IV

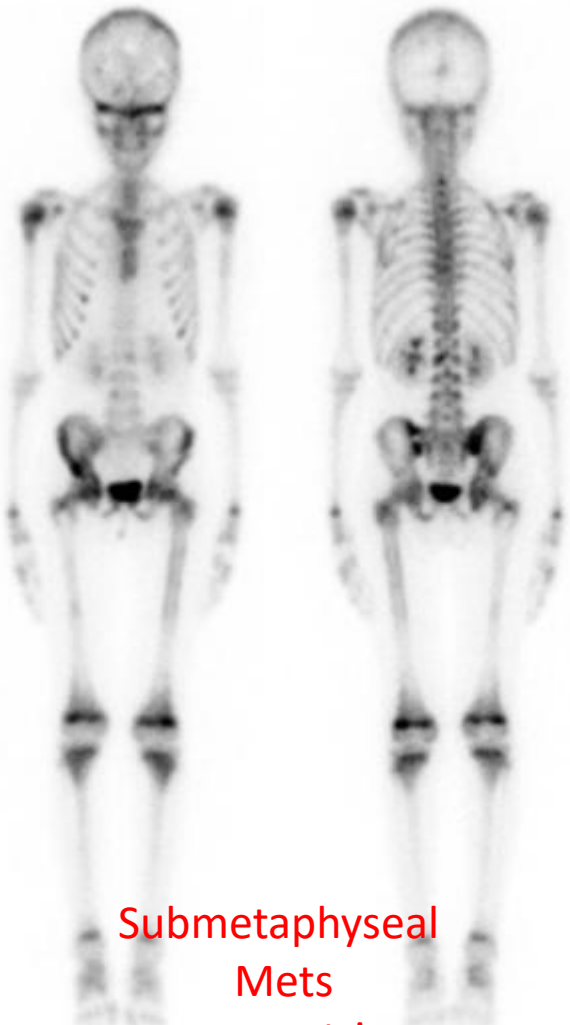
9y girl, initial diagnosis

Blood pool



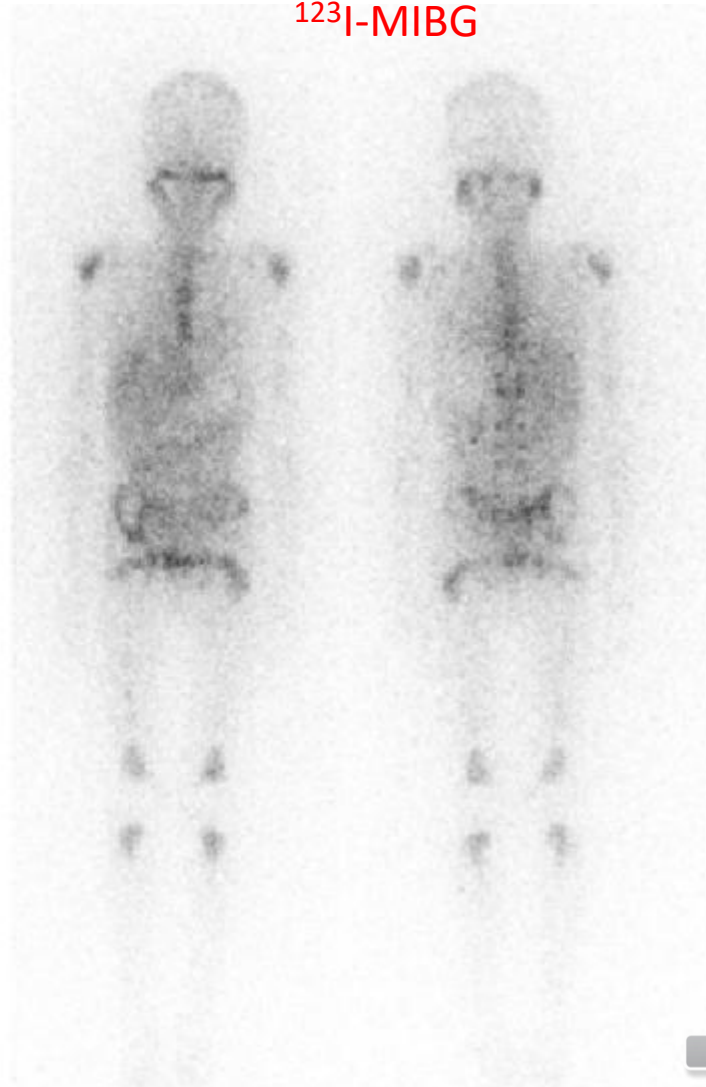
Inflammatory
mets

Bone uptake



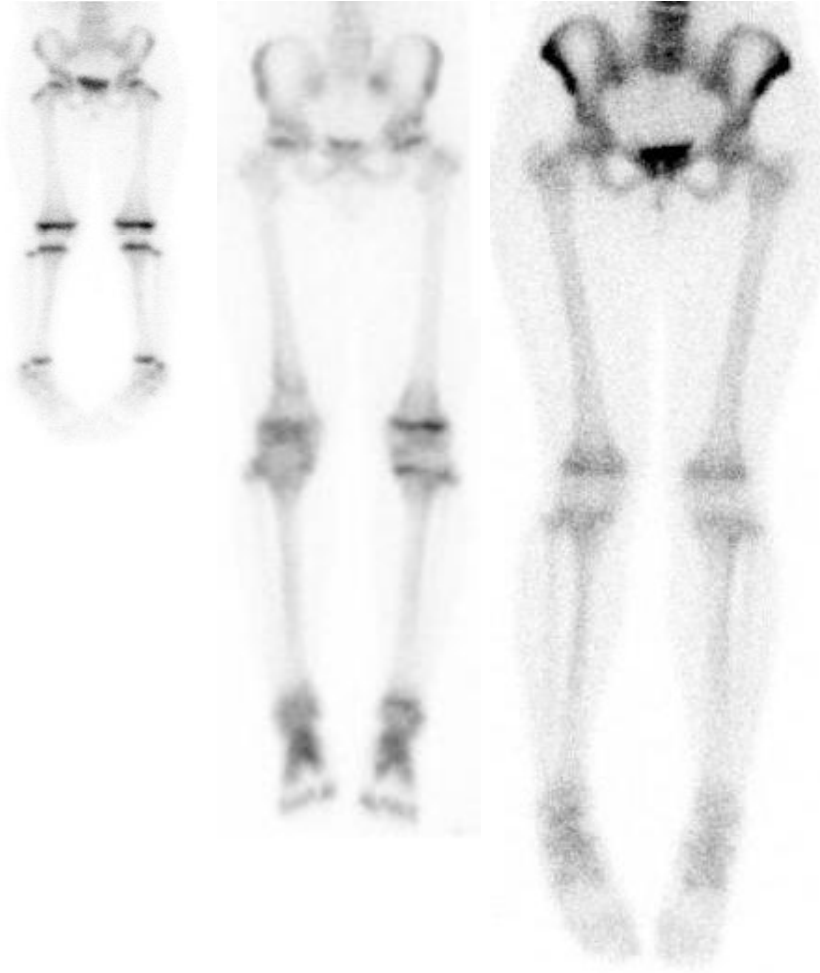
Submetaphyseal
Mets
symmetric

¹²³I-MIBG



Nuclear Medicine of the MSK system - Indications & Protocols

SUMMARY

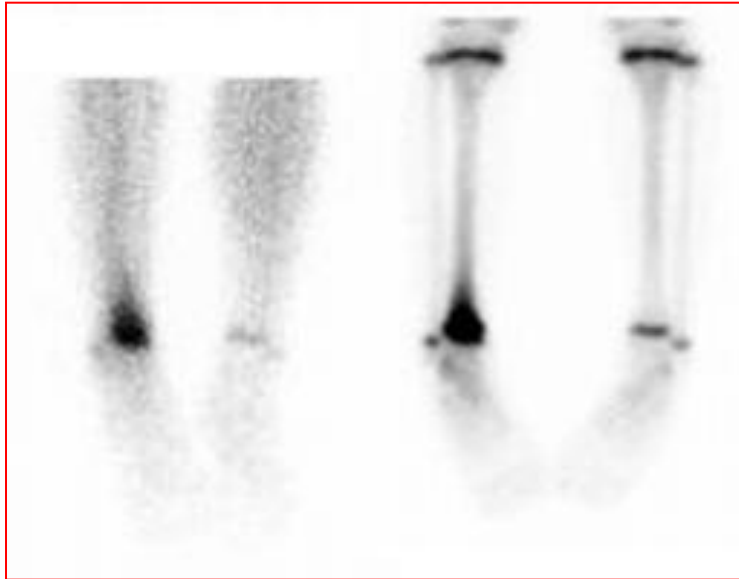
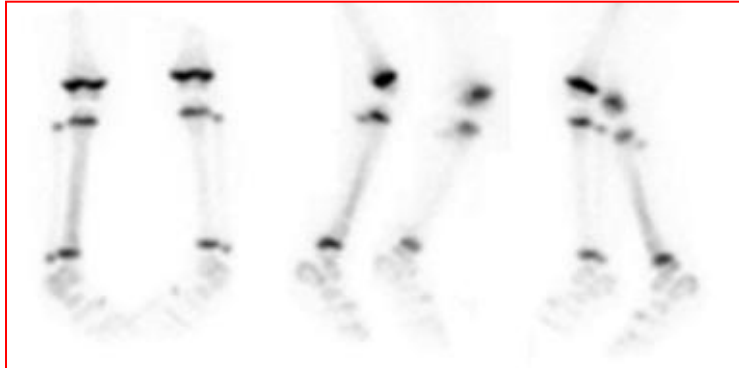


- 1. maturity and development patterns affect the image interpretation.**
2. In some diseases, the location and morphology of the lesions differ during childhood:
 - bone fractures
 - osteomyelitis
3. diseases and diagnostics in Paediatrics are very different from those of adults.
 - some diseases in children does not exist in adults
 - they are not widely known



Imaging of the Developing Skeleton

SUMMARY

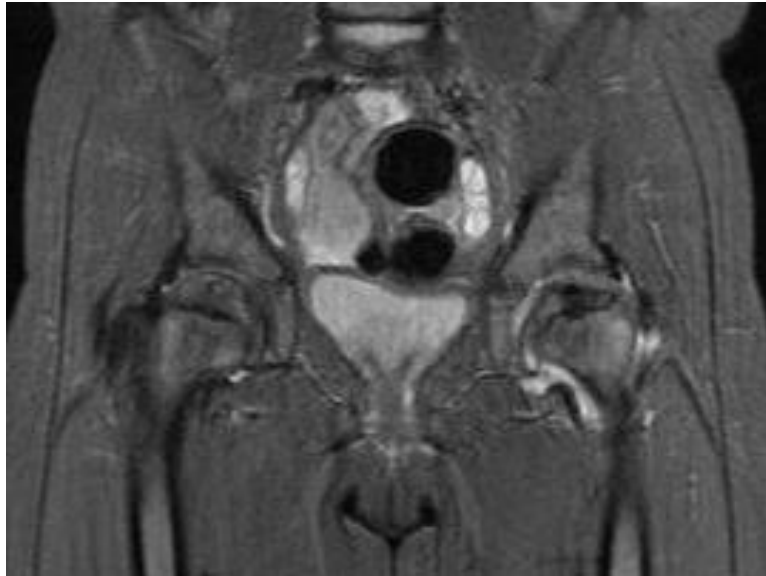


1. maturity and development patterns affect the image interpretation.
2. In some diseases, the location and morphology of the lesions differ during childhood:
 - bone fractures
 - osteomyelitis
3. diseases and diagnostics in Paediatrics are very different from those of adults.
 - some diseases in children does not exist in adults
 - they are not widely known



Imaging of the Developing Skeleton

SUMMARY

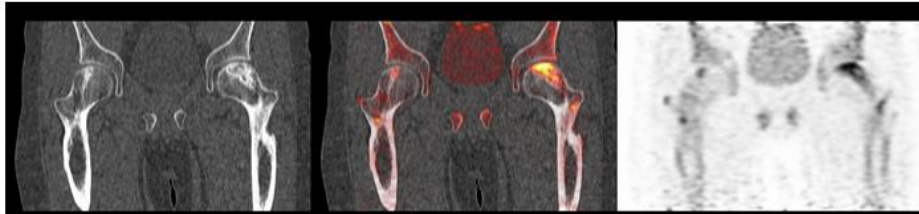
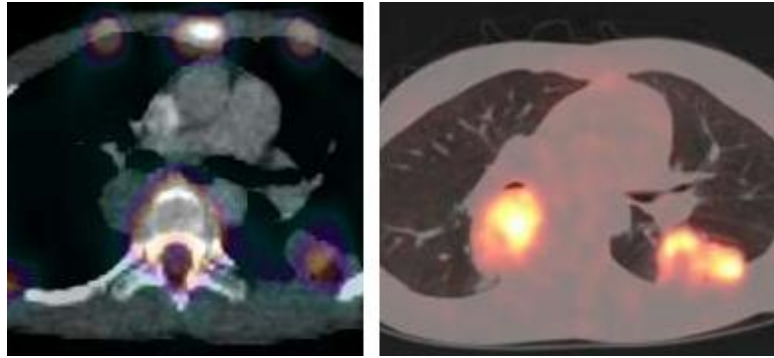


1. maturity and development patterns affect the image interpretation.
2. In some diseases, the location and morphology of the lesions differ during childhood:
 - bone fractures
 - Osteomyelitis
3. diseases and diagnostics in Paediatrics are very different from those of adults.
 - some diseases in children does not exist in adults
 - they are not widely known

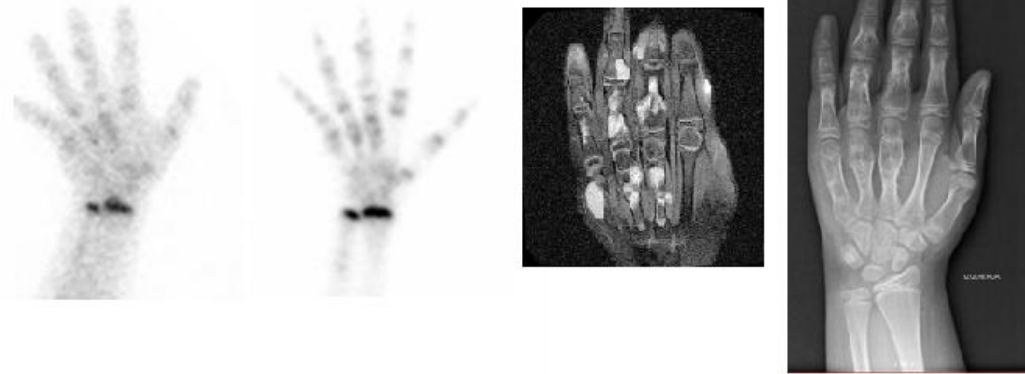


Imaging of the Developing Skeleton

SUMMARY



4. Hybrid images are the future of our specialities
5. NM has the metabolic lesions
6. Radiology has the anatomic information
7. The collaboration between radiologists and nuclear medicine physicians is crucial



Nuclear Medicine of the MSK system

Indications & Protocols



Isabel Roca
isaroca@gmail.com