

Block Bewegungsapparat

Nuklearmedizinische Vorlesung

Bewegungsapparat 2

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Palliativtherapie

Schmerzen bei Skelettm metastasen

- Prinzip:
„Therapeutische Skelettszintigraphie“
- z.B. **Samarium-153 EDTMP**
 - Gamma- und Betastrahler (HWZ ca. 46h), d.h. diagnostischer und therapeutischer Strahler
 - reichert an in osteoblastischen Metastasen
 - kritische Organe: gesunder Knochen, KM, Blase



Palliativtherapie Schmerzen bei Skelettmastasen



Tc-99m-Phosphonat

Intravenöse Applikation



Sm-153-EDTMP

Palliativtherapie

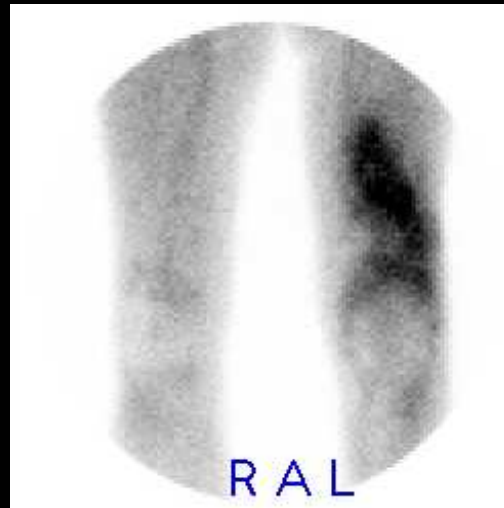
Schmerzen bei Skelettmetastasen



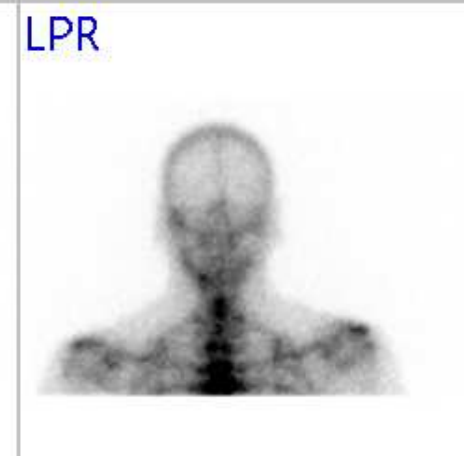
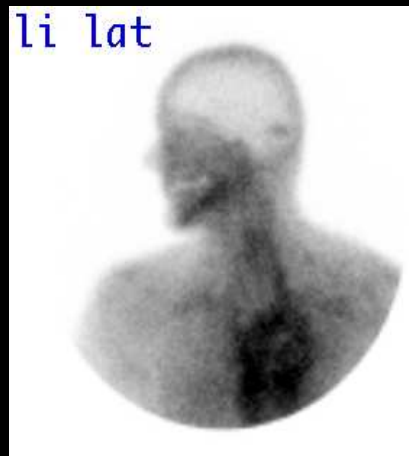
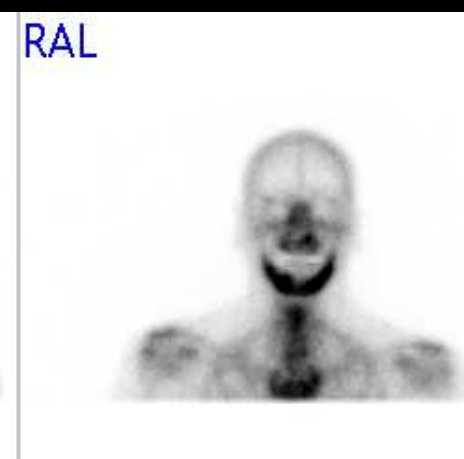
- erfolgreiche Schmerzbekämpfung: 60-70 %
- Wirkdauer: ca. 3-4 Monate
- mehrfache Wiederholung möglich

- 3-Phasen-Szintigraphie
 - => **Weichteilentzündung**: 1. + 2. Phase positiv
 - Osteomyelitis**: alle 3 Phasen positiv
- Hohe Sensitivität (90%)
- Geringe Spezifität (60-70%)
- Nach Therapie bleibt die SSC noch mehrere Monate positiv: Remodelling des Knochens
 - => andere Verfahren zur Verlaufsbeurteilung

Fluide chronische Osteomyelitis

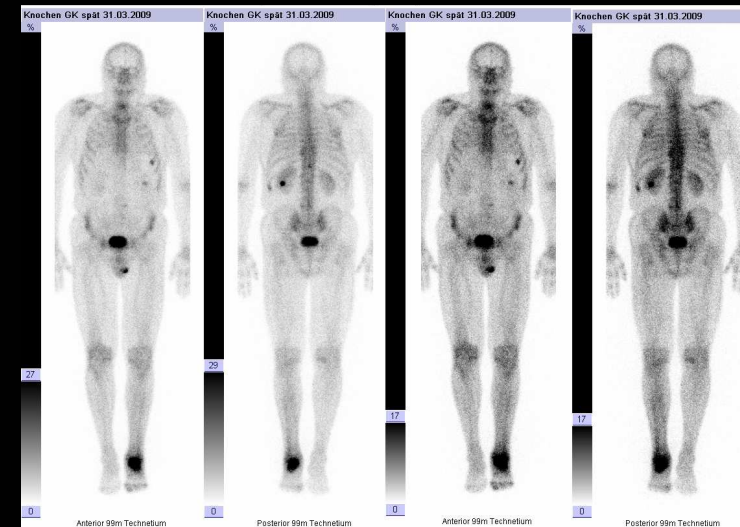
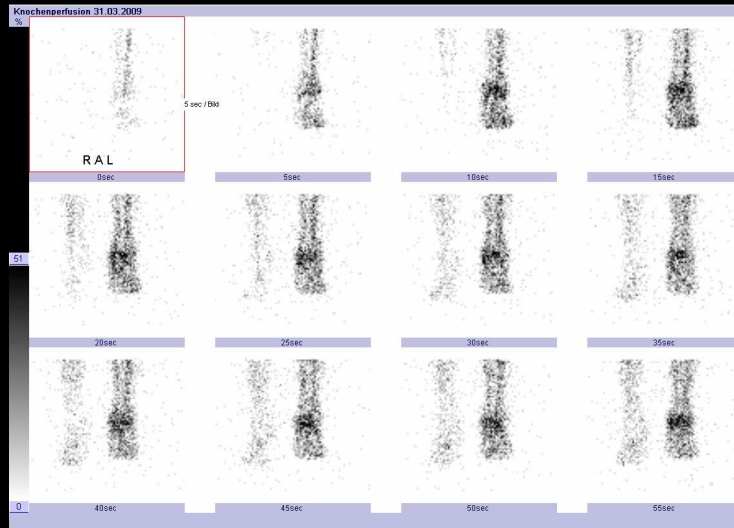


Entzündung



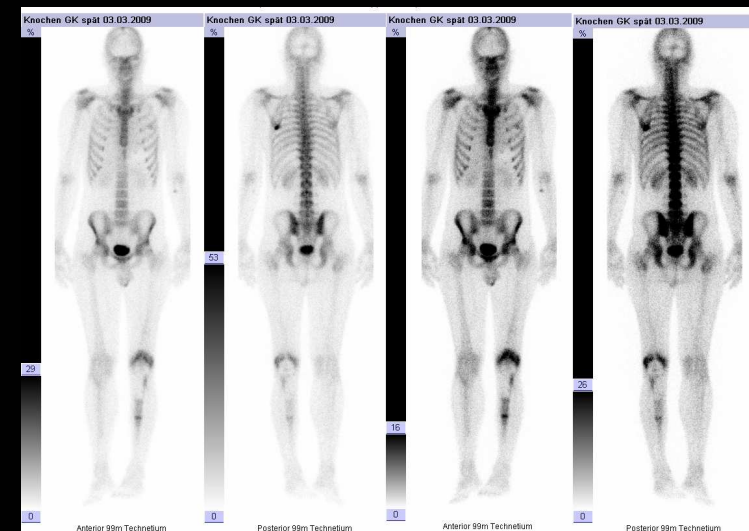
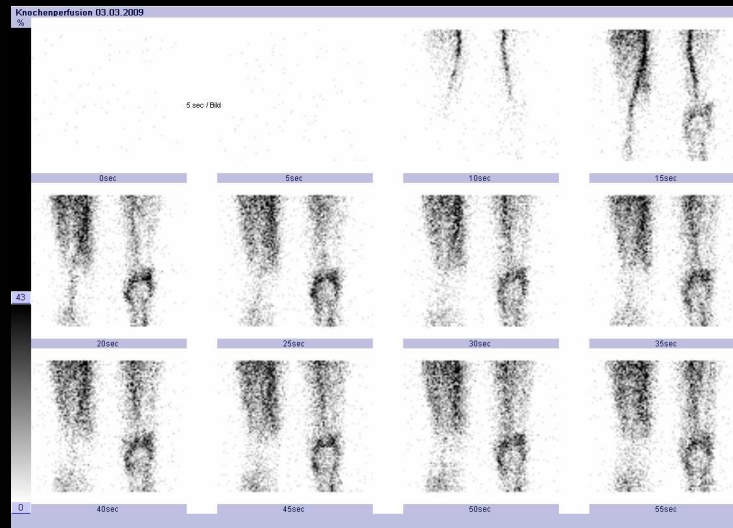
Osteomyelitis Mandibula

Entzündung



Z.n. bakteriellem Weichteilinfekt
Operative Sanierung
Schwellung nach 14 Tagen
Osteomyelitis?

Entzündung



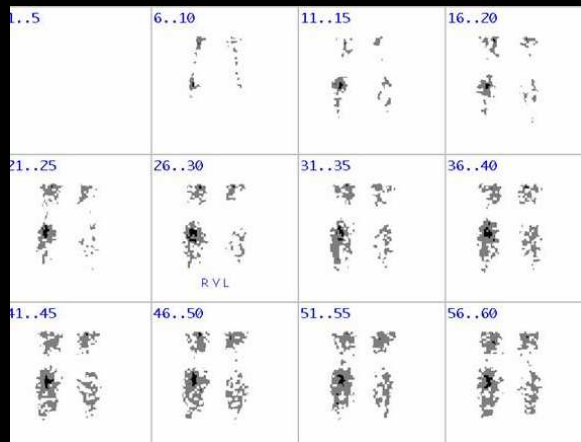
Z.n. Osteosarkom
Prothese li Kniegelenk
Lockerung vs. Infektion?

- ^{111}In - oder $^{99\text{m}}\text{Tc}$ -markierte **autologe Leukozyten**

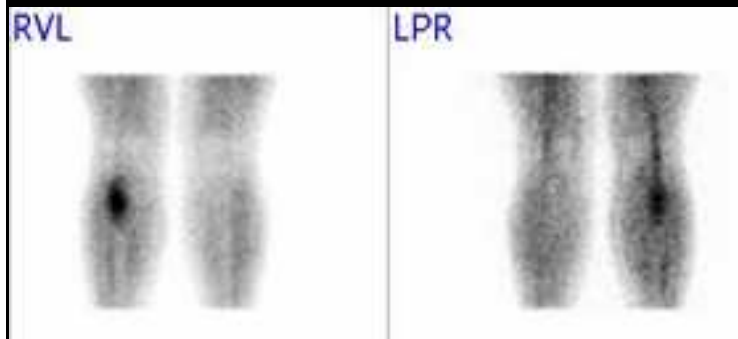
Nachteil: aufwendiges Verfahren

- $^{99\text{m}}\text{Tc}$ -markierte **Antigranulozytenantikörper**
erkennen *Non-specific-cross-reacting-Antigen* (NCA)
NCA: auf Promyelozyten, Myelozyten, Granulozyten
 - Anti-NCA-95-AK (ganzes IgG)
 - Anti-NCA-90-Fab-Fragment

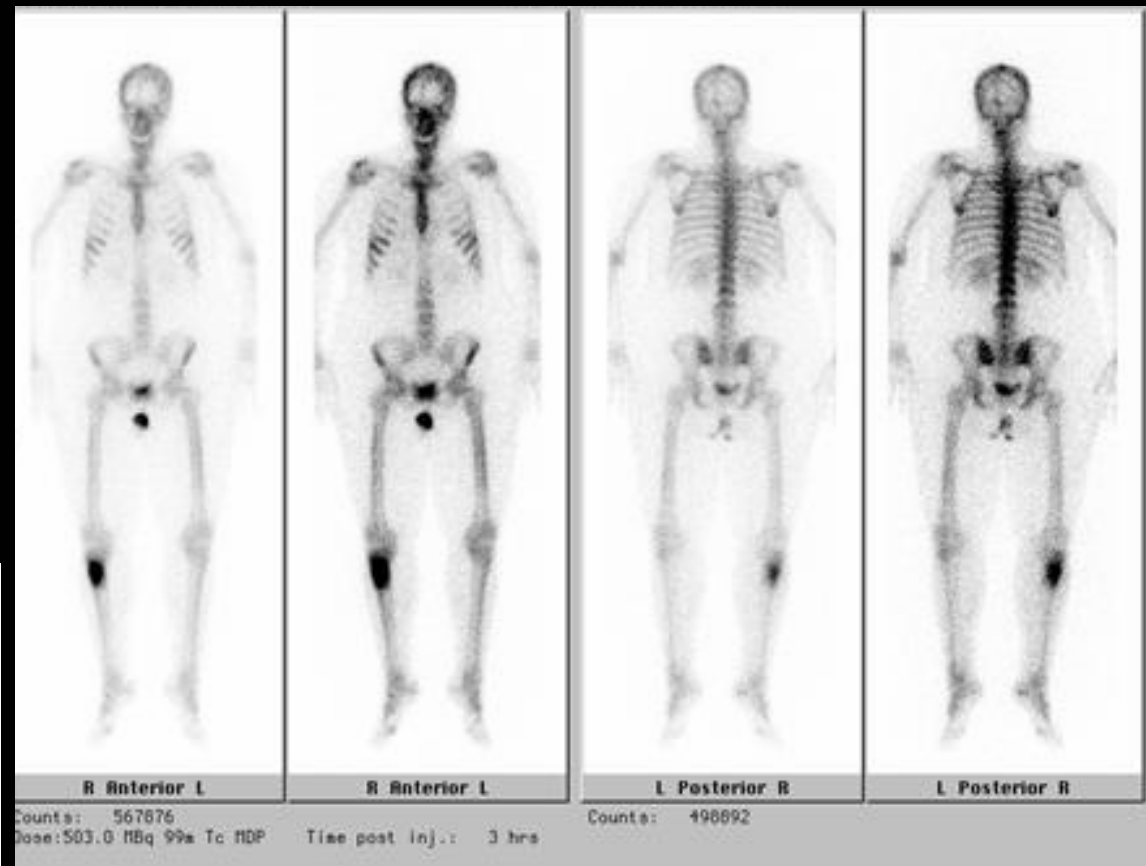
V.a. Osteomyelitis prox. Tibia rechts



Perfusion



Weichteilphase

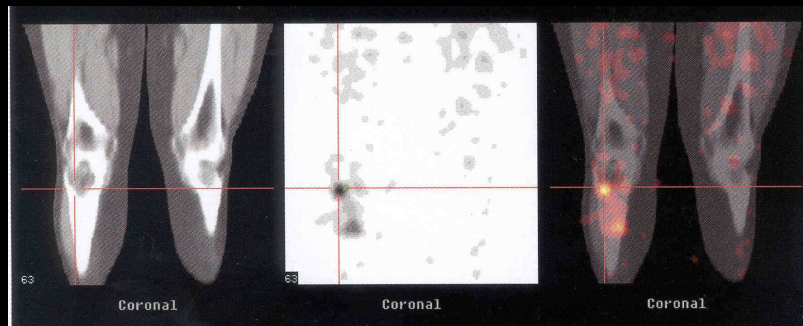
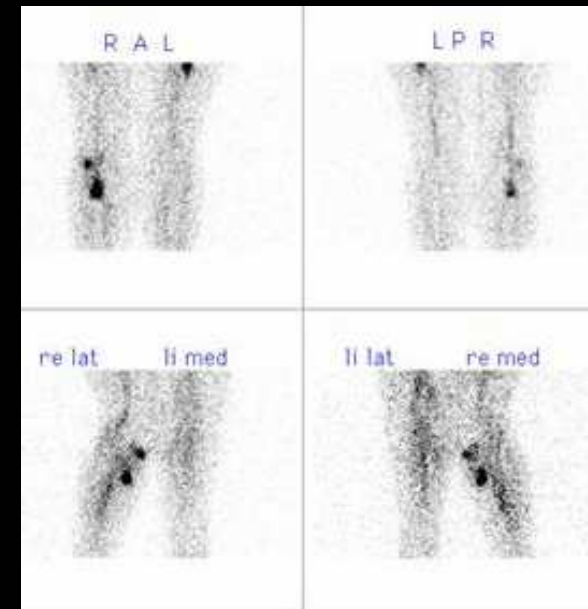


Mineralisationsphase

Leukozytenszintigraphie 4 und 24 h p.i.



4 h p.i.



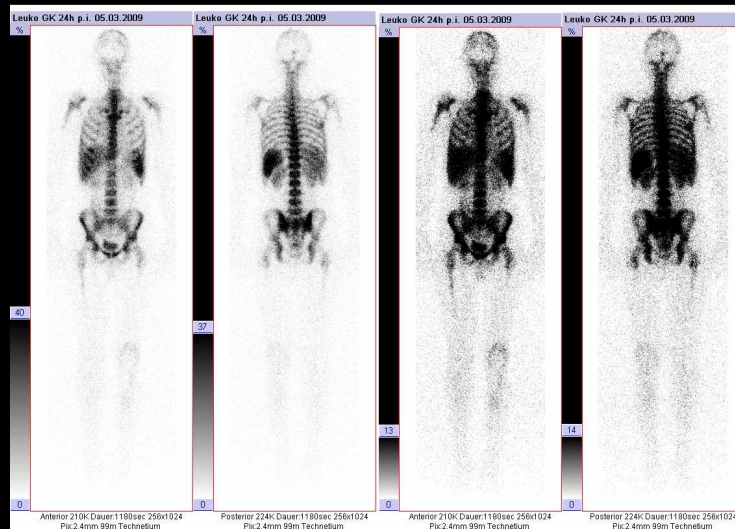
24 h p.i.

CT

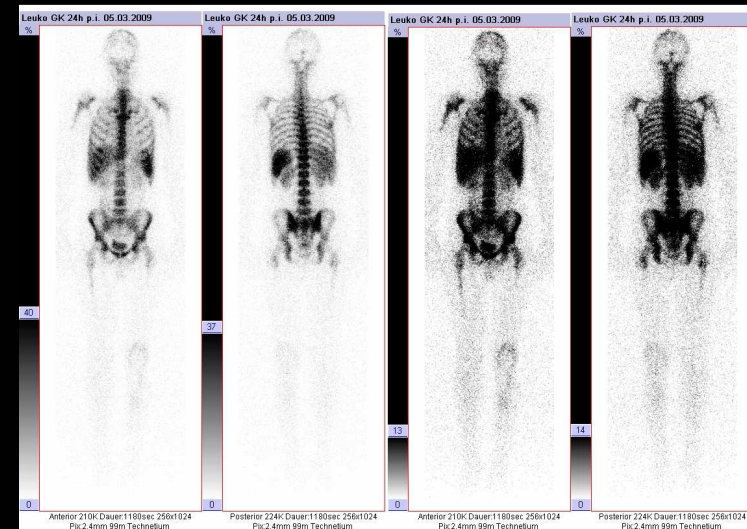
SPECT

Fusion

Leukozytenszintigraphie 4 und 24 h p.i.



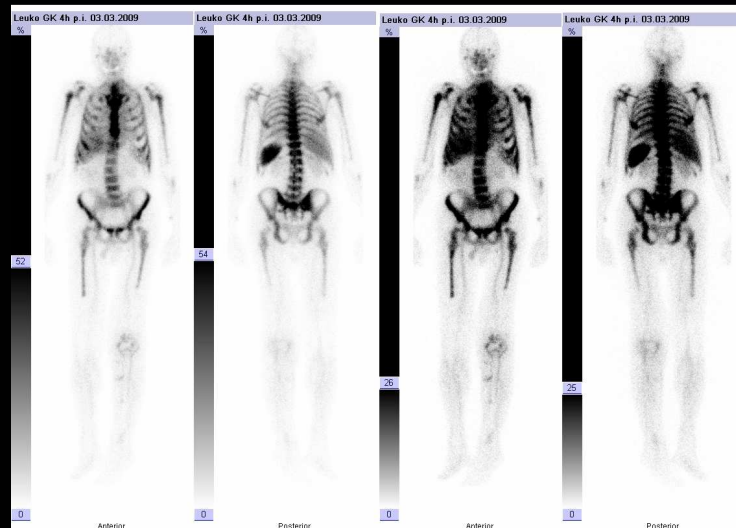
4 h p.i.



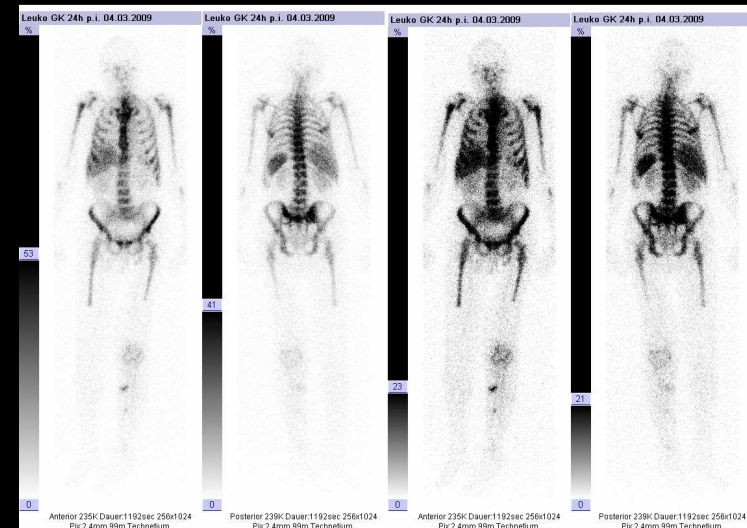
24 h p.i.

Z.n. Osteosarkom
Prothese li Kniegelenk
Lockerung vs. Infektion?

Leukozytenszintigraphie 4 und 24 h p.i.



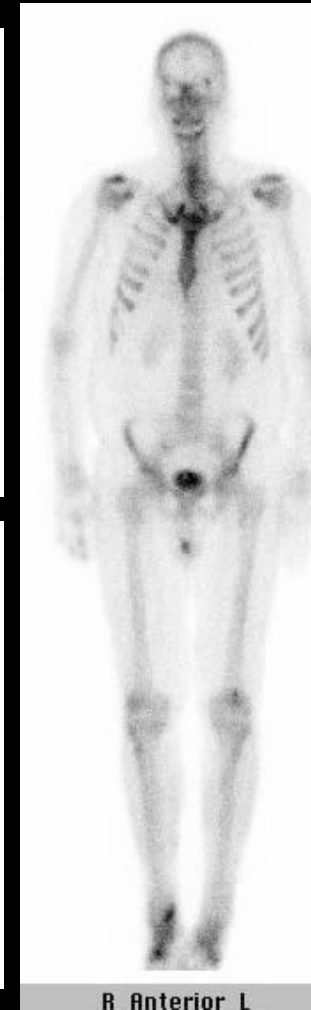
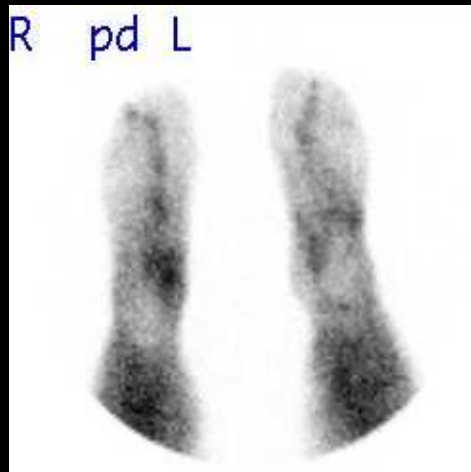
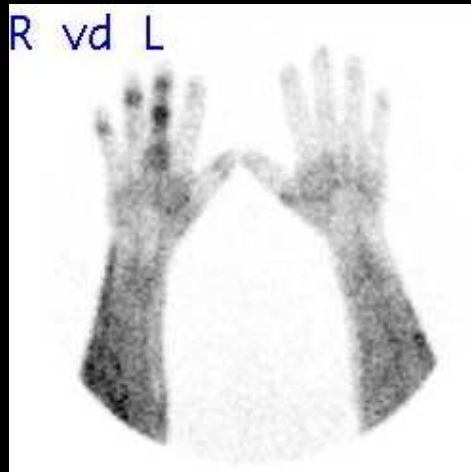
4 h p.i.



24 h p.i.

Infektion einer MUTARS-Prothese
Weichteilkomponente Unterschenkel medial

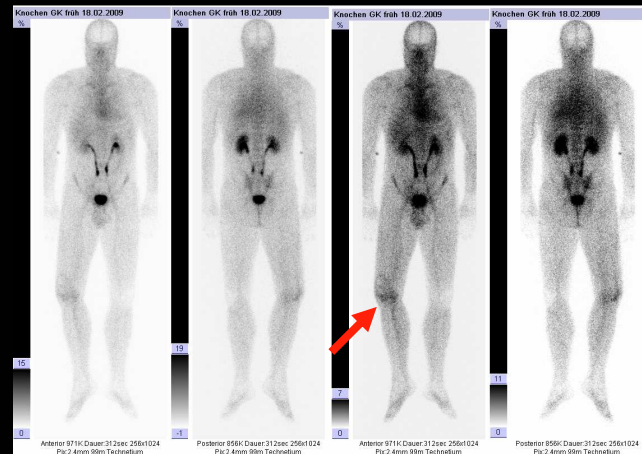
Entzündung



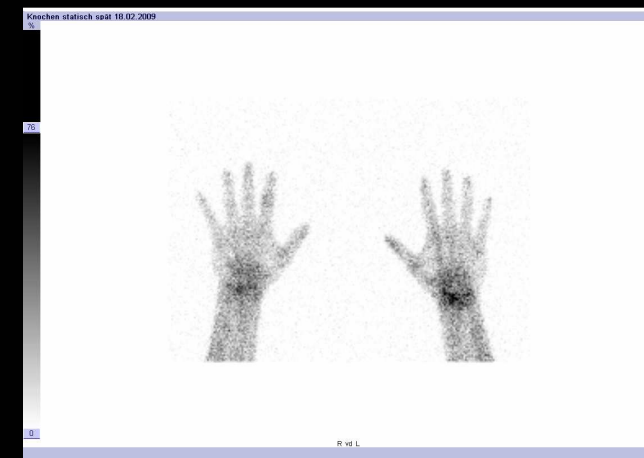
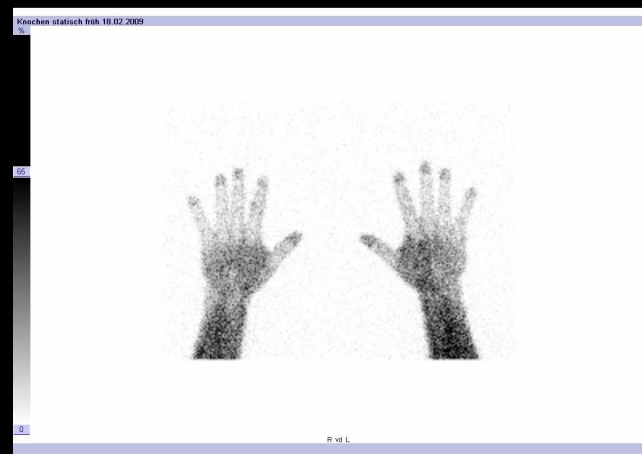
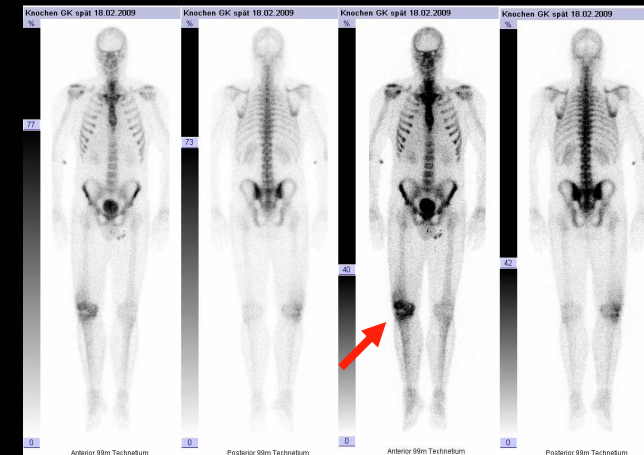
Psoriasisarthropathie

Psoriasisarthropathie

Frühphase

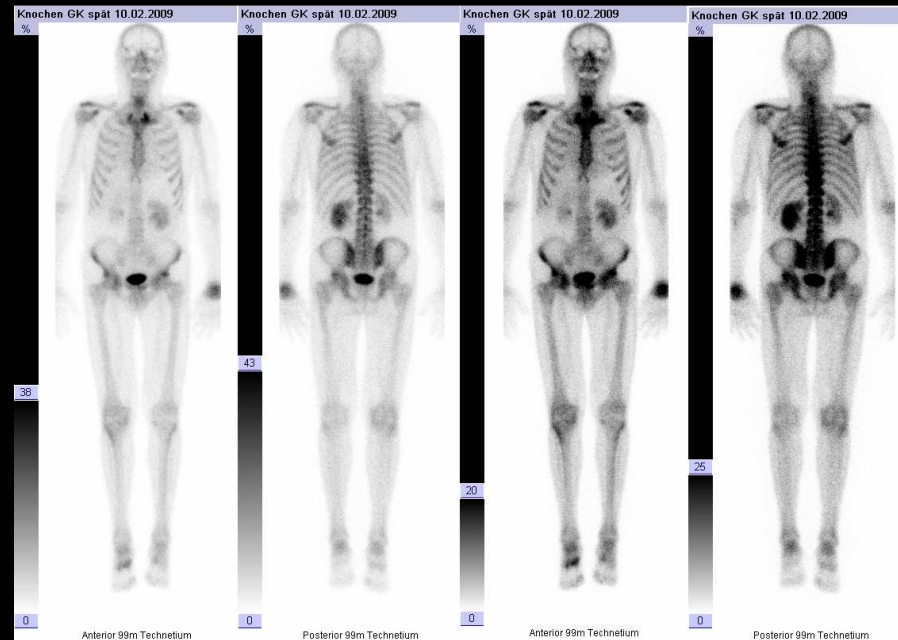
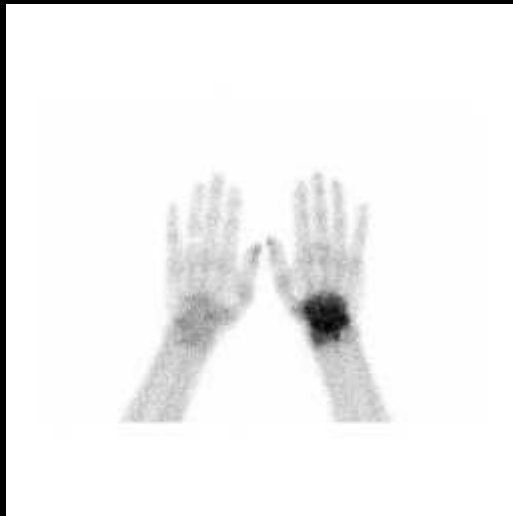


Mineralisationsphase



Psoriasis – Kniegelenksbeteiligung

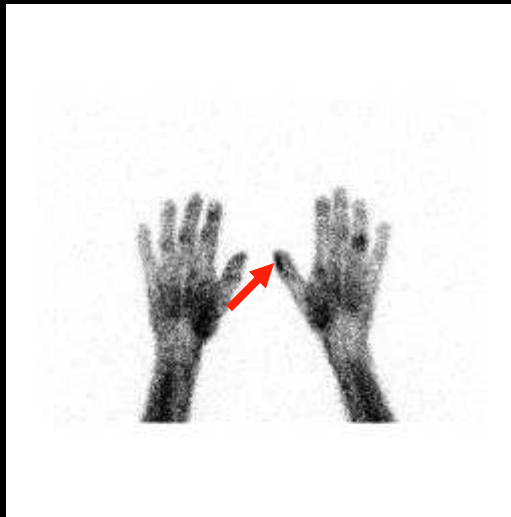
Aktivierte Arthrosen



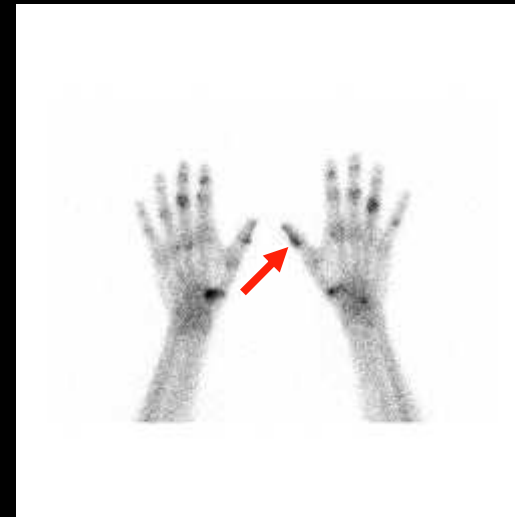
Aktivierte Arthrose linkes Handgelenk

Aktivierte Arthrosen

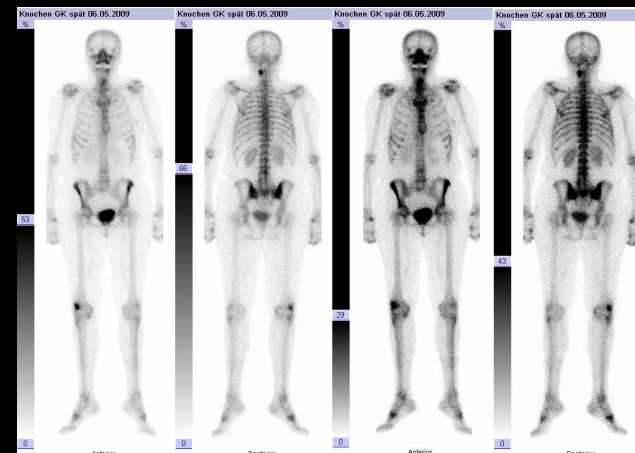
Frühphase



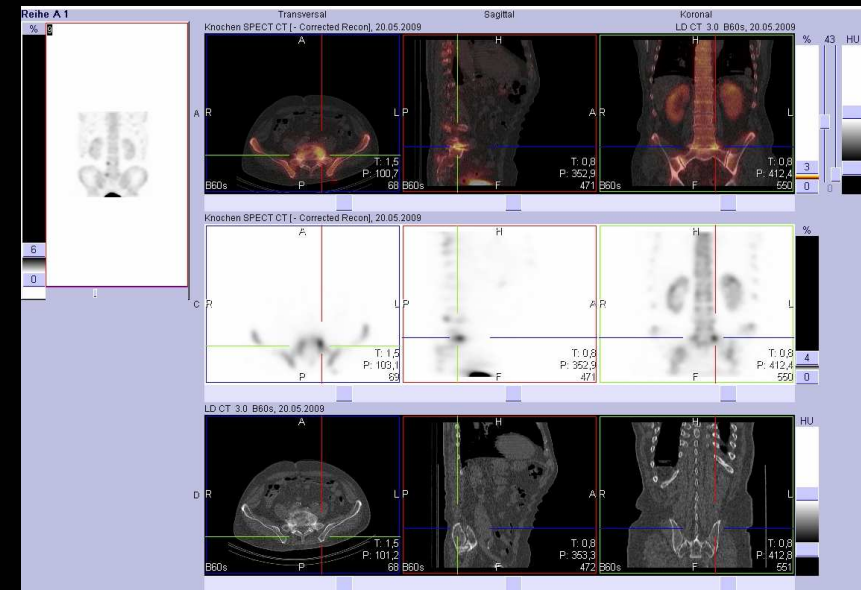
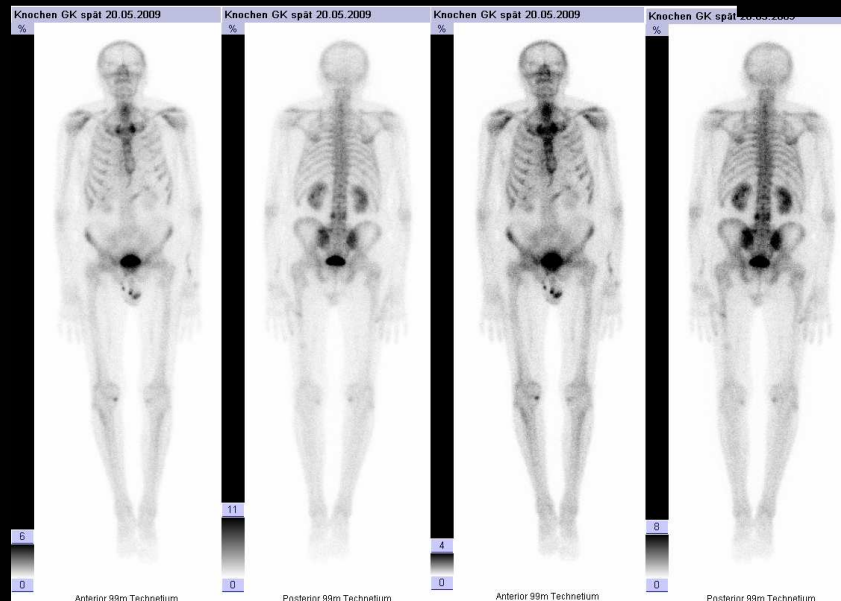
Mineralisationsphase



Aktivierte Arthrose Fingergelenke
Daumenendglied: V.a. Osteomyelitis



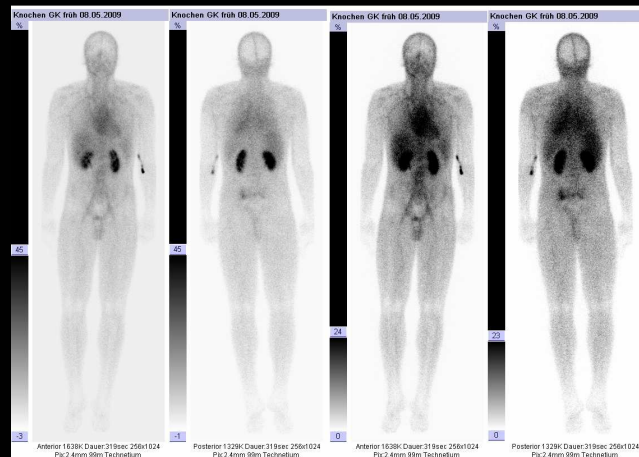
Arthrose



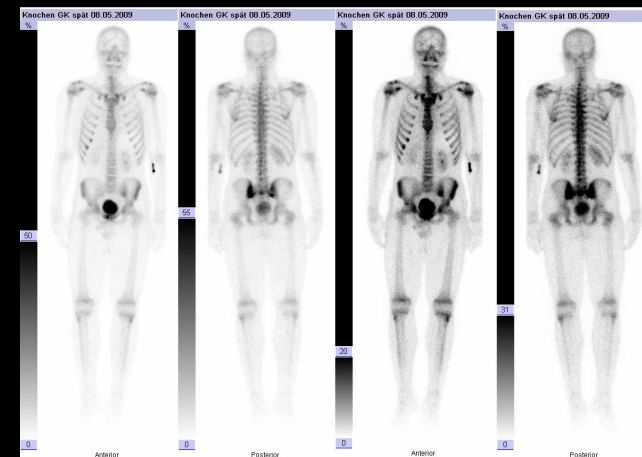
Patient mit V.a. Bronchialkarzinom
Frage nach ossären Metastasen
Arthrose Facettengelenke

Sakroiliitis

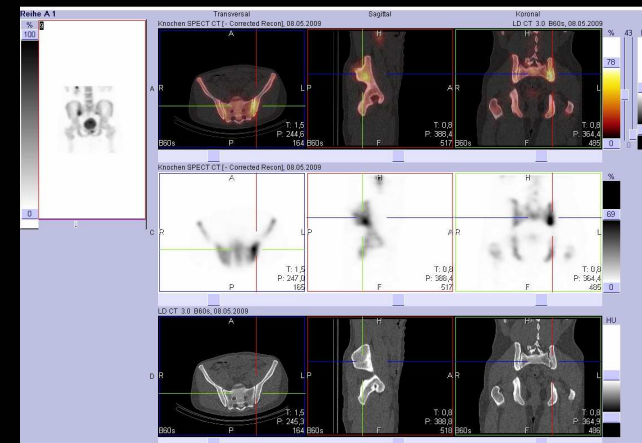
Frühphase



Mineralisationsphase



Sakroiliitis (M.Bechterew)



Diabetische Vaskulopathie

Frühphase



Mineralisationsphase



Diabetische Vaskulopathie
Minderanreicherung in der gesamten rechten Hand

- **Einzelphotonen** (Gamma-Teilchen)
 - Tc-99m
 - Iod-123
- **Positronen** (werden zu Gamma-Paar)
 - C-11
 - N-13
 - O-15
 - F-18

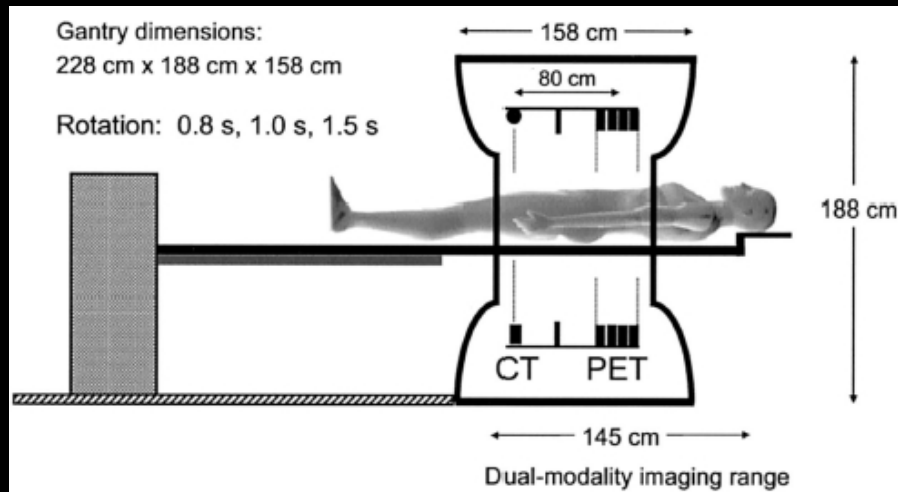
- Erleichterte Diffusion über Glucosetransporter
- Transporter in malignen Tumoren oft überexprimiert
- Schlüsselenzyme der Glykolyse oft überexprimiert
- Phosphorylierung durch Hexokinase (FDG-6-Phosphat)
- **Kein** Einbau in Glykogen oder Einschleusung in Pentosephosphatzyklus

=> Anreicherung von FDG-6-Phosphat im Tumorgewebe

„metabolisches Trapping“

Kombinierte PET/CT

- gemeinsame Akquisition von PET und CT
- Hardware-Fusion
- Identische Lagerung
- Laserpositionierungssystem



CTI/Siemens Biograph 16

Kinder / Jugendliche

- embryonales Rhabdomyosarkom
- Osteosarkom
- Ewingsarkom

Erwachsene

- Chondrosarkom
- malignes fibröses Histiozytom

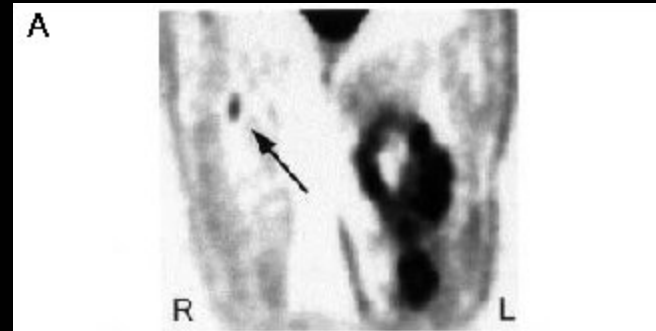
- **Grading**
- **Staging**
- **Therapiekontrolle**
- **Rezidivdiagnostik**

• Methoden: *3-Phasen-Skelettszintigraphie*
PET und PET/CT

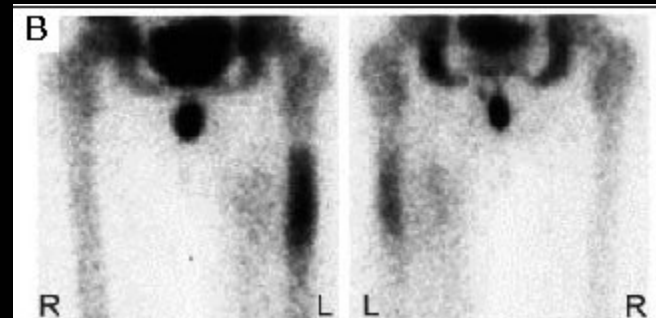
Ewing-Sarkom

Staging - Knochenmetastasen

FDG-PET



SSC



MRT



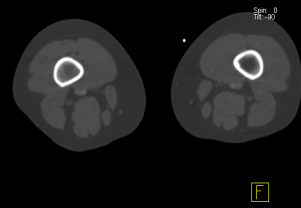
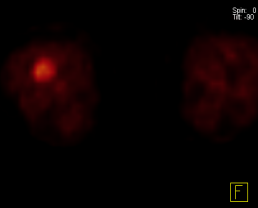
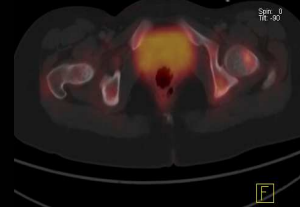
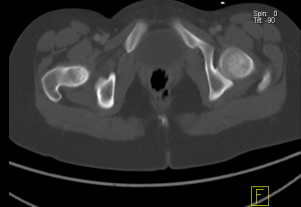
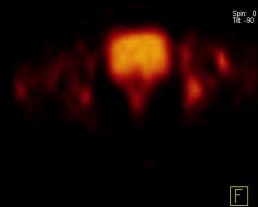
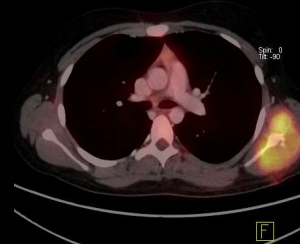
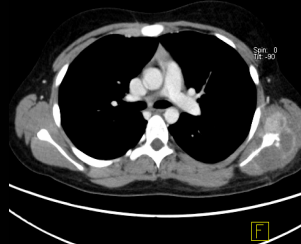
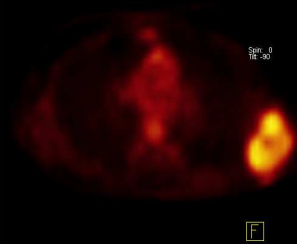
Primäre maligne Knochentumore

Staging - Knochenmetastasen



		n	Sens.[%]	Spec.[%]	Accur.[%]
SSC	Alle	118	71	92	88
	ES	66	68	87	82
FDG-PET	Alle	118	90	96	95
	ES	66	100	96	97

Ewing-Sarkom Knochenmetastasen



FDG-PET

CT

Fusion

FDG-PET

Primäre maligne Knochentumore

Staging - Lungenmetastasen

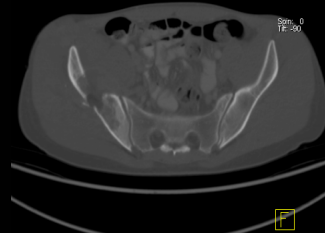
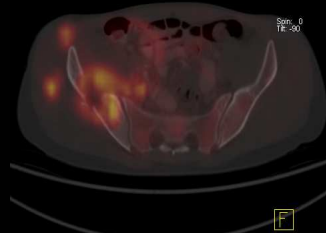
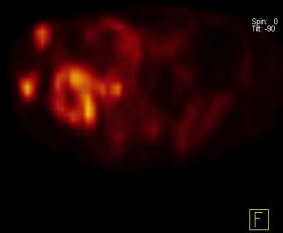
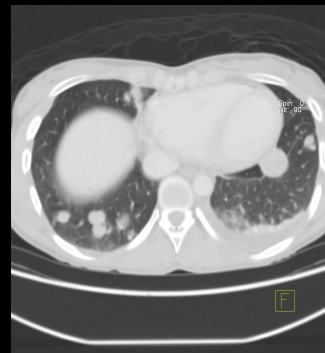
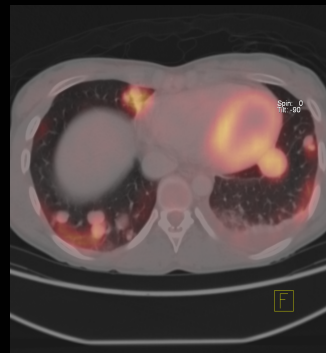


		n	Sens. [%]	Spec. [%]	Accur. [%]
CT	All	110	83	100	96
	ES	61	75	100	96
	OS	49	88	100	97
FDG-PET	All	110	54	95	86
	ES	61	50	100	92
	OS	49	56	91	82

CT + wenn 1 Läsion ≥ 10 mm oder mehrere < 10 mm and ≥ 5 mm

Franzius, *Ann Oncol* 2001

Ewing-Sarkom Lungenmetastasen



FDG-PET

Fusion

CT

FDG-PET

Diskussion

- Größe < 10 mm (Partialvolumeneffekt)
- geringe metabolische Aktivität
- Unterscheidung: Metastase vs. Primärtumor ?
- Atmung

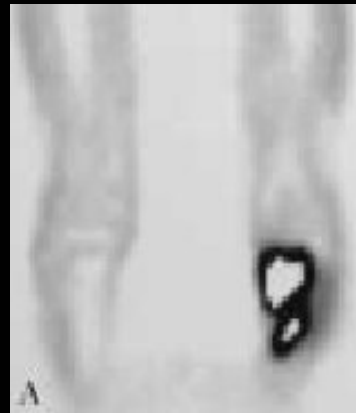
Ewing-Sarkom Therapiekontrolle

Chemotherapie

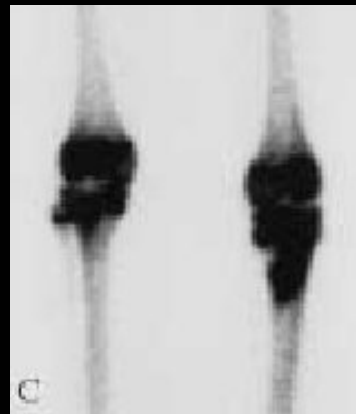
prä

post

FDG-PET



SSC



Diskussion

Therapieansprechen ist ein wichtiger prognostischer Faktor

Frühes Therapie-monitoring ?

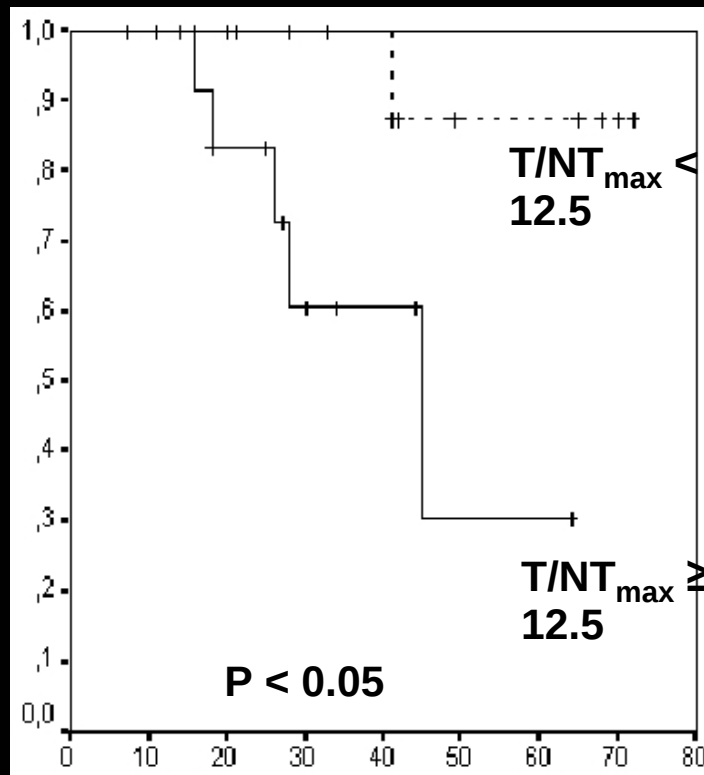
Änderungen im therapeutischen Management ?

Osteosarkom: Prognose

Initialer FDG-Uptake im Primärtumor

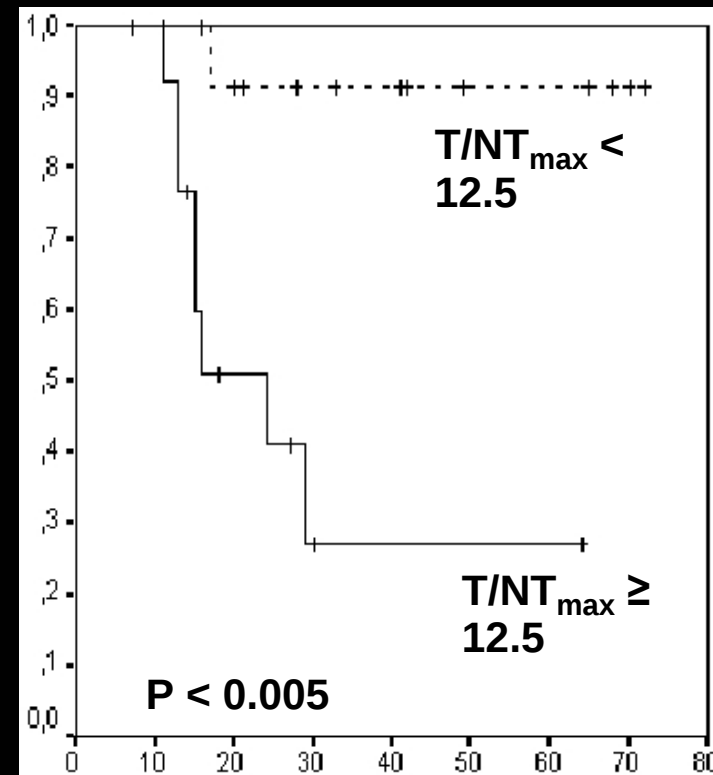
Total Survival

Cumulative Survival



Follow-up [Mo.]

Event Free Survival



Follow-up [Mo.]

Sekundäre Knochentumore



Prostatakarzinom

Mammakarzinom

Bronchialkarzinom

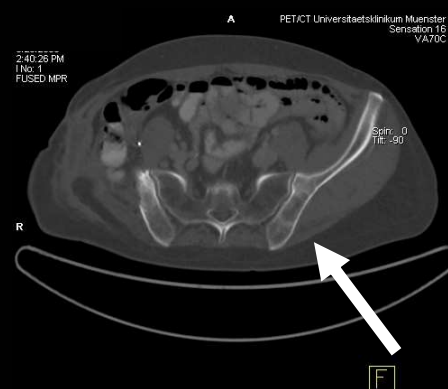
Follikuläres Schilddrüsenkarzinom

Ossäre Lymphommanifestationen

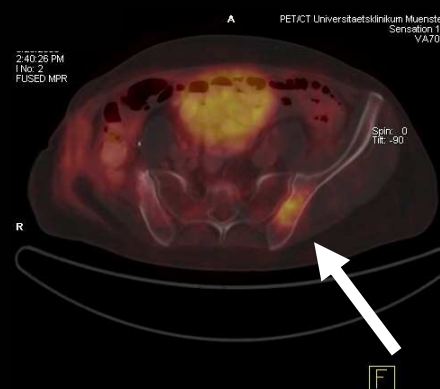
etc.

=> **Unterschiedliche FDG-Anreicherung**

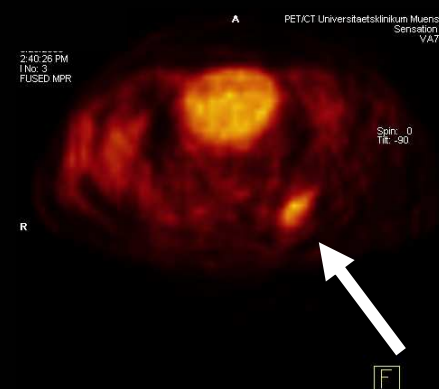
SD-Karzinom ossäre Metastasierung



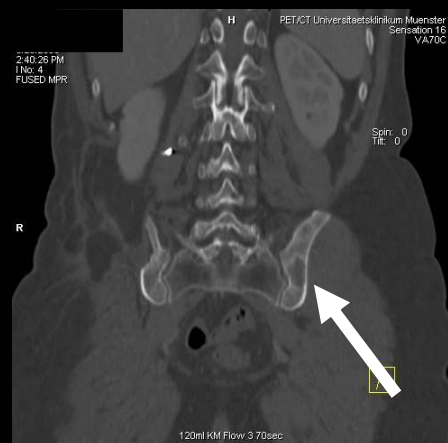
120ml KM Flow 3 70sec



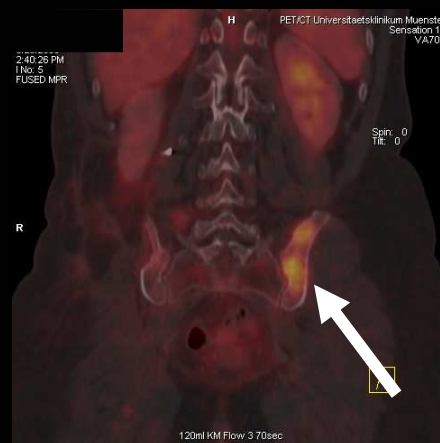
120ml KM Flow 3 70sec



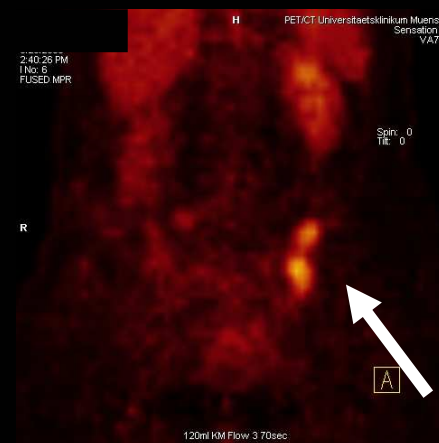
120ml KM Flow 3 70sec



120ml KM Flow 3 70sec



120ml KM Flow 3 70sec



120ml KM Flow 3 70sec

CT

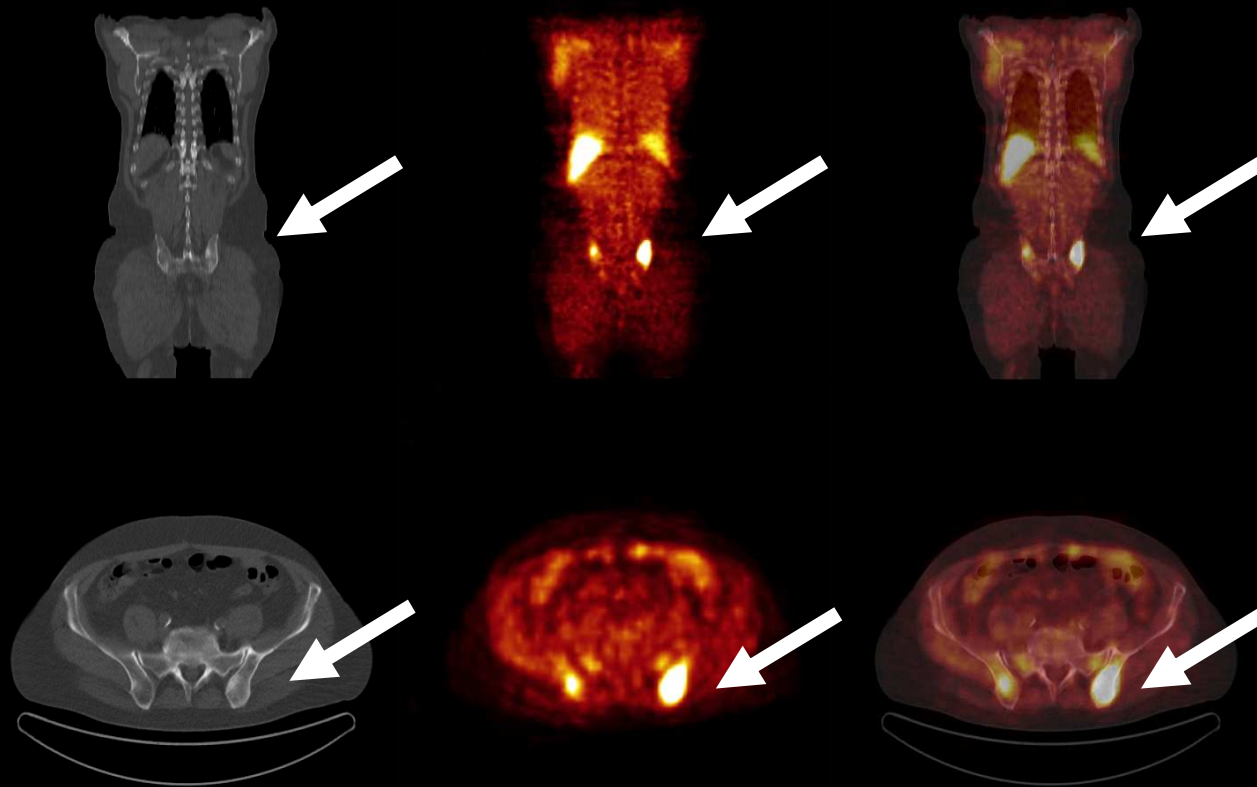
Fusion

PET

- Membranphospholipid-Synthese ist gesteigert bei vielen malignen Tumoren
- Nachweis durch ^{11}C -Cholin
- Hoher Uptake: Milz, Leber, Pankreas
- aber: kaum Ausscheidung in die Blase

=> gut für Prostata-Ca
(Lokalrezidiv + ossäre Metastasen)

^{11}C -Cholin Prostata-Karzinom



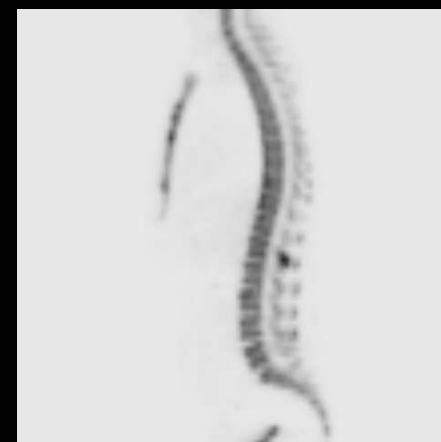
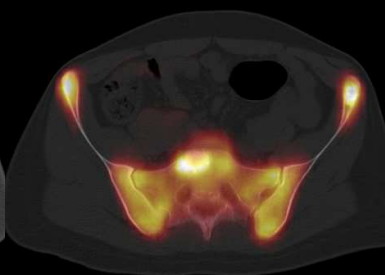
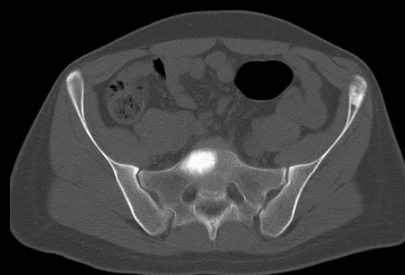
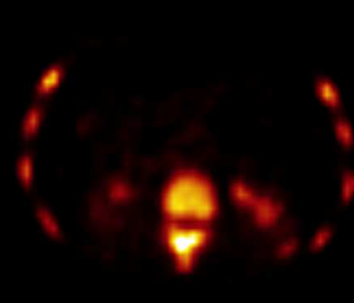
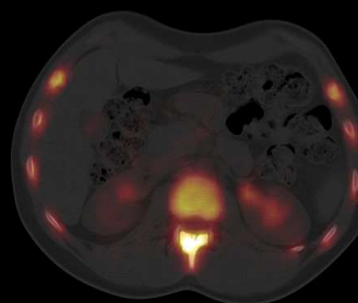
Ossäre
Metastasierung

CT

^{11}C -Cholin-PET

Fusion

Neue Tracer: Fluorid (^{18}F)



CT

Fusion

PET

^{18}F -PET

Kleintier-PET

FDG

26.04.05



Li/Re-Ratio

2,3

03.05.05



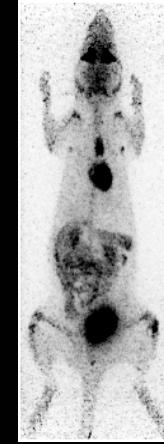
1,7

10.05.05



1,4

17.05.05



1,0

Fluorid



Li/Re-Ratio

1,7



1,9



1,6



1,2

- ... Homepage der Nuklearmedizin
 - www.nuklearmedizin.uni-muenster.de
 - Reiter „Lehre“