



Diyabetik Ayak Lezyonlarının Radyonüklid Yöntemlerle Görüntülenmesi

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Diyabetik ayak komplikasyonları

- Selülit
- Osteomyelit
- Şarko eklemi
- Şarko eklemi ve osteomyelit



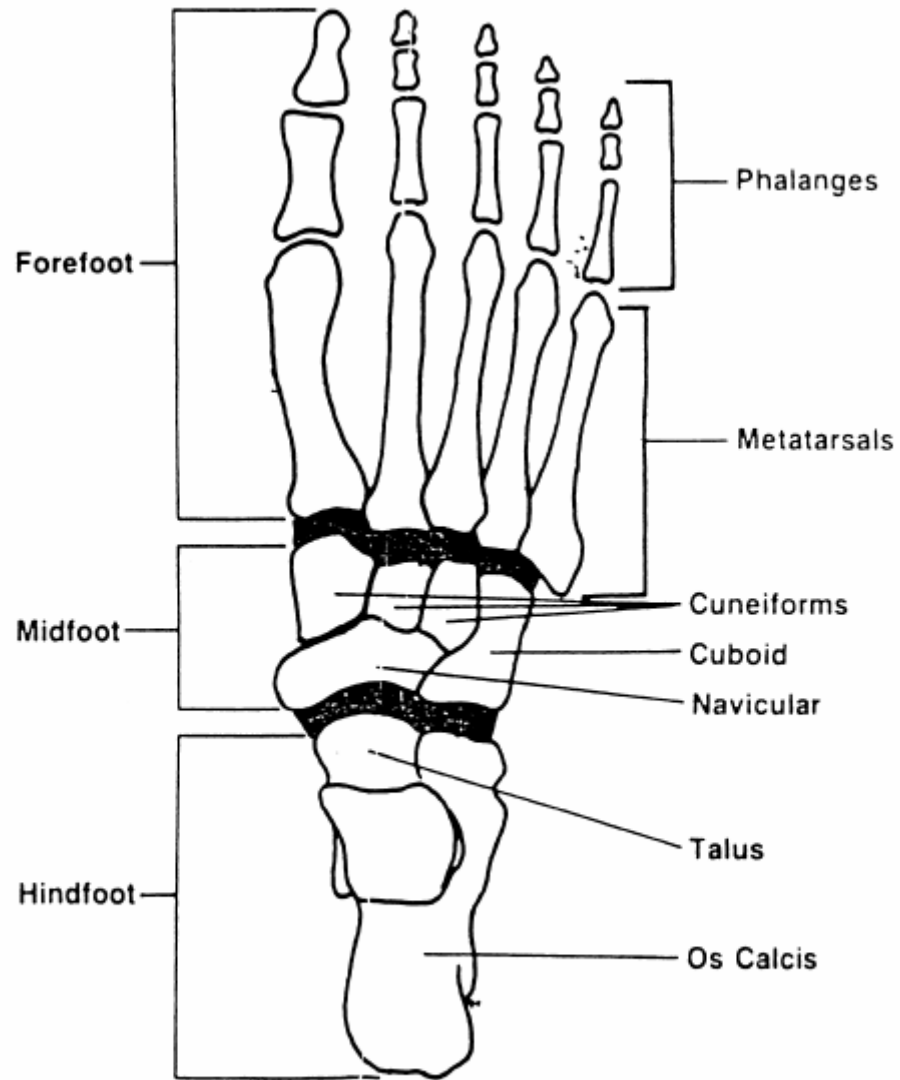
Radyofarmasötikler

- Tc^{99m} MDP (Kemik sint)
- Ga^{67}
- Tc^{99m} HIG
- Lökositler:
 - a- Tc^{99m} HMPAO
 - b- In^{111} WBC
- Tc^{99m} ciproflaxin
- Antigranülosit antikorları
- Tc^{99m} Sülfür colloid (Kemik iliği sintigrafisi)
- F^{18} -FDG- PET
- F^{18} -FDG lökosit-PET
- Tc^{99m} MDP+ Ga^{67}
- Tc^{99m} MDP+ Tc^{99m} HIG
- Tc^{99m} MDP+ Tc^{99m} HMPAO+ Tc^{99m} sülfür colloid
- Tc^{99m} MDP+ In^{111} HMPAO+ Tc^{99m} sülfür colloid



Yöntemler

- Kemik sintigrafisi + İşaretli lökosit sintigrafisi
- Kemik sintigrafisi + İşaretli lökosit sintigrafisi (Tc 99m ile) + **Kemik iliği Sintigrafisi**
- Kemik sintigrafisi + İşaretli lökosit sintigrafisi (In 111 ile) + **Kemik iliği Sintigrafisi**
- İşaretli lökosit SPECT+ **Kemik iliği Sintigrafisi**
- SPECT/CT (İşaretli lökosit ile)
- F¹⁸ -FDG PET/CT
- F¹⁸ -FDG-lökosit PET/CT





Kemik Sintigrafisi

- Kanlanma: Artmış vaskülarite
- Kan Havuzu: Artmış
- Geç Faz: Osteoblastik aktivite artışı
- Sensitivitesi yüksek (% 80-100), spesifitesi düşüktür. (% 40-60)
- Negatifse enfeksiyon yok
- Pozitifse enfeksiyon varlığını göstermez.



Kemik Sintigrafisinin Pozitif Olduđu Durumlar

- Travma
- İyileşen kırık
- Ameliyat sonrası deđişiklikler
- Nörotropik deđişiklikler
- Enfeksiyon



Lökosit Sintigrafisi

- Granülositler Tc ile veya In ¹¹¹ ile işaretlenir.
 - Sensitivitesi % 80 , spesifitesi % 90.
 - Travma
 - Fraktür
 - Ameliyat sonrası değişiklikler
 - Nörotropik değişiklikler 'e sekonder enfeksiyonlarda kullanılır.
- (Kemik iliği spesifiteyi düşürür)



LÖKOSİTLER



% 65 Nötrofil



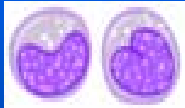
% 4 eosinofil



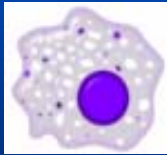
% <1 Bazofil



% 25 Lenfosit



% 6 Monosit



Makrofaj

Granülositler

Agranülositler



Tc 99m HMPAO Lökosit işaretleme

- Yaklaşık olarak 2 saat sürer.
- Antikoagülanlı enjektöre 40 ml kan alınır.
- Alınan kan 1-2 saat dik olarak eritrositlerin çökmesi için bekletilir (hidroksietilstarch ile gravity sedimentasyon)
- Eritrositler ayrıldıktan sonra lökosit ve trombositler ayrıştırılır.
- Lökositten zengin plasma santrifüj edilir.
- Dibe çöken lökositler işaretlenir.



Tc ^{99m} HMPAO

- Lipofilik
- Lökositlerin hücre membranını geçer.
- Membranı geçince hidrofilik olur ve içeride kalır.
- Nükleus ve mitakondriye bağlanır.

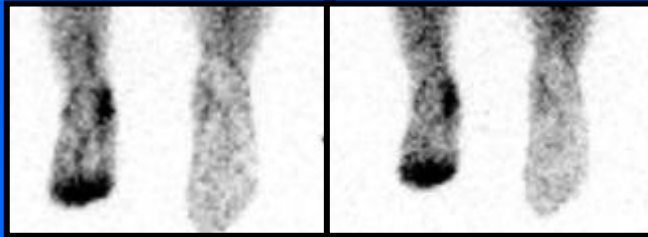


Tc 99m HMPAO Lökosit İşaretleme

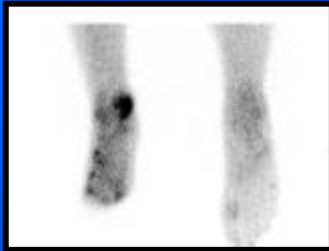
- En az 2000 mm³ lökosit sayımı olmalı
- Nötropenik hastalarda işaretleme hassasiyeti düşer.
- İşaretleme lökositlerin kemotaksisini bozmaz.
- Lökosit hücrelerinden nötrofiller daha fazla olduğu için bakteriyel enfeksiyonları gösterme hassasiyeti yüksektir.



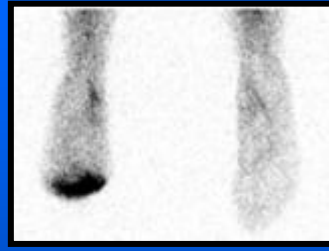
Kanlanma



Kan havuzu



Tc 99m MDP



Tc 99m HMPAO Lökosit

- 70 y kadın
- 3 ay önce Sol ayak 5 parmak ampute
- Kuneiform ve cuboid kemikte osteomyelit?



Kanlanma



Kan havuzu

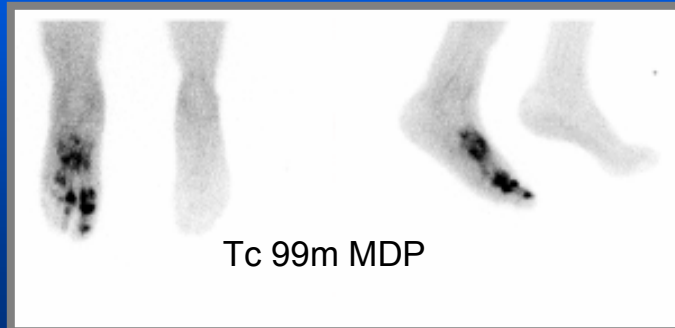
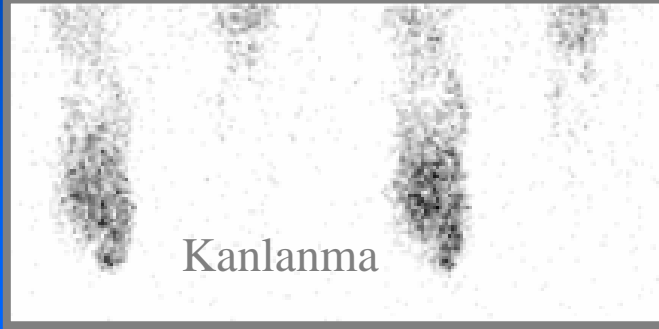


Tc 99m MDP

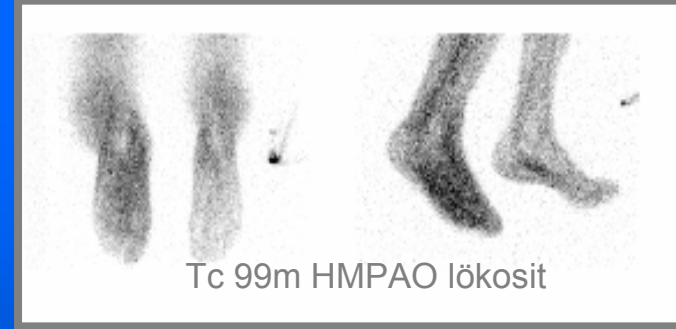


Tc 99m HMPAO Lökosit

- 55y erkek
- 6 ay önce sağ ayak 2. parmak amputasyonu
- 2 ay önce 3. falanks amputasyonu
- WBC: 5.6
- CRP 12.1 mg /l
- Diabetik ayak osteomyeliti?

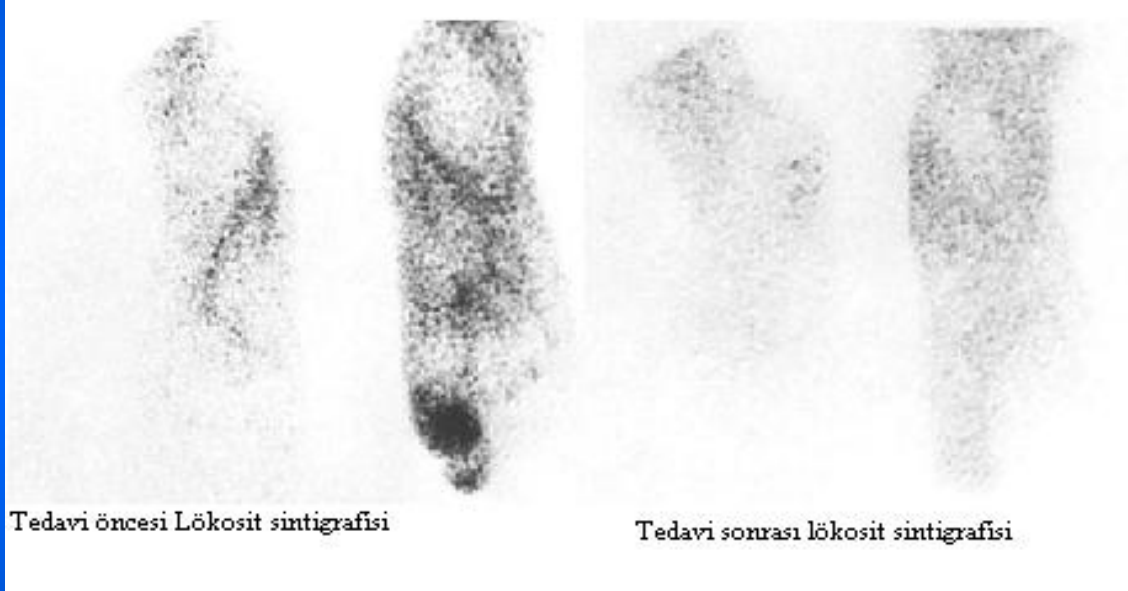


- Sol ayak başparmağında kızarıklık, yara, 3 aydır tedavi görüyor
- Osteomyelit?



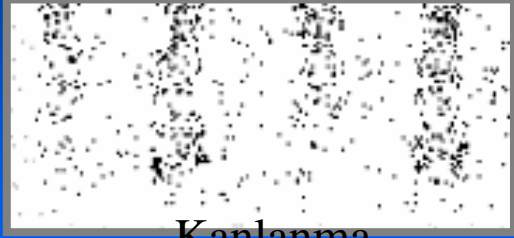


Medikal tedavi takibi-Lökosit sintigrafisi

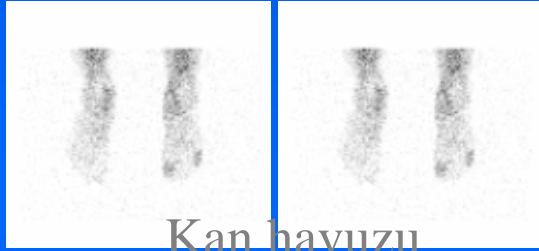


Tedavi öncesi Lökosit sintigrafisi

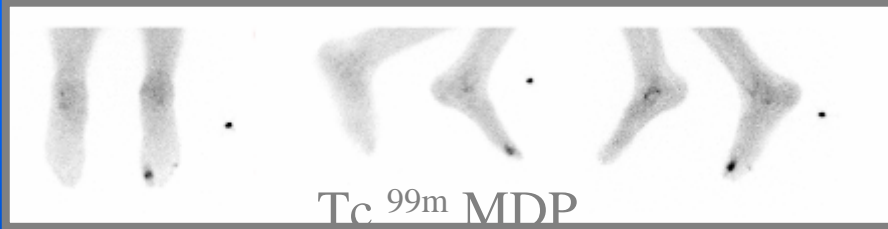
Tedavi sonrası lökosit sintigrafisi



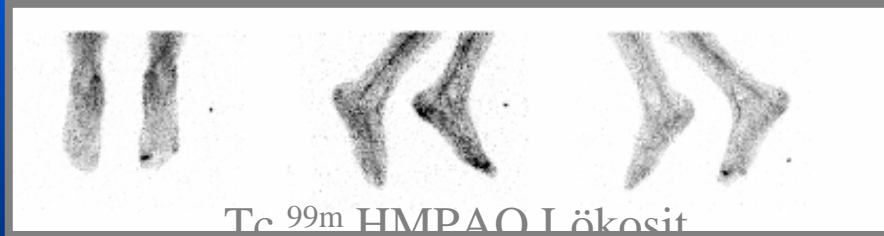
Kanlanma



Kan havuzu



Tc ^{99m} MDP



Tc ^{99m} HMPAO Lökosit

- İki yıldır sağ ayak başparmağında akıntı
- Küretaj geçirmiş,
- Tedaviye cevap, devam eden osteomyelit



Diyabetik ayakta kemik, lökosit ve HIG sintigrafileri

	S	Sp	Ppv	Npv	Acc
3P MDP	100	50	64	64	74
4P MDP	100	67	73	73	83
HIG early	100	59	80	80	85
WBC early	94	100	100	100	96
4P MDP and HIG early	100	67	73	73	79
4P MDP and WBC early	92	100	100	100	96

Unal SN, Birinci H, Baktiroglu S, Cantez S. Comparison of Tc-99m methylene diphosphonate, Tc-99m human immuno globulin, and Tc-99m-labeled white blood cell scintigraphy in the diabetic foot. *Clin Nucl Med* 2001; 26:1016-1021.



Diyabetik ayakta görüntüleme metodlarının karşılaştırılması: Meta analiz

	Lesions	Sensitivity	Specificity	Lesions	Accuracy	Lesions	PPV	NPV
^{99m}Tc -MDP	719	90.3	46.4	640	65	643	65.1	71.1
^{111}In -WBC	463	86	74.4	428	77	398	72.4	82.6
^{99m}Tc -WBC	283	85.8	84.5	283	85.9	283	89.9	80.8
$^{111}\text{In}/^{99m}\text{Tc}$ -WBC	205	80.7	88.5	147	84.6	53	NA	NA
$^{99m}\text{Tc}/^{111}\text{In}$ -HIG	97	96.8	66.5	97	83.2	97	72	87.7
^{99m}Tc -MoAb	63	95.8	70.2	63	84.2	63	76.1	96.4
^{99m}Tc -Fab	151	91.3	62	151	81.9	151	81.4	79.4
MRI	364	90.1	73.9	223	80.5	128	87.3	85.7
Radiography	544	61.9	67.5	486	65.6	332	71.3	58.5
Total	2889			2518		2148		

Capriotti M, Chianelli M, Signore A. Nuclear medicine imaging of diabetic foot infection: results of metaanalysis. Nucl Med Commun 2006; 57: 757-764



Ön ayak

- Üç fazlı kemik sintigrafisi (negatifse enfeksiyon ekarte edilir.)
- Lökosit sintigrafisi
 - Tanı ve medikal tedavi takibinde



Orta ve arka ayak

- **Nöropatik eklem**
- **Osteomyelit**
- **Nöropatik eklemlerle birlikte olan osteomyelit**

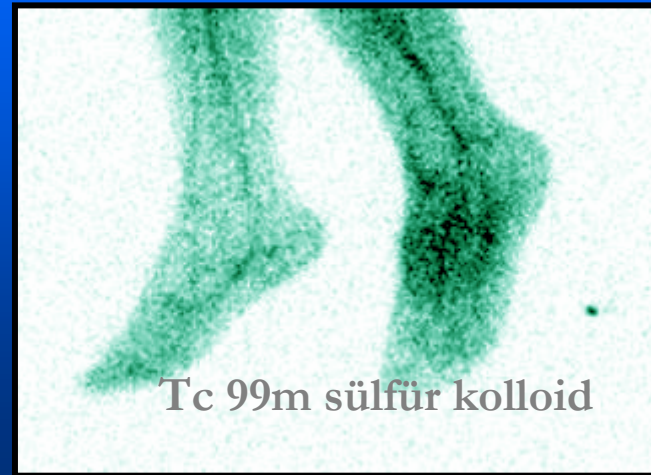
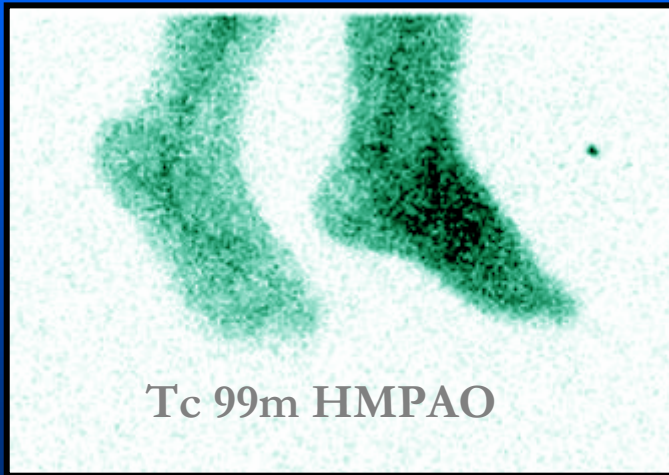
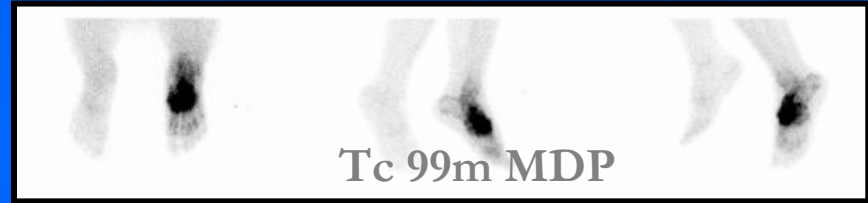
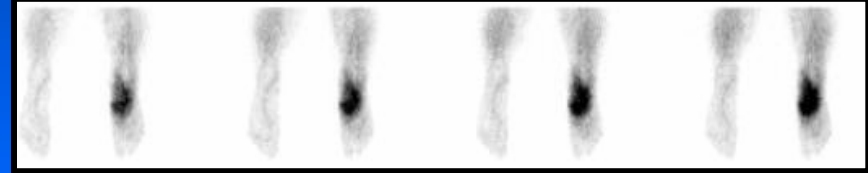
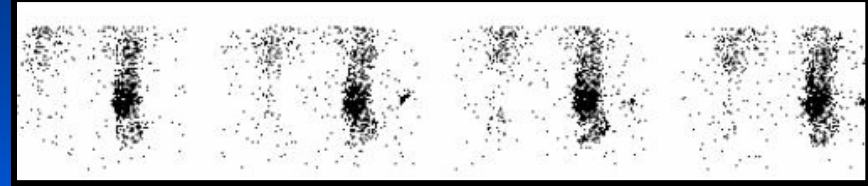


Kemik iliđi Sintigrafisi

- **Kırık iyileşmesinde**
- **Şarko eklemінде iyileşen kırıklarda**
 - » Kemik iliđi aktivitesi artar.
 - » Lökosit sintigrafisi pozitifleşir, spesifitesi düşer.

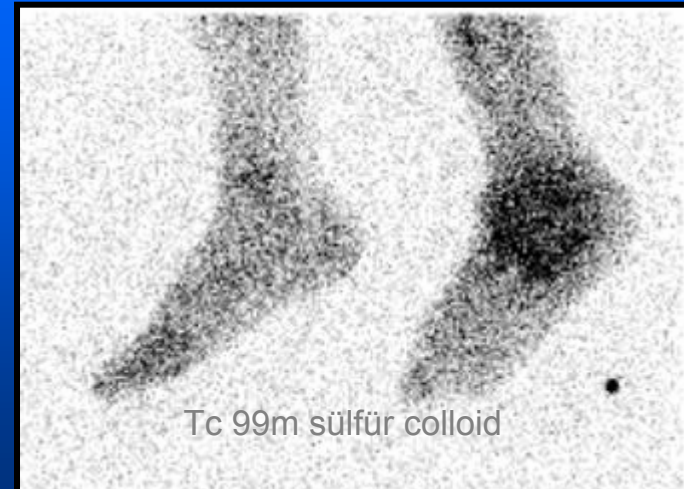
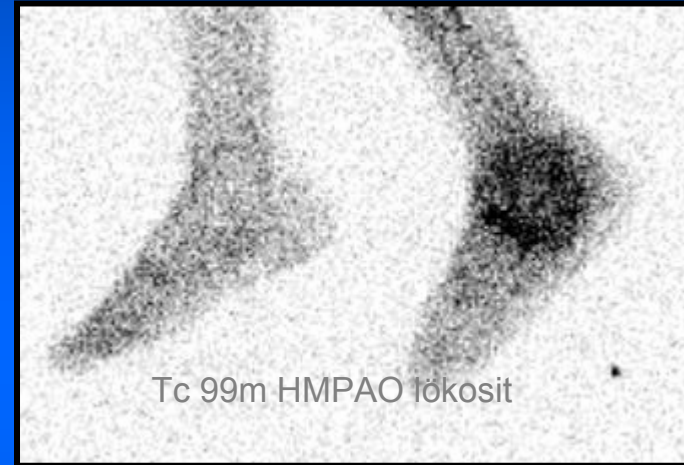
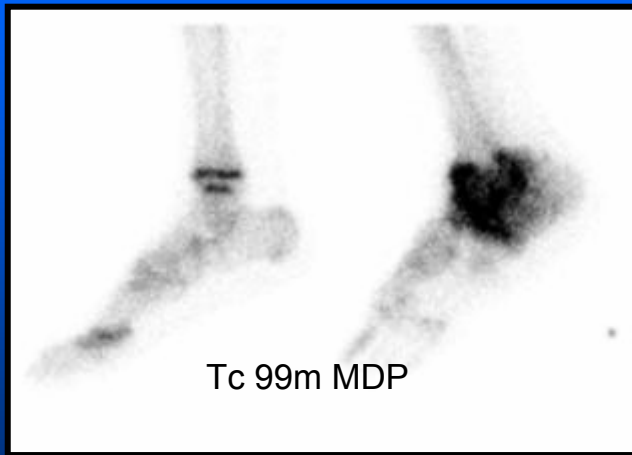
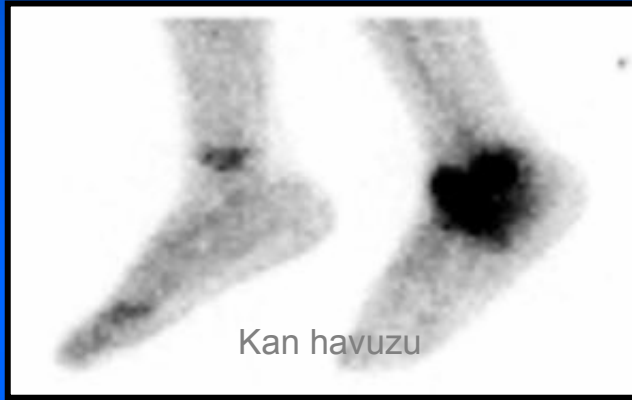
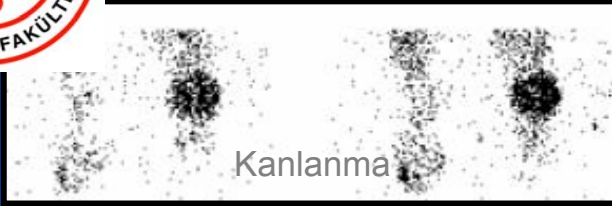


Sağ ayakta 2 aydır şişlik , CRP 79
MR: Ayak bileği ve ayakta yumuşak
dokuda ödem,
Enfeksiyon?, şarko eklemi?



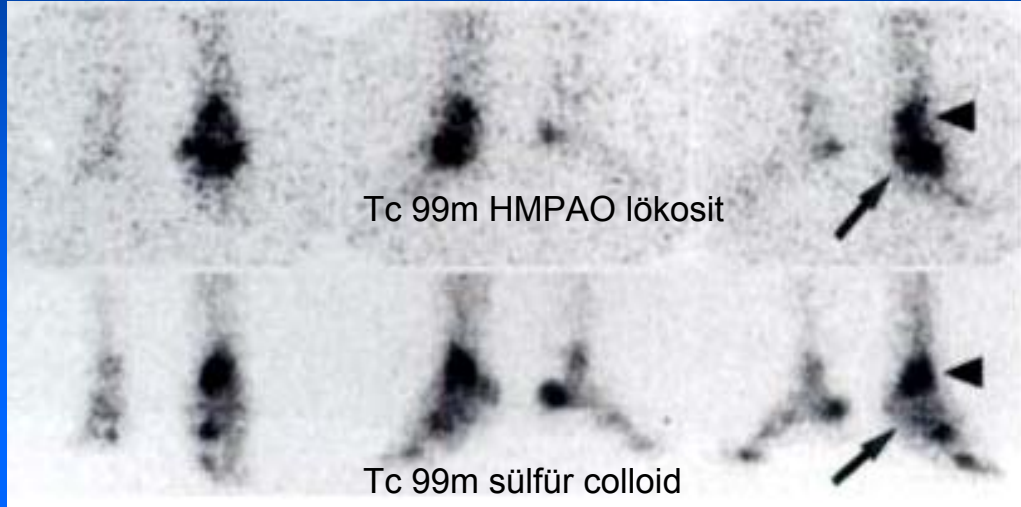


Charcot eklemi? osteomyelit?



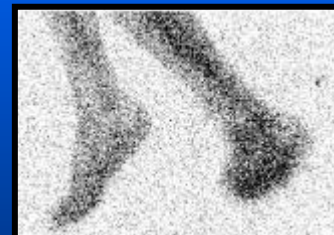
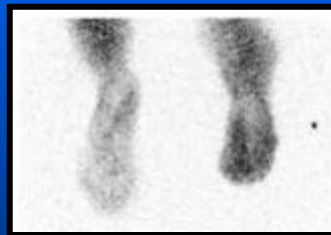
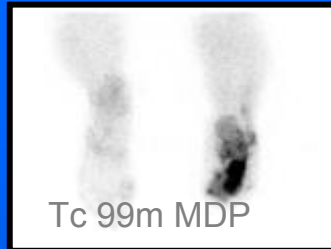
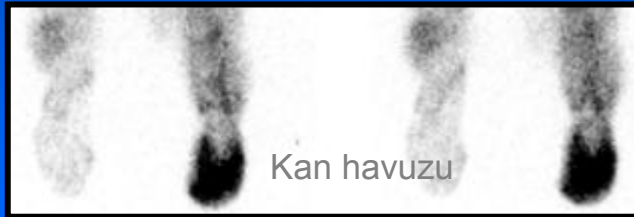
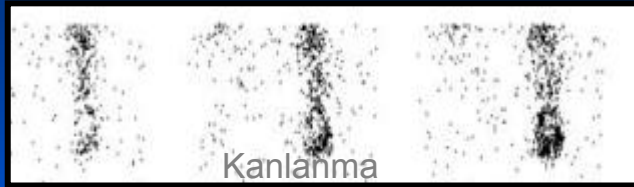


Şarko eklemi?
Osteomyelit?





Tc ^{99m} HMPAO lökosit SPECT

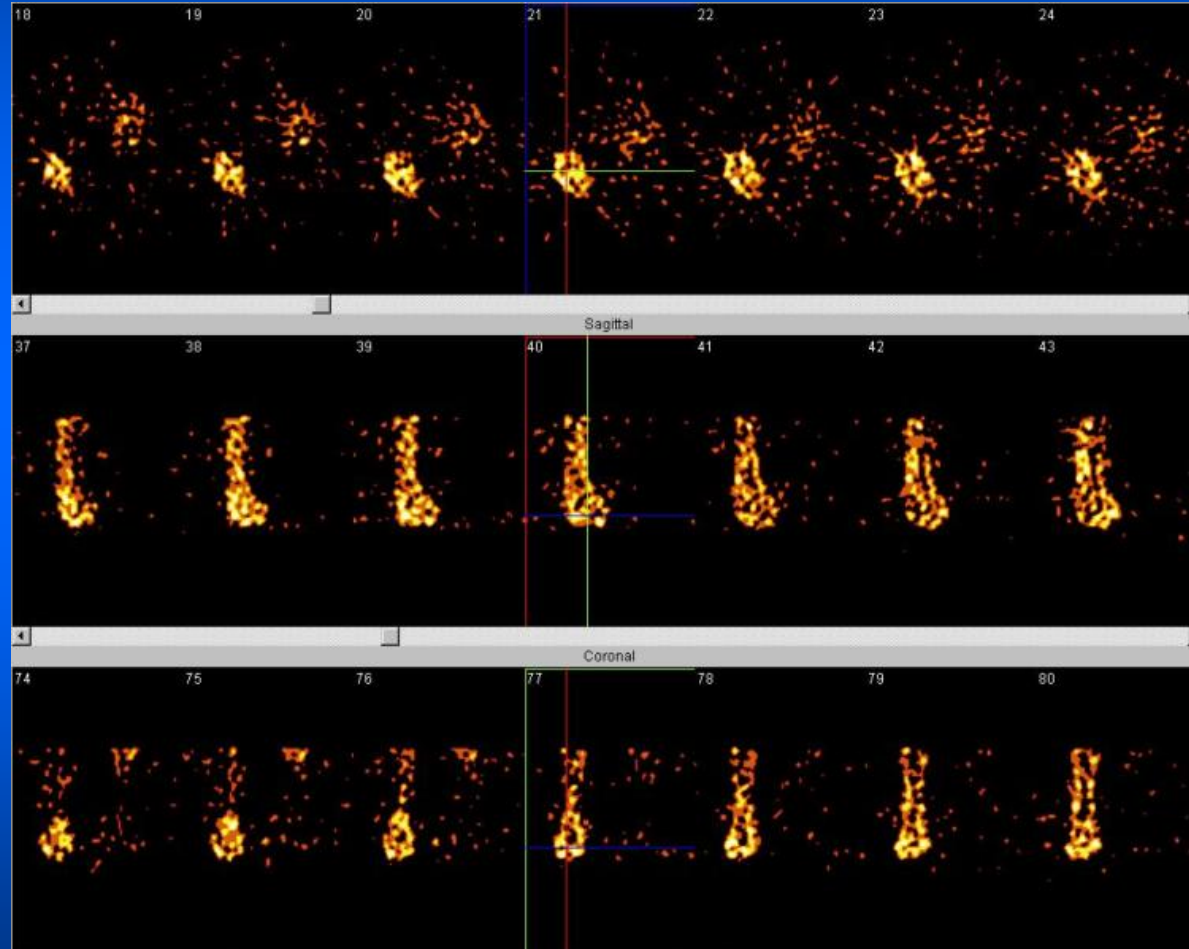


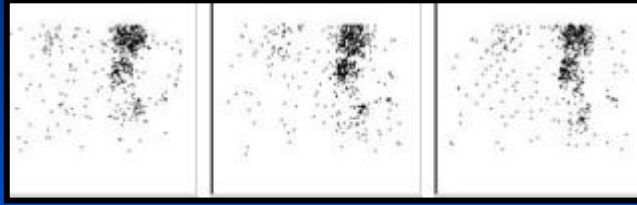
Tc 99m HMPAO lökosit

- 54 y erkek
- 3 ay önce tüm parmaklar ampute
- Sağ ayak lateralinde akıntı
- Osteomyelit?

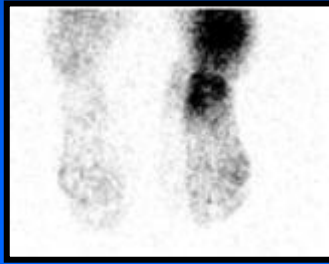


Tc ^{99m} HMPAO lökosit SPECT

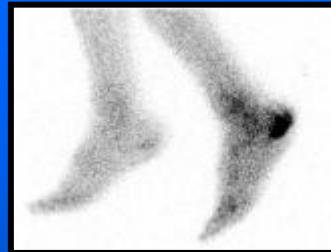
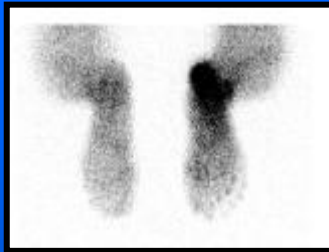




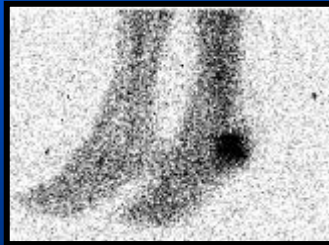
Kanlanma



Kan havuzu



Tc 99m MDP

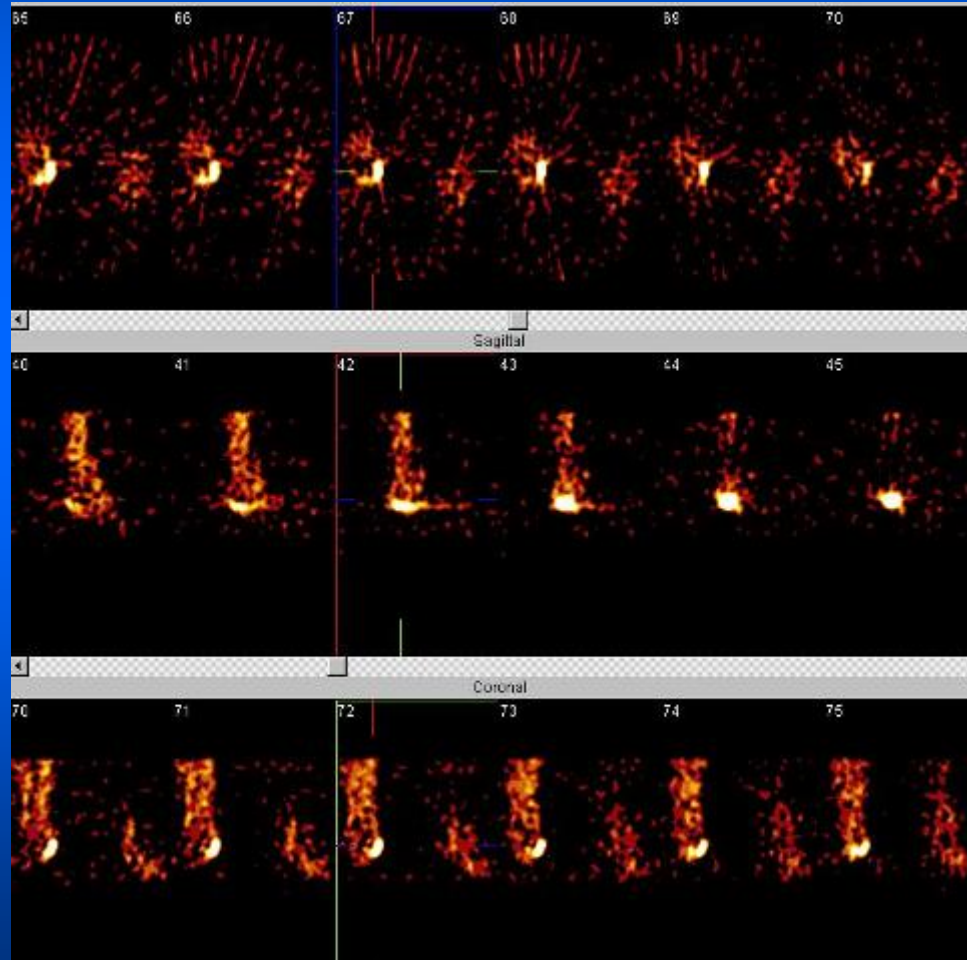


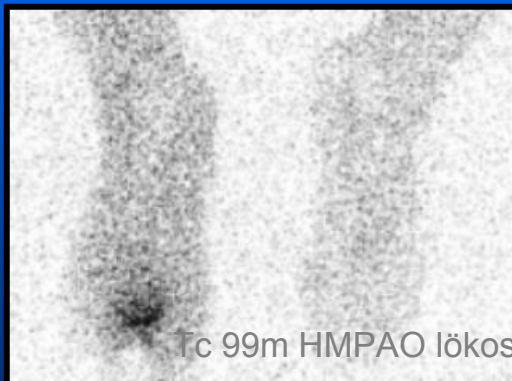
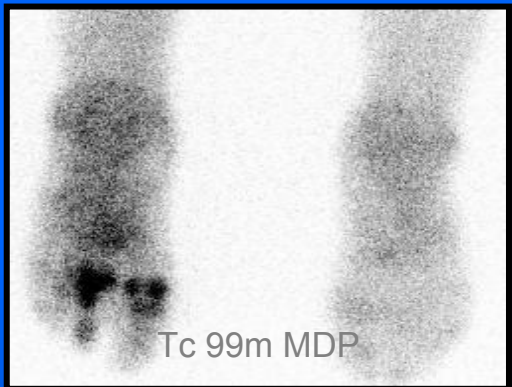
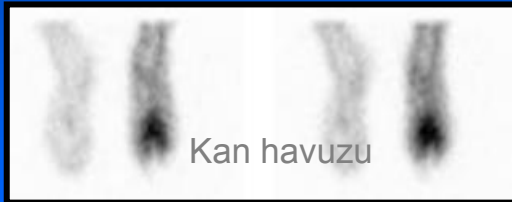
Tc 99m HMPAO lökosit

- Topuktan akıntılı yara
- Osteomyelit?
- Selülit?



Tc ^{99m} HMPAO lökosit SPECT

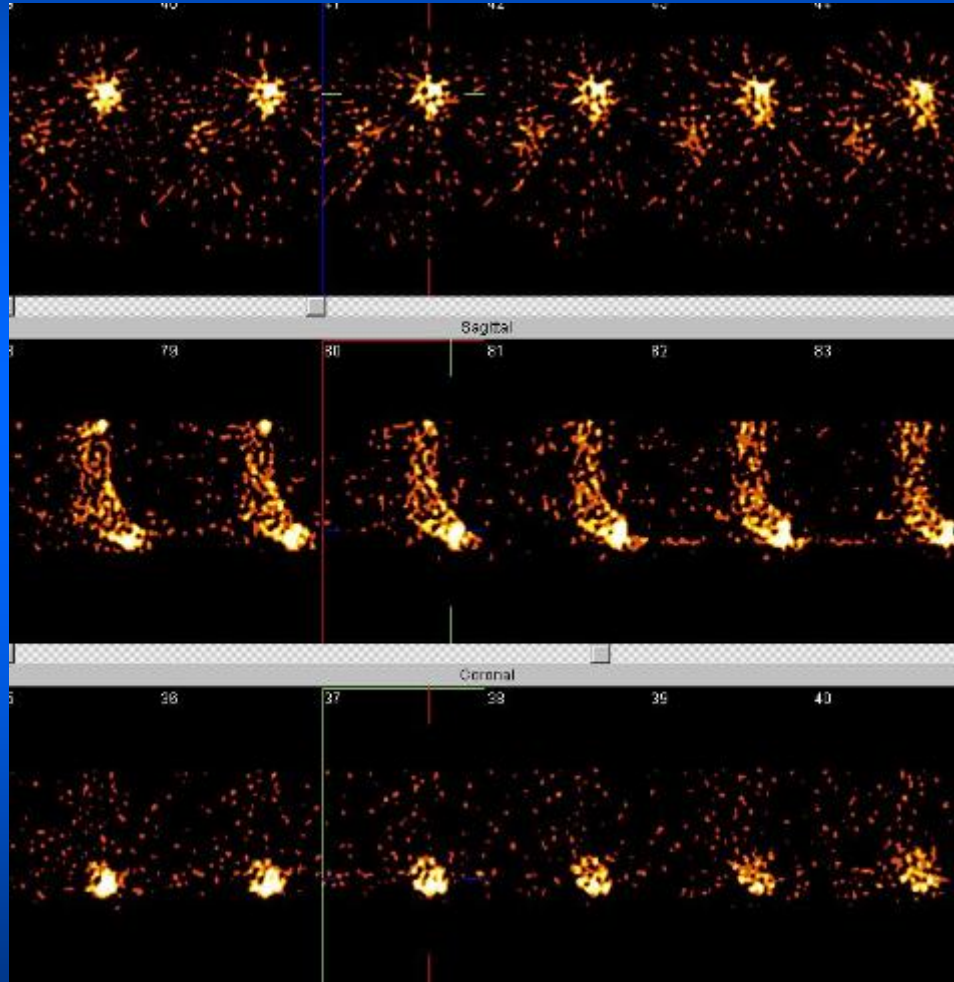




- 43 y kadın
- Sol ayak 1. parmaktan akıntı
- Osteomyelit?



Tc ^{99m} HMPAO lökosit SPECT





F¹⁸ -FDG- PET/CT

- Mononükleer hücrelerde glukoz kullanımı artar.
- Aktif granülositlerde tutulur.



F¹⁸ -FDG- PET/CT

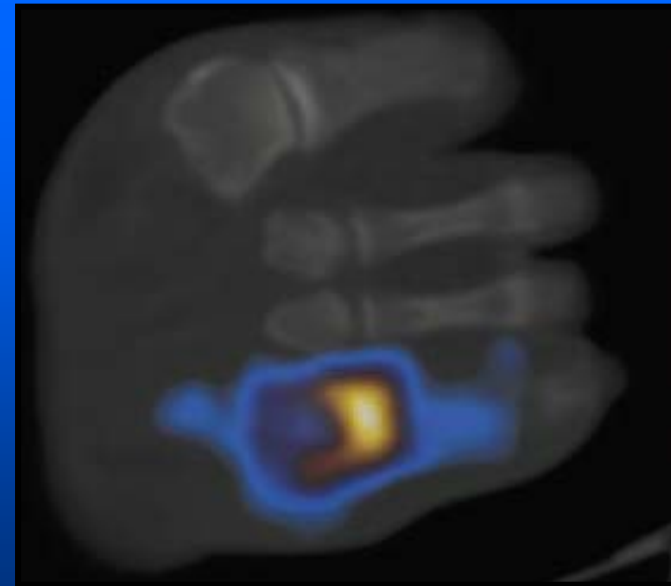
PET



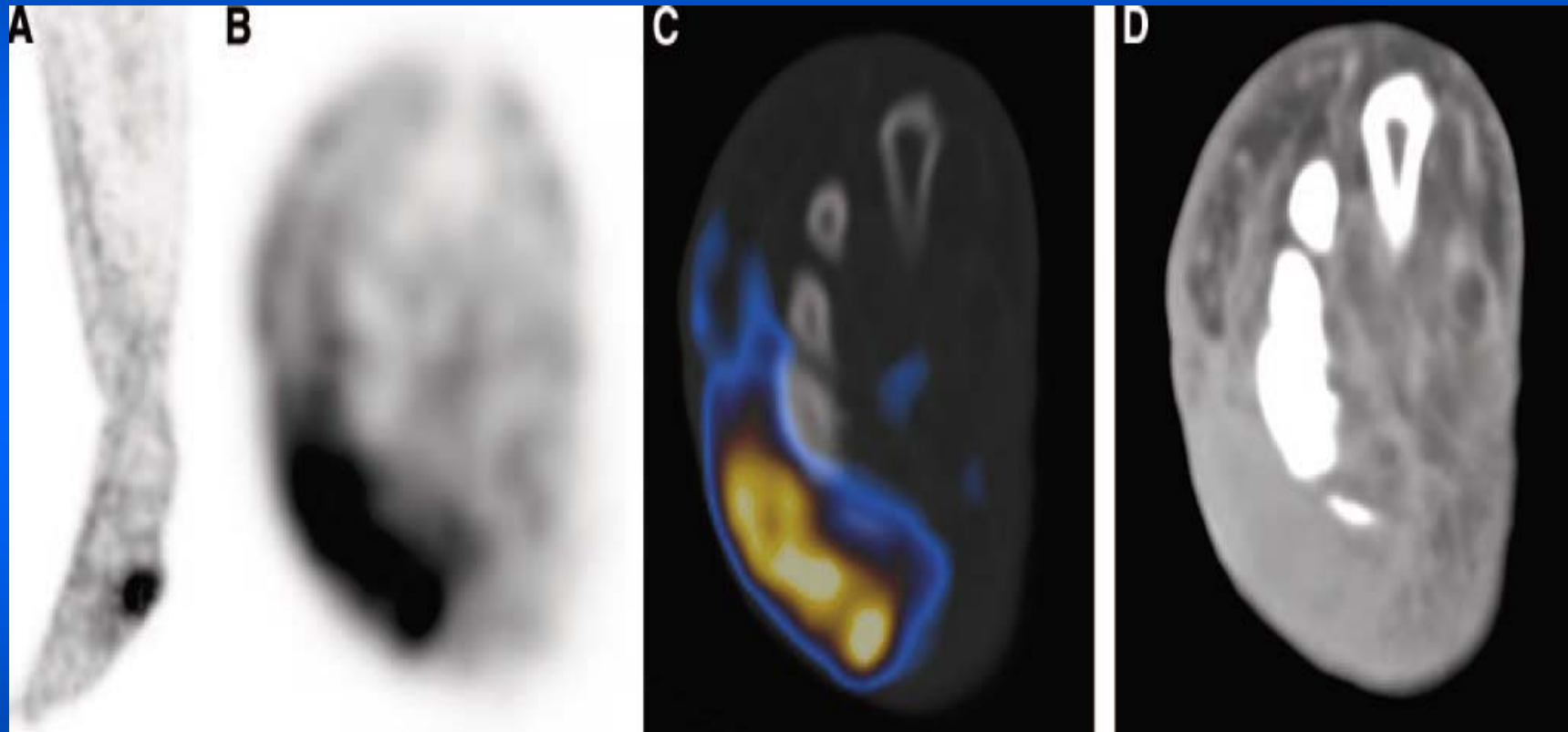
CT



PET/CT

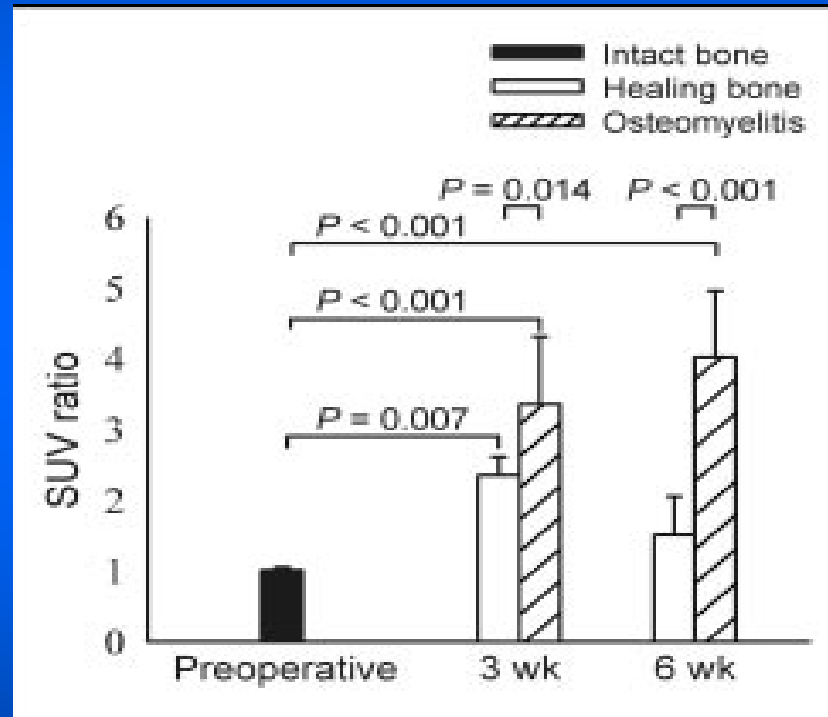


F¹⁸ -FDG- PET/CT

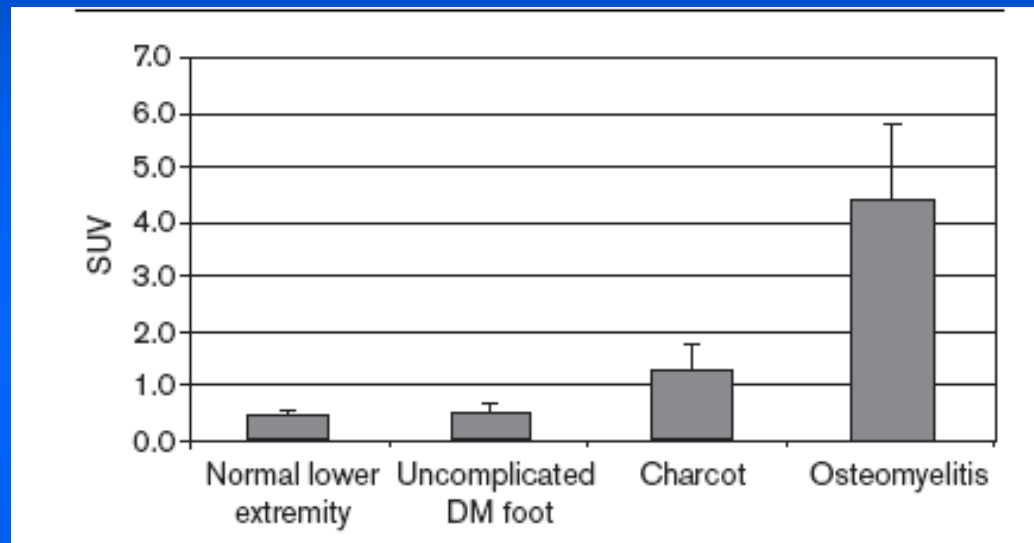




F¹⁸ -FDG- PET



Koort J . Comparative 18F-FDG PET of Experimental *Staphylococcus aureus* Osteomyelitis and Normal Bone Healing J Nucl Med 2004; 45:1406–1411



_Basua S, Chryssikosa Tt, Housenia M,. Malayb S,Shaha J, Zhuanga H and ALAVI. Potential role of FDG PET in the setting of diabetic neuro-osteoarthropathy:can it differentiate uncomplicated Charcot's neuroarthropathy from osteomyelitis andsoft-tissue infection? Nuclear Medicine Communications 2007, 28:465–472



FDG PET'in Şarko eklemi için duyarlılığı ve doğruluğu % 100 ve % 93 olarak tespit edilmiştir. Aynı çalışmada MR için bu değerler % 76.9 ve % 75 TİR.*

Basua S, Chryssikosa Tt, Housenia M., Malayb S, Shaha J, Zhuanga H and ALAVİ. Potential role of FDG PET in the setting of diabetic neuro-osteoarthropathy: can it differentiate uncomplicated Charcot's neuroarthropathy from osteomyelitis and soft-tissue infection?. Nuclear Medicine Communications 2007, 28:465–472

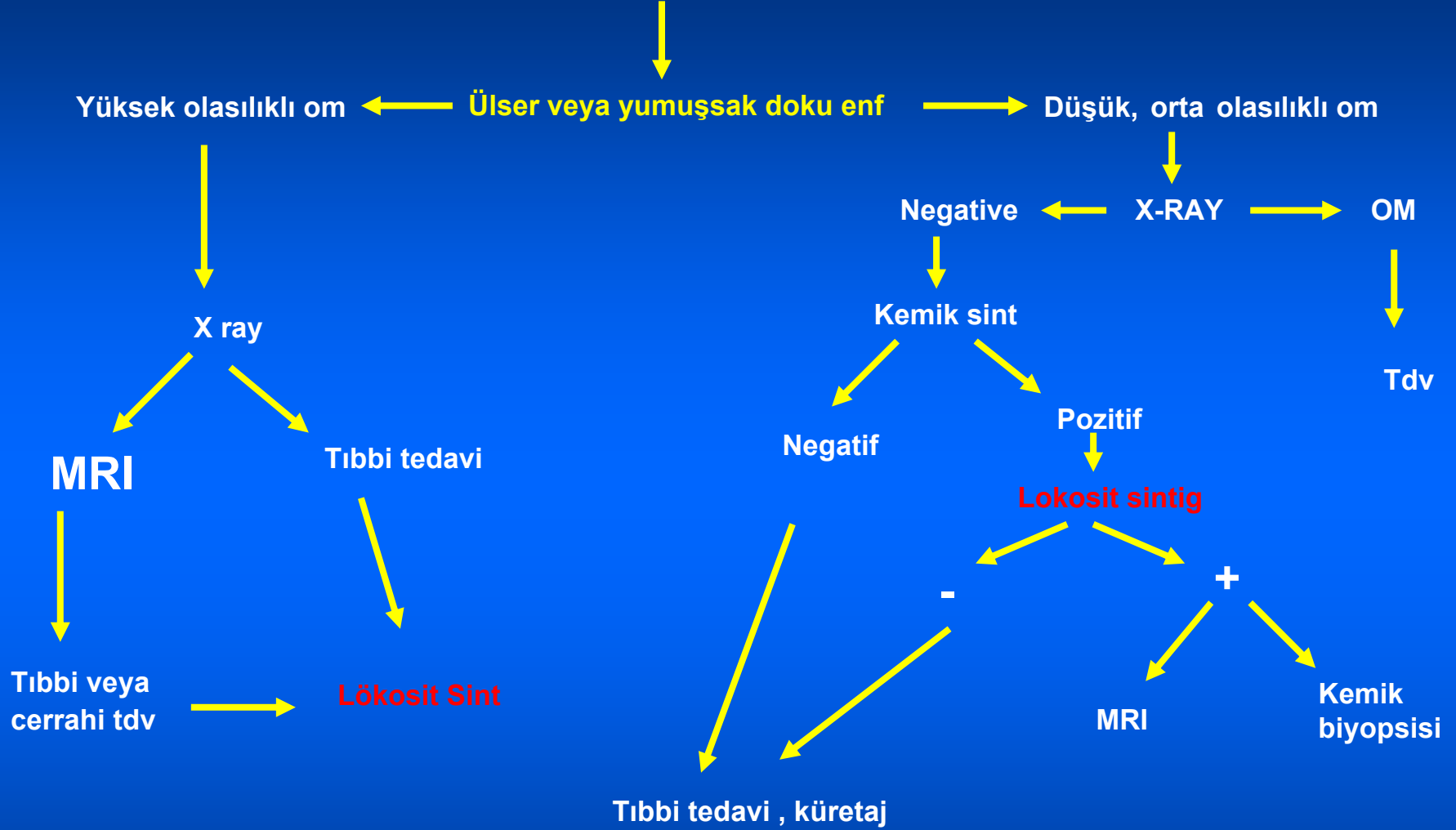


Diyabetik ayak

- **Ön ayak:** Kemik sintigrafisi ve İşaretli lökosit
- **Orta ve arka ayak:** İşaretli lökosit ve kemik iliği sintigrafileri

ÖN AYAK

Klinik muayene



ORTA /ARKA AYAK

