Diabetic Foot & Infection Imaging

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26 November 2015

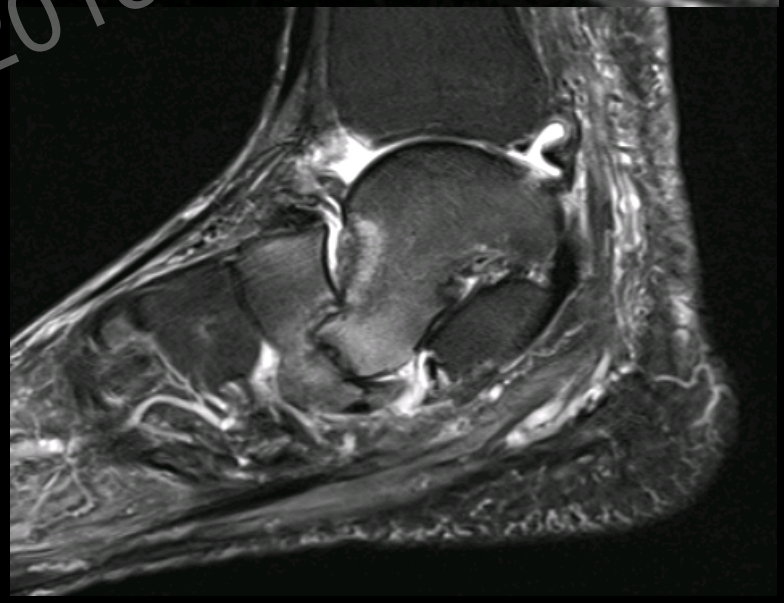
University of Zurich[UZH]

The Balgrist

MRI of Diabetic Foot

1. Pedal Osteomyelitis

2. Charcot Foot & Osteomyelitis



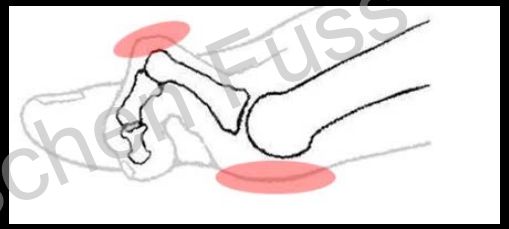
Pedal Osteomyelitis

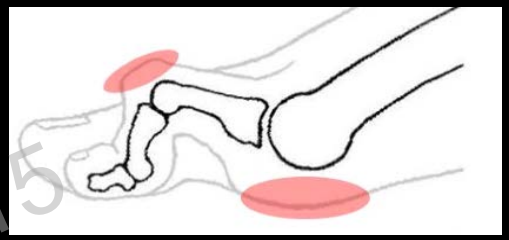
- Foot infections: Contiguous spread of a skin ulcer
- Lifetime risk of foot ulcers in diabetic patients: 25 %

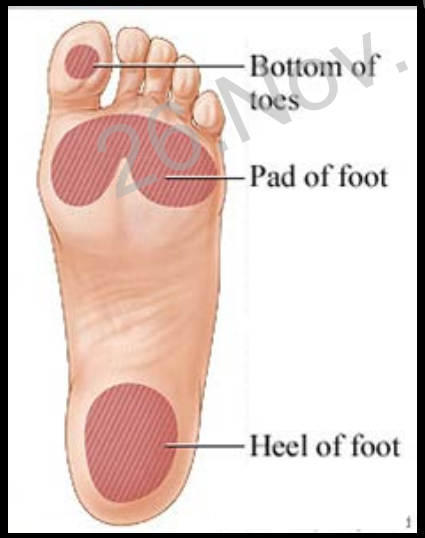
Pedal Osteomyelitis

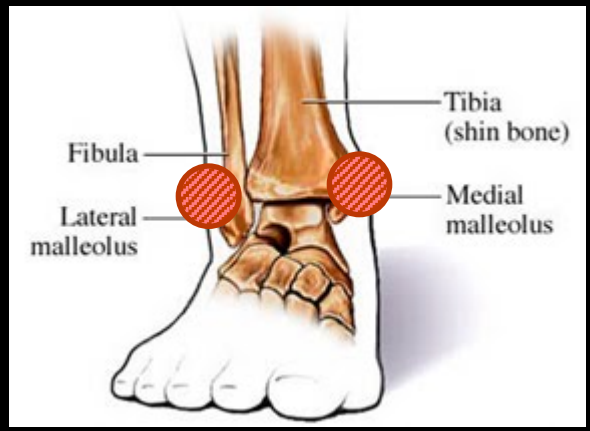
Typical locations of ulceration

- Toes
- Metatarsal Heads
- Calcaneus
- Malleoli









Donovan A, Schweitzer M: RadioGraphics 2010;30:723-736

http://www.webmd.com/diabetes

Pedal Osteomyelitis

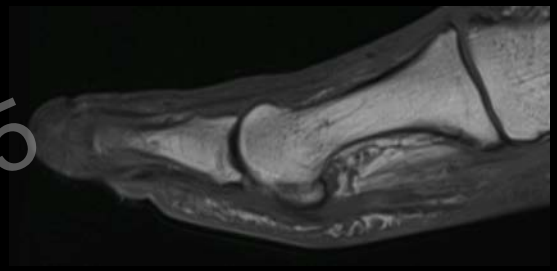
X-ray:

- Cheap, high availability, good anatomical overview
- Low sensitivity (43-75 %), low specificity (75-80%), only late changes (10-14 d) , exact extent not visible

Pedal Osteomyelitis

MRI:

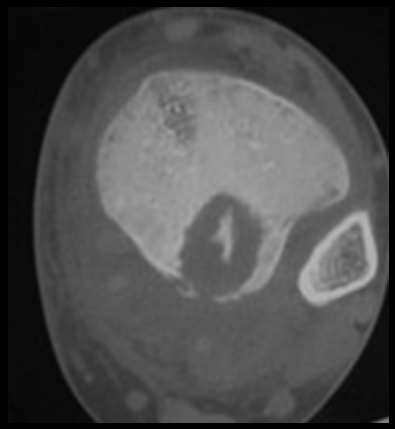
- Detects early signs of osteomyelitis (3-5 d)
- Sensitivity: 90 %; Specificity: 80 %
- Good anatomical resolution
- Bones and soft tissue evaluation
- No radiation
- Almost 100 % NPV for exclusion of osteomyelitis
- Expensive, not always available, contraindications



Pedal Osteomyelitis

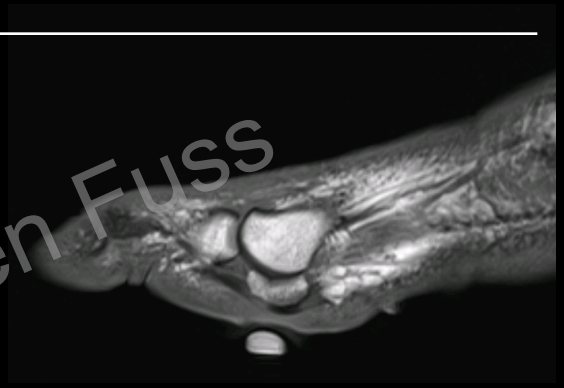
CT:

- Acute: Sensitivity: 67 %; Specificity: 50 %
- Evaluation of chronic osteomyelitis: detection of sequestrum or involucrum
- Expensive, radiation dose, soft tissue evaluation



Termat FM et al. : J Bone Joint Surg Am. 2005;87 (11): 2464-71.

MR Imaging



How ?

- Crucial: To know the ulcer location !!
- Small field of view: Forefoot or hindfoot

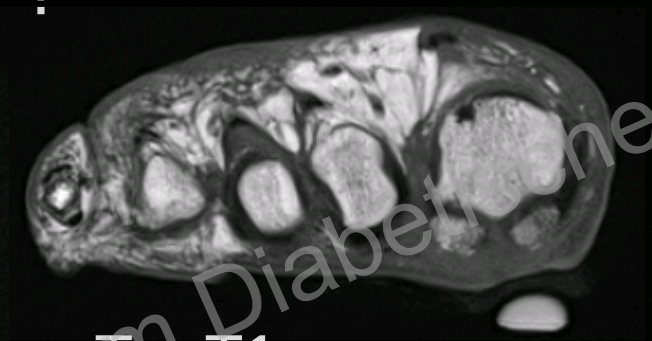
<u>Important:</u>

- Native T1-weighted sequence in two planes: Osteomyelitis
- Stir-sequence: Bone marrow edema, soft tissue infection

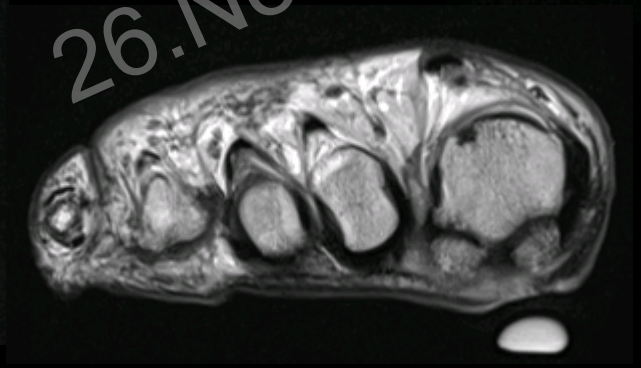
MR Imaging

Image protocol ?

Cor Stir



Tra T1



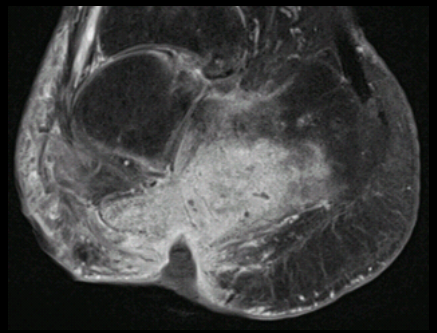
Tra T2

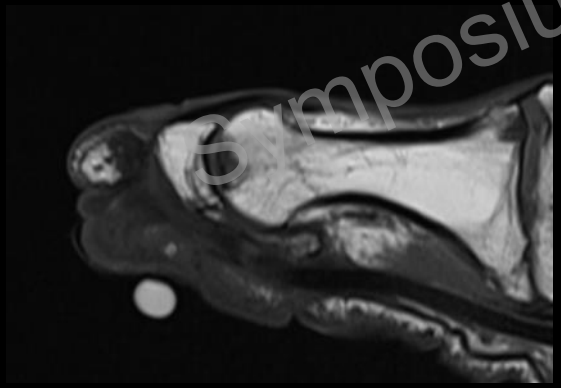
Sag T1

MRI findings in Osteomyelitis

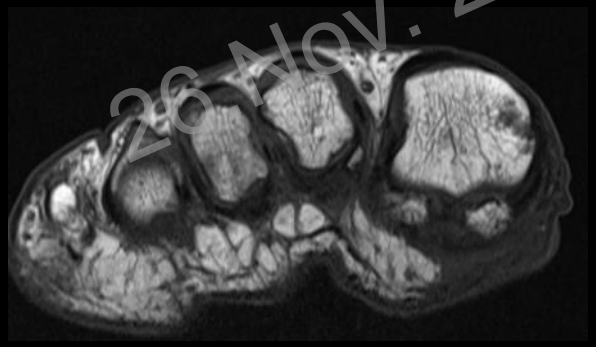
1. Locate ulcer & adjacent soft tissue changes

- Skin ulcer, skin callus, sinus tract,
- Subcutaneous edema & imbitition

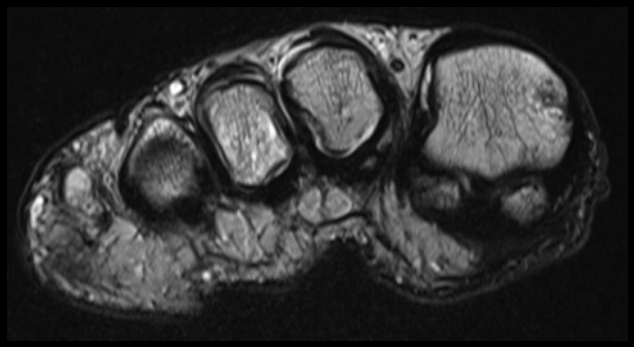




T1



T1

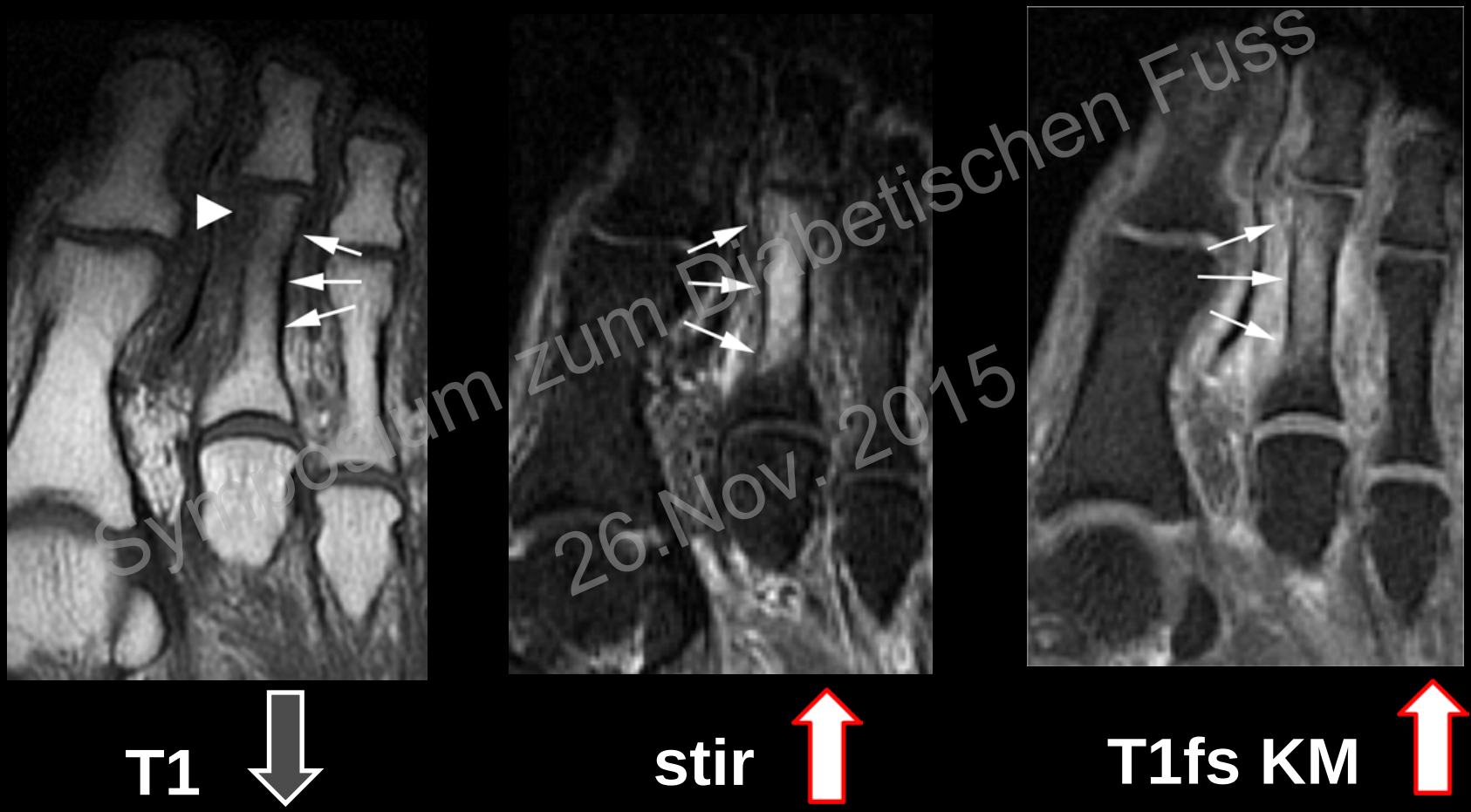


T2

Donovan A. and Schweitzer M.: RadioGraphics 2010;30:723-736

MRI findings in Osteomyelitis

2. Look for bone marrow signal changes



Palestro CJ et al.: Best Pract Res Clin Rhe197-218. Review

IDSA Guidelines 2012 (Infectious Diseases Society of North America)

MRI findings in Osteomyelitis

T1-Weighted MRI Characteristics of Pedal Osteomyelitis

Mark S. Collins[1]
Matthew M. Schaar
Doris E. Wenger
Jawayant N. Mandrekar

OBJECTIVE. The objective of our study was to better define the T1-weighted MRI characteristics of surgically proven pedal osteomyelitis.

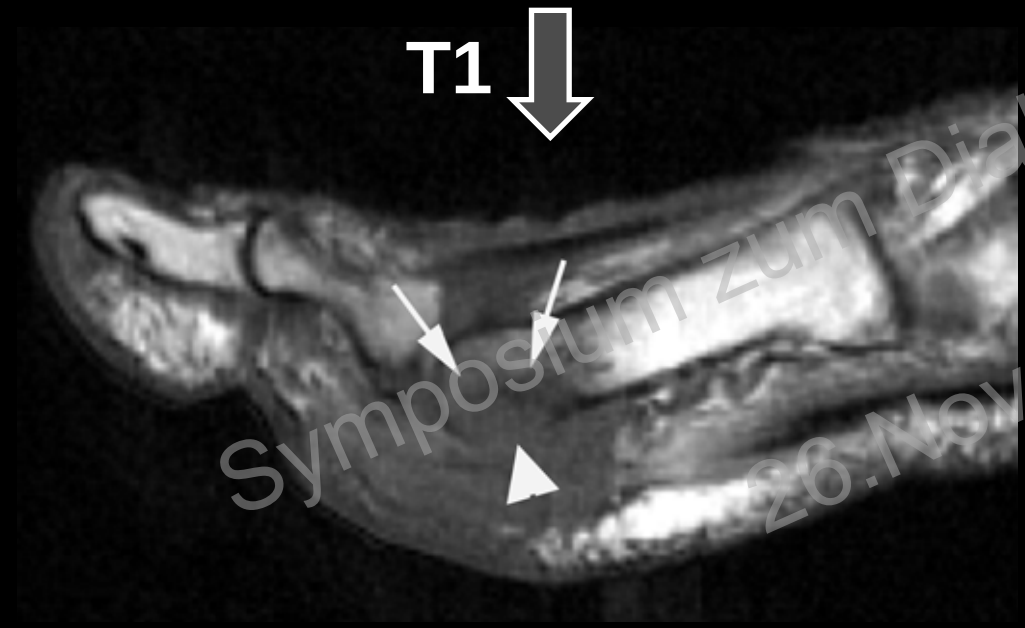
CONCLUSION. Decreased T1 marrow signal in a geographic medullary distribution with a confluent pattern and concordance with fat-suppressed T2- and T1-weighted postcontrast signal abnormality was present in 100% of the surgically proven cases of pedal osteomyelitis. None of the patients with decreased T1 marrow signal in a subcortical distribution or in a hazy, reticulated pattern had surgically proven osteomyelitis regardless of the fat-suppressed T2-weighted or postcontrast T1-weighted findings.

Crucial : pattern and location of signal drop in T1w-sequence

Collins MS et al.: AJR 2005;185:386-393

MRI findings in Osteomyelitis

Osteomyelitis



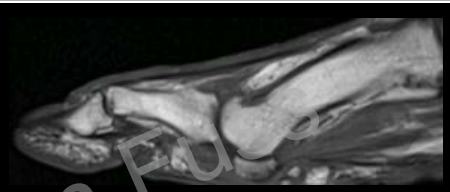
Geographic, confluent

Reactive Edema

Subcortical distribution and/or hazy reticular, less sharp

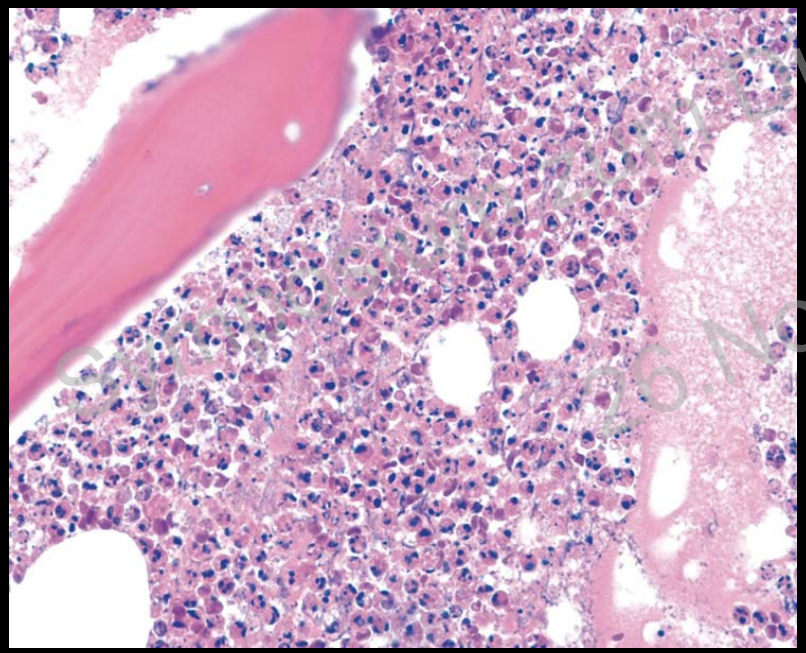
Collins MS et al.: AJR 2005;185:386-393

MRI findings in Osteomyelitis

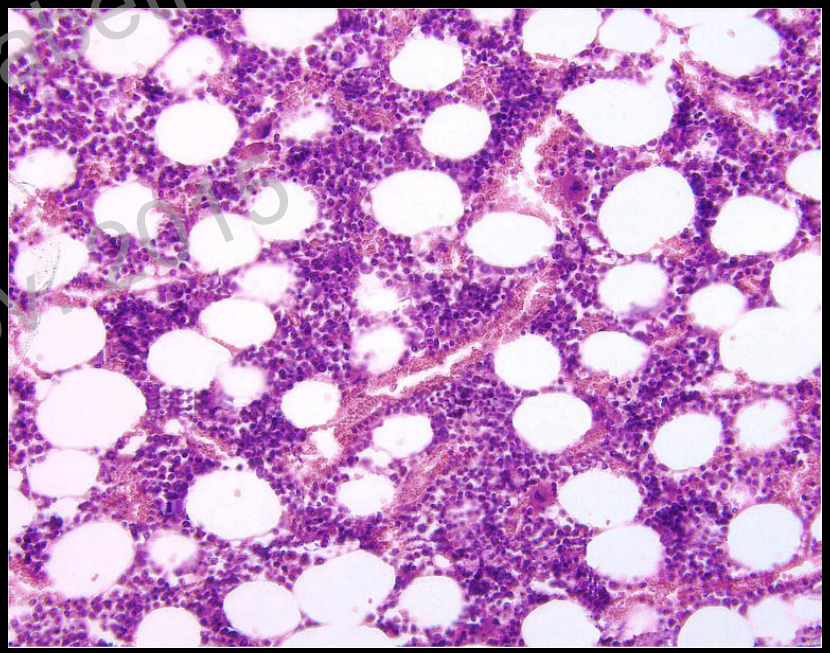


Reactive bone marrow edema:

- non-infectious edema, no replacement of adipocytes



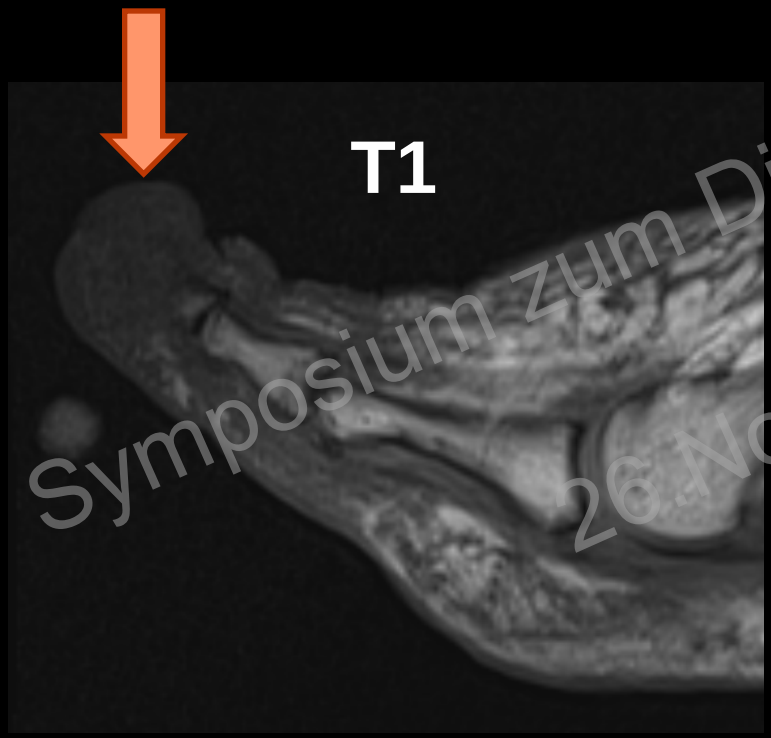
Osteomyelitis



Reactive Edema

Collins MS et al.: AJR 2005;185:386-393

MRI findings in Osteomyelitis



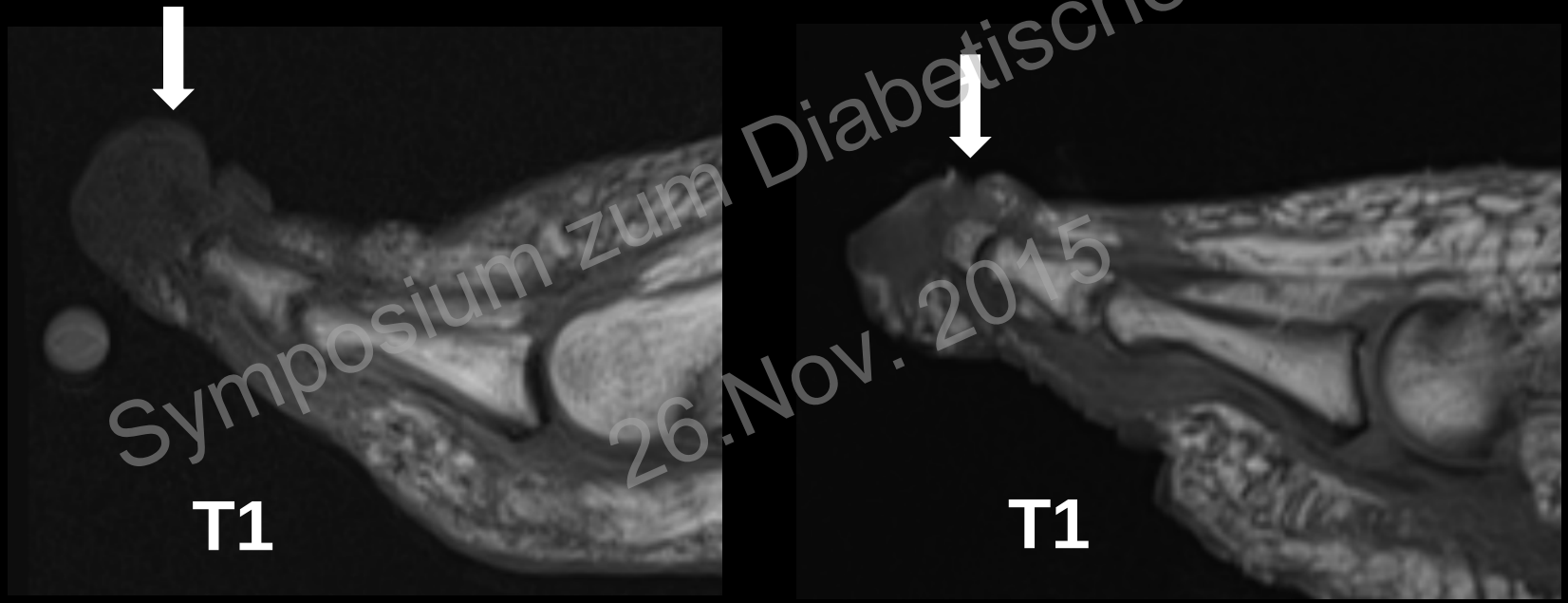
Osteomyelitis

Reactive Edema

Collins MS et al.: AJR 2005;185:386-393

MRI findings in Osteomyelitis

3 month later with antibiotics



Osteomyelitis

3. toe

Collins MS et al.: AJR 2005;185:386-393

MRI findings in Osteomyelitis

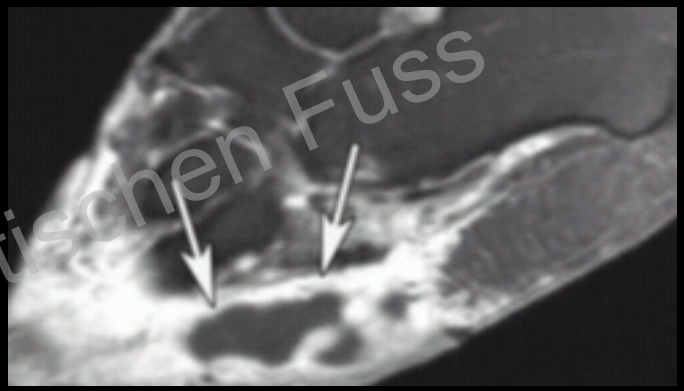
Do we need contrast ?

- In uncomplicated cases NOT necessary:
  Signal changes in T1w- and fluid-sensitive sequence
- High risk patients: renal insufficiency
- Recommended for evaluation of soft tissue and suspected complications

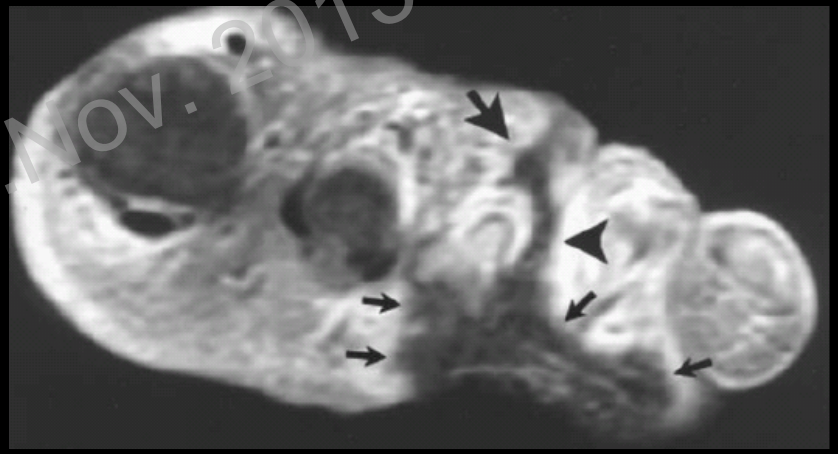
Palestro CJ et al.: Best Pract Res Clin Rheumatol. 2006 Dec;20(6):1197-218. Review

MRI with CM

- Cellulitis or abscess ?



- Gangrene or vital tissue ?



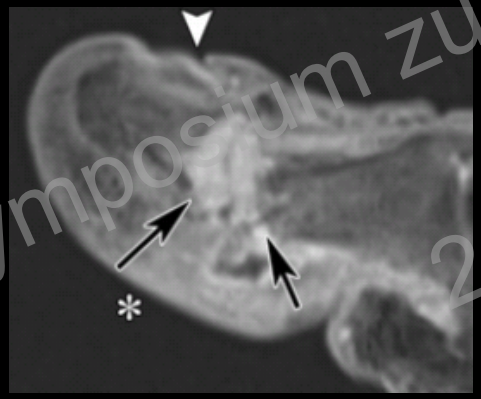
Palestro CJ et al.: Best Pract Res Clin Rhe197-218. Review

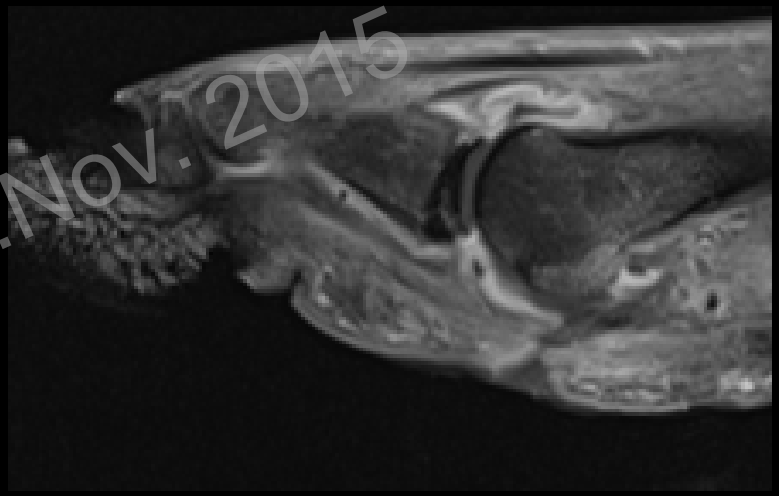
IDSA Guidelines 2012 (Infectious Diseases Society of North America)

MRI with CM

- Septic Arthritis:

  Synovial thickening with enhancement &
  joint effusion





Palestro CJ et al.: **Best Pract Res Clin Rheumatol**. 2006 Dec;20(6):1197-218. Review

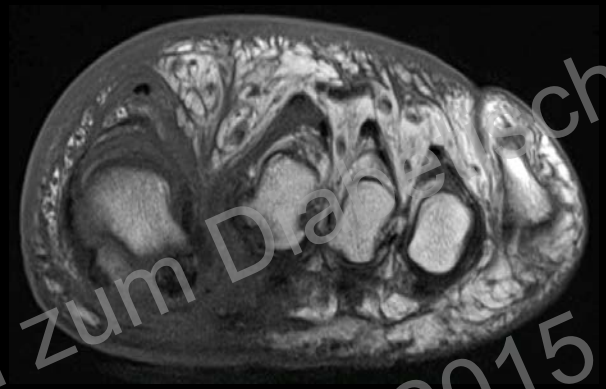
Case

59-year-old male, IDDM II (25 years), long-term ulcer plantar MTP I

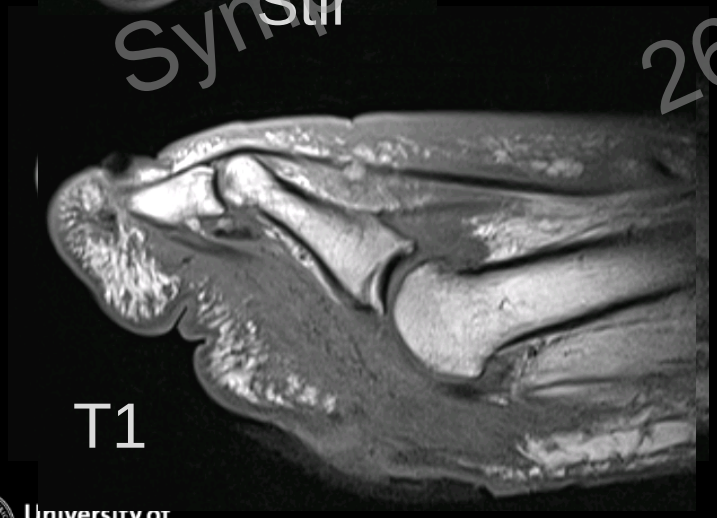
Case

59-year-old male, IDDM II (25 years)

Stir



T1



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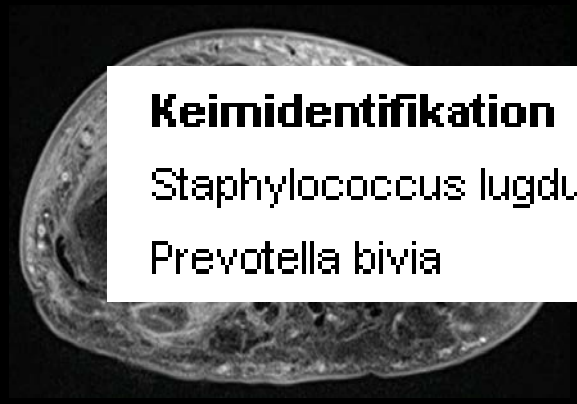


Keimidentifikation

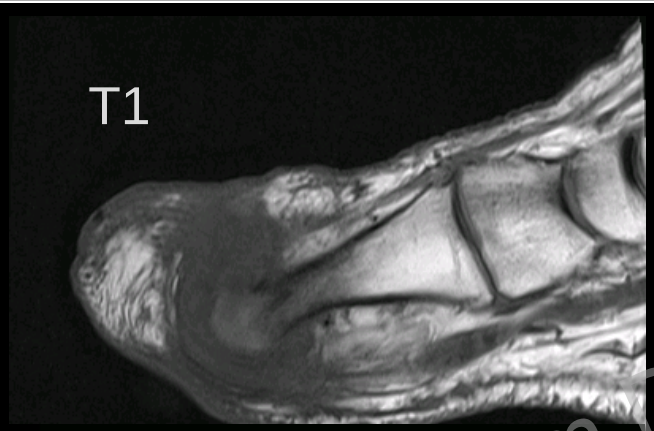
Staphylococcus lugdunensis

Prevotella bivia

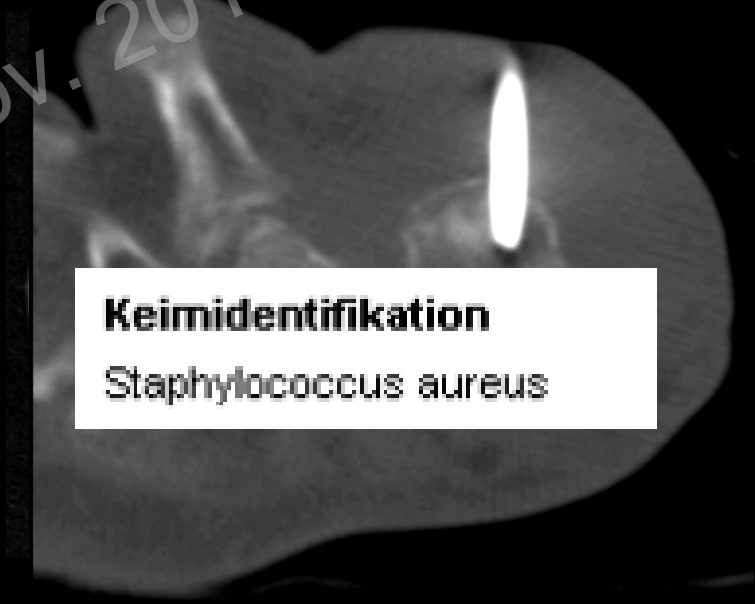
Case

- 1 week later: acute necrosis Dig. I: Exartikulation
- 6 weeks later:

Case



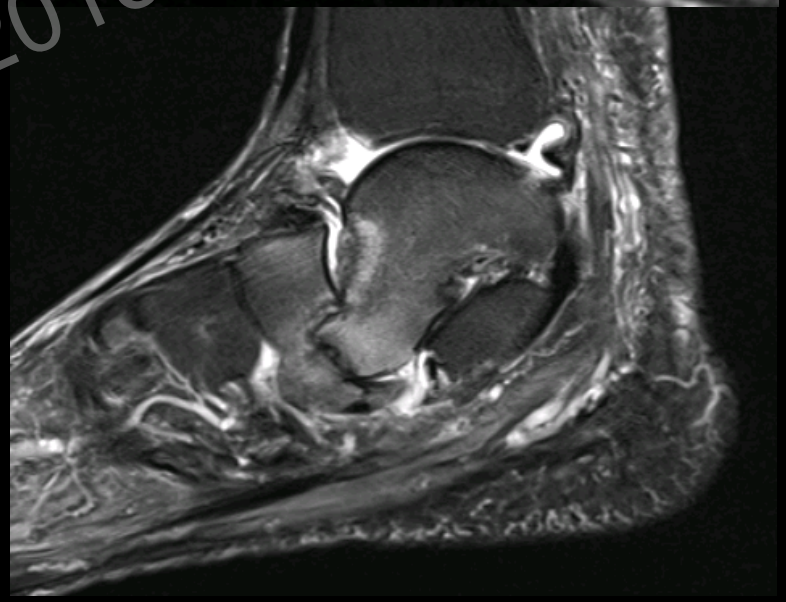
Stir



MRI of Diabetic Foot

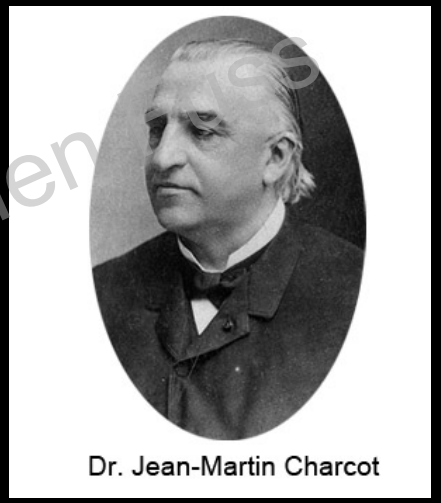
1. Pedal Osteomyelitis

2. Charcot Foot & Osteomyelitis



Charcot Foot

- Neuropathic osteoarthropathy
- Jean-Martin Charcot in 1883
- Prevalence: 0.1-0.4%
- Patients 5th and 6th decade
- Risk: Diabetes more than 10 years
- 9-35% bilateral disease


Dr. Jean-Martin Charcot

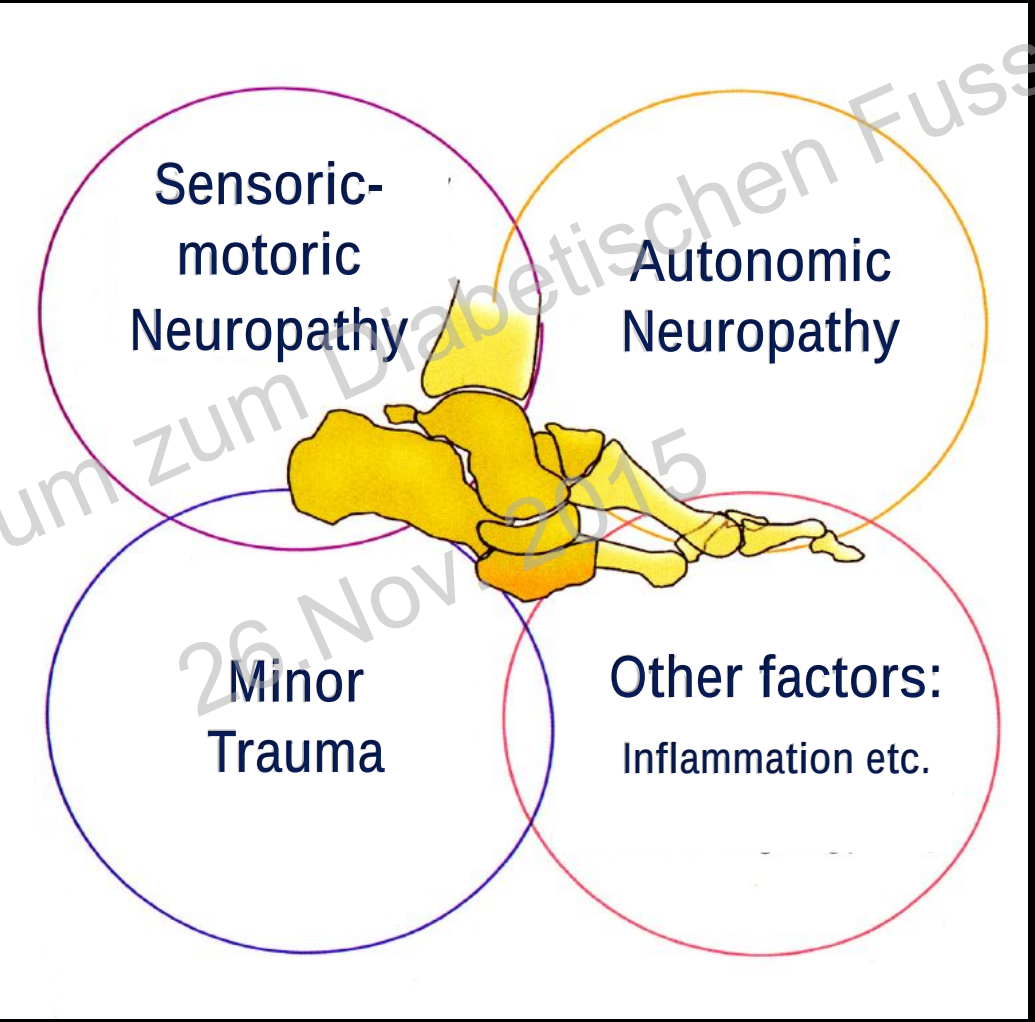
Ledermann HP, Morrison WB: Semin Musculoskelet Radiol. 2005 Sep;9(3):272-83

Rogers LC et al.:Diabetes Care. 2011 Sep;34(9):2123-9.

Koller A, Führer J, Wetz HH: Orthopäde. September 2004, Volume 33, Issue 9, pp 972-982

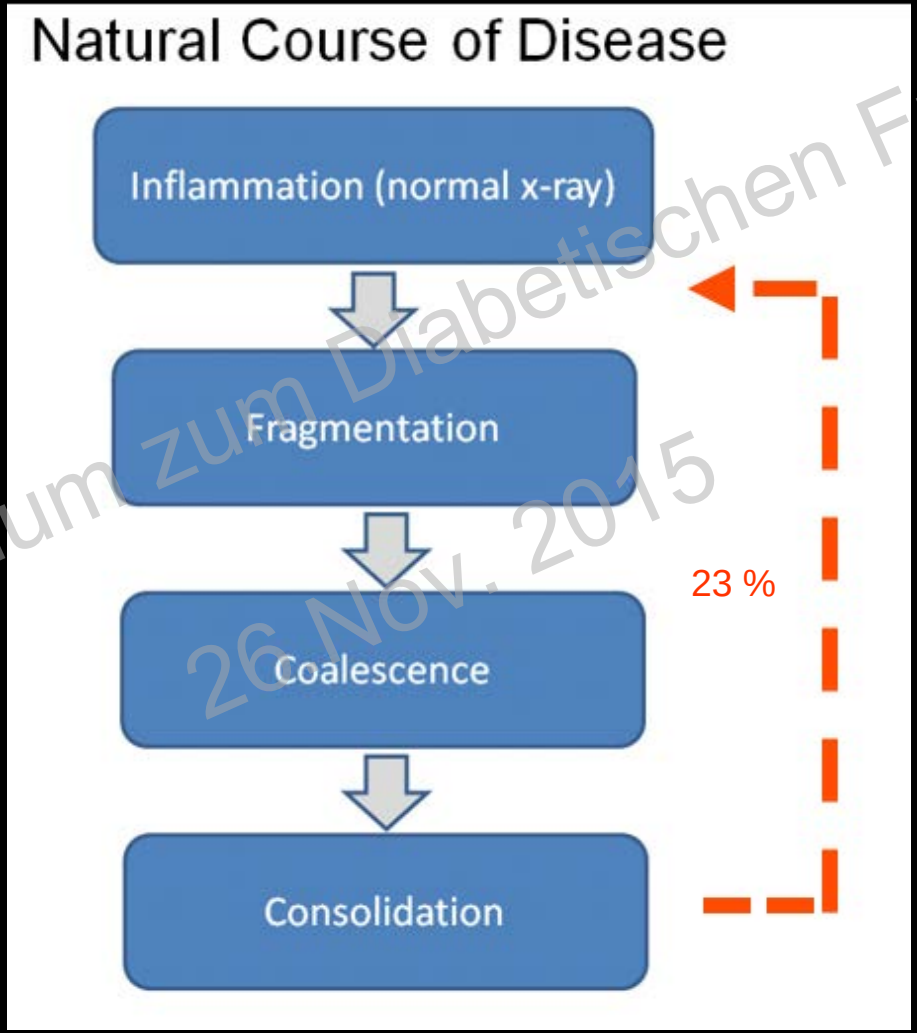
Charcot Foot

Pathogenesis:



Kaynak G et al.:Diabetic Foot & Ankle 2013, 4: 21117

Charcot Foot



Charcot Foot

Typical course of foot alignement changes

Baseline

15 month

24 month

5 weeks

Hastings M et al.:J Bone Joint Surg Am. 2013;95:1206-13

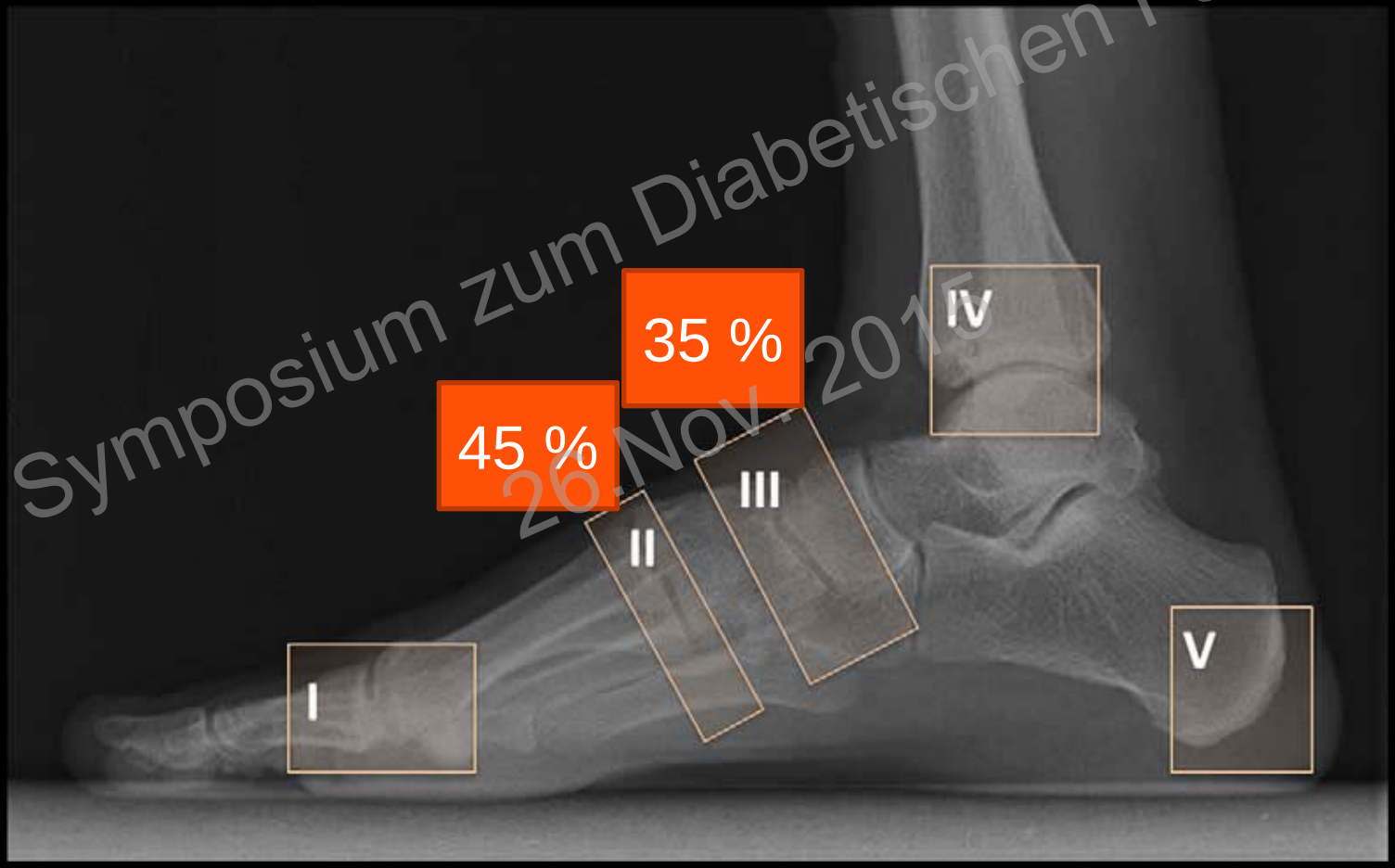
Charcot Foot

Irreversible Deformation :

«Rocker Bottom Foot»

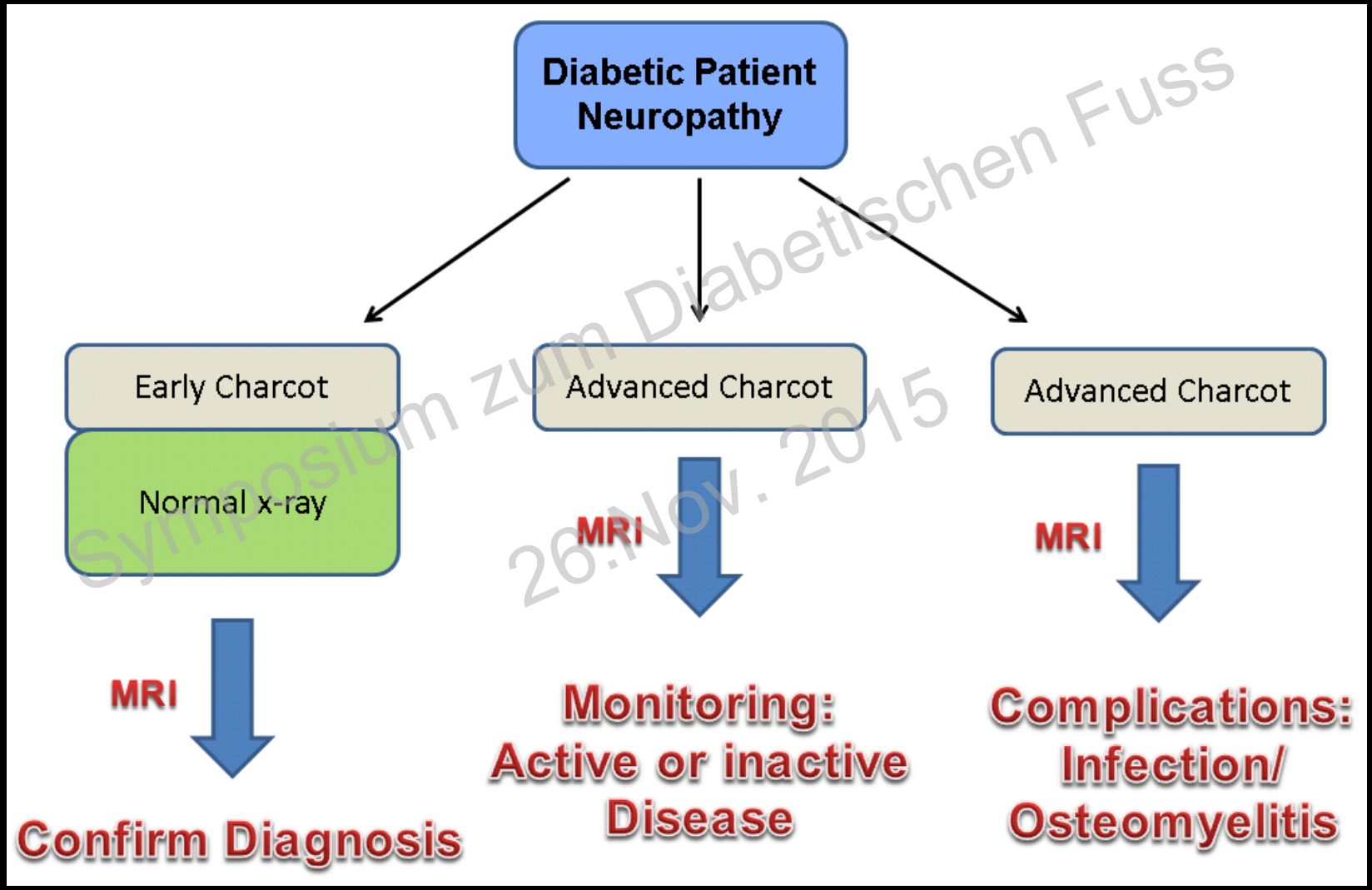
Charcot Foot

Anatomical Distribution (Sanders and Frykberg):



Ergen F et al.:Diabetic Foot & Ankle 2013, 4: 21884

Role of MRI


Diabetic Patient
Neuropathy
Early Charcot
Normal x-ray
MRI
Confirm Diagnosis
Advanced Charcot
MRI
Monitoring:
Active or inactive
Disease
Advanced Charcot
MRI
Complications:
Infection/
Osteomyelitis
Symposium zum Diabetischen Fuss
26.Nov. 2015

MR Imaging protocol

Sag stir whole foot

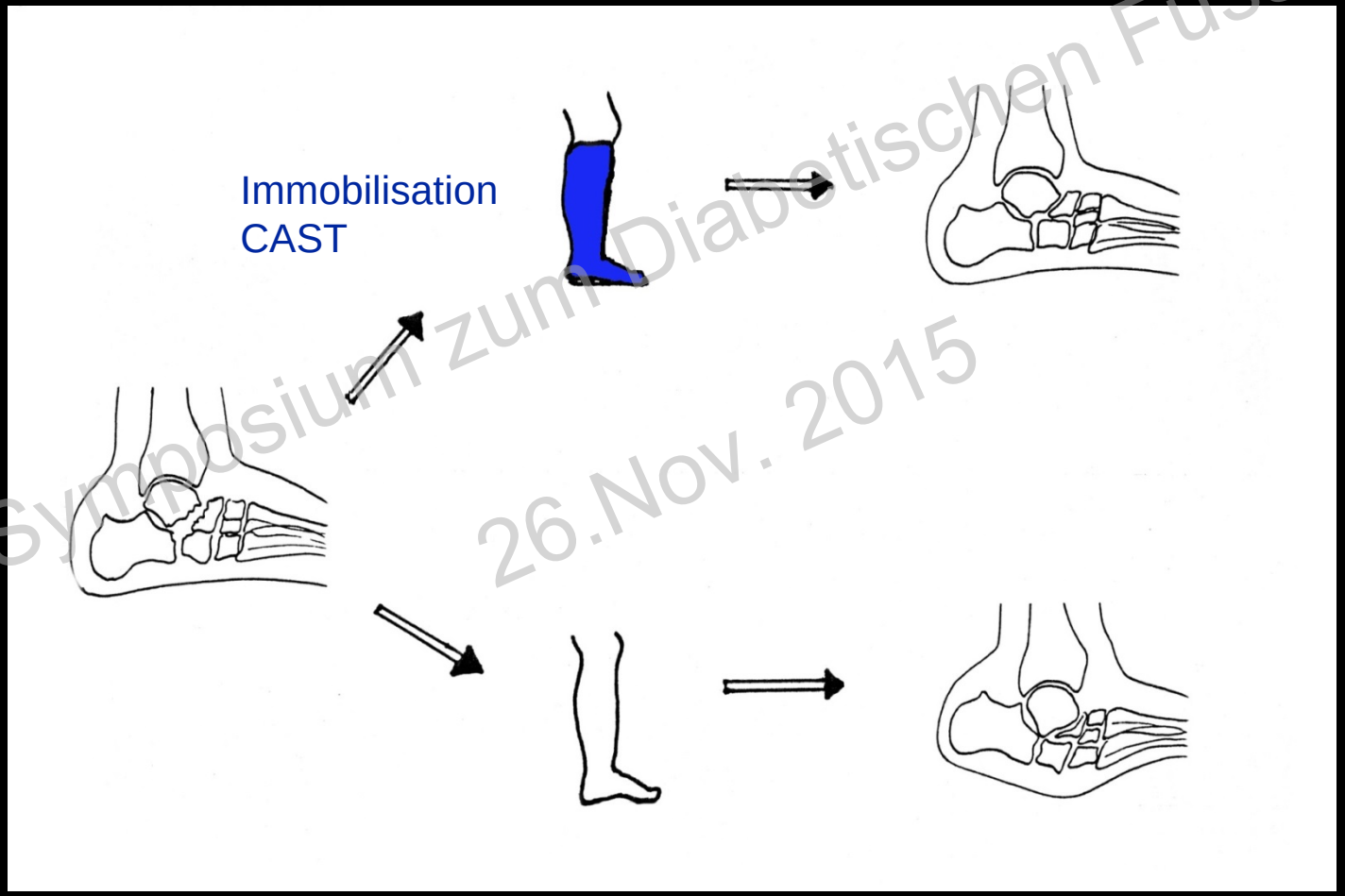
Sag T1 whole foot

Tra T1 incl. TMT joints

Cor T2 incl. TMT joints

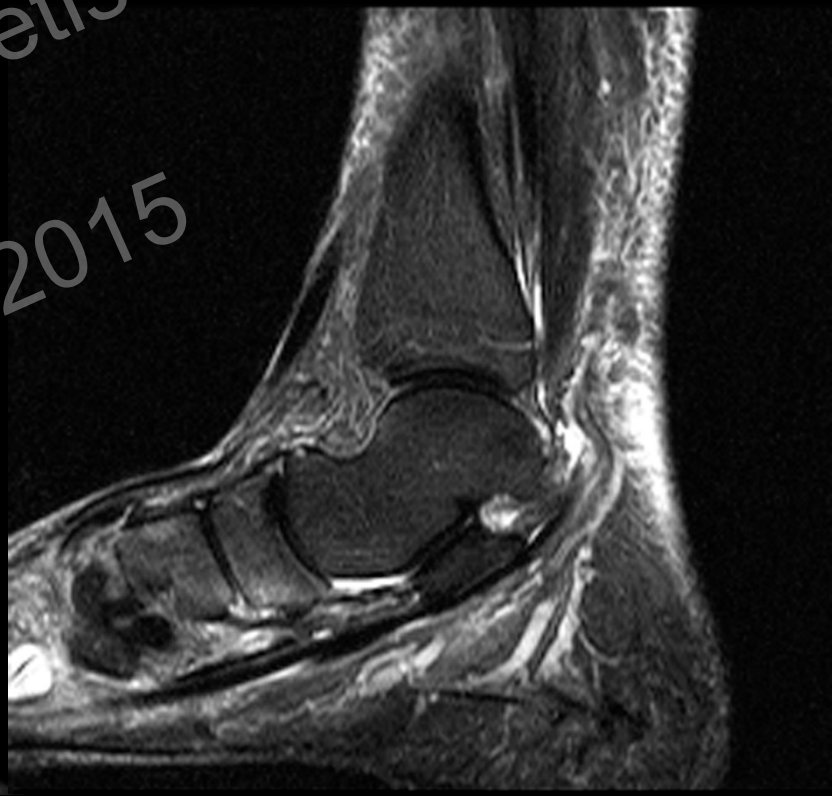
Benefit of MRI

1. Early detection of Charcot



Benefit of MRI

1. Early detection of Charcot



Benefit of MRI

<u>Early MR – findings:</u>

- Bone marrow edema
- Soft tissue edema
- Lisfranc joint disease
- Subchondral bone marrow edema
- Joint effusion
- Microfractures

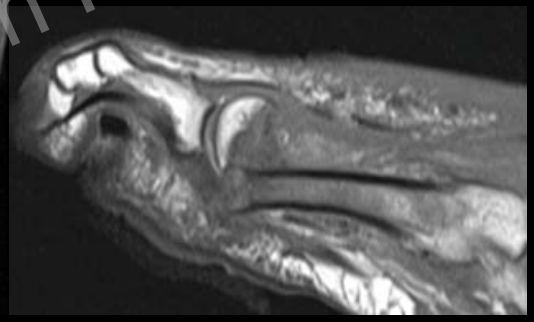
Ledermann HP, Morrison WB: Semin Musculoskelet Radiol. 2005 Sep;9(3):272-83

Koller A, Führer J, Wetz H: Orthopäde 2004: 33:972-982

Charcot Foot

Stir

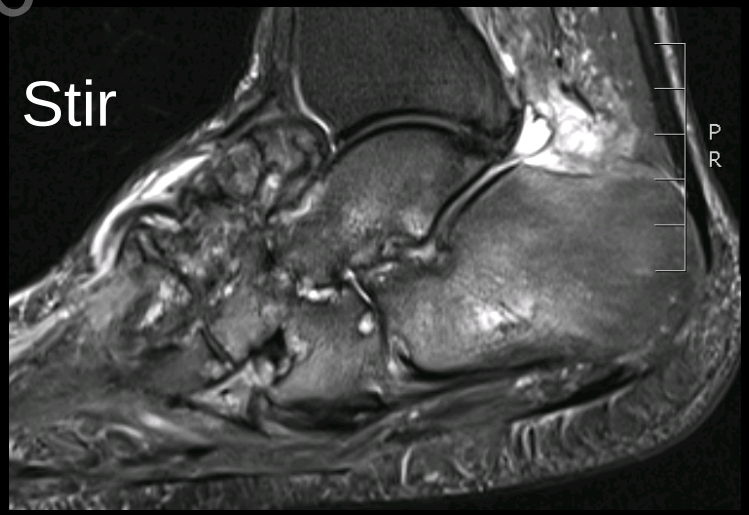
T1



Late MR - Findings:

- Joint destructions
- Bone fragmentation
- Subchondral cysts
- Bone proliferation/Debris

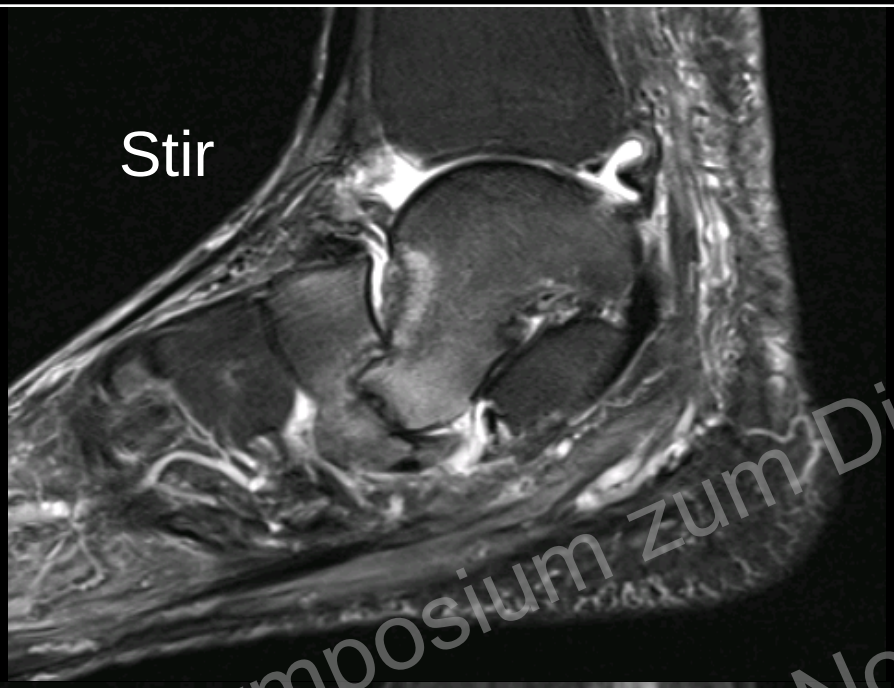
Stir

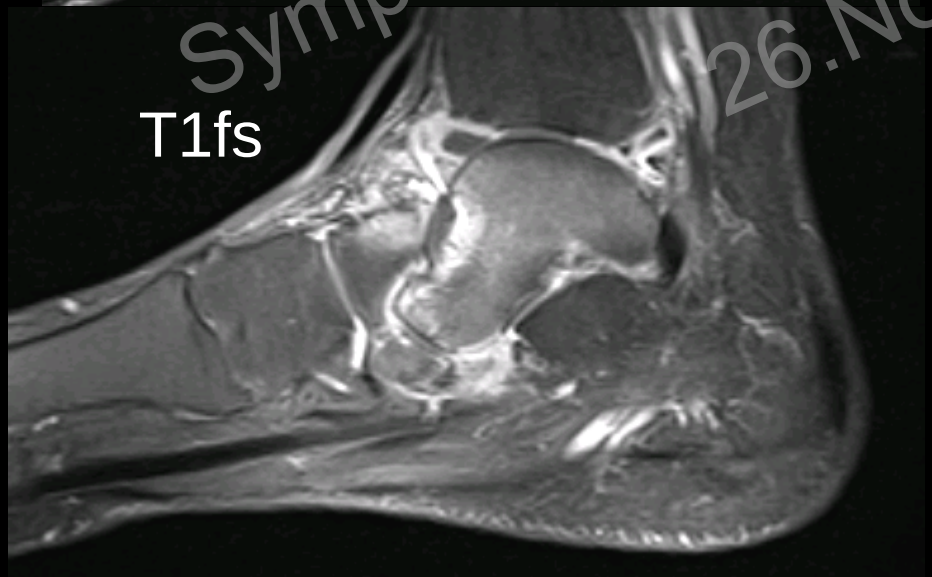


Ergen F et al.:Diabetic Foot & Ankle 2013, 4: 21884

Ledermann HP, Morrison WB: Semin Musculoskelet Radiol. 2005 Sep;9(3):272-83

Longstanding Charcot





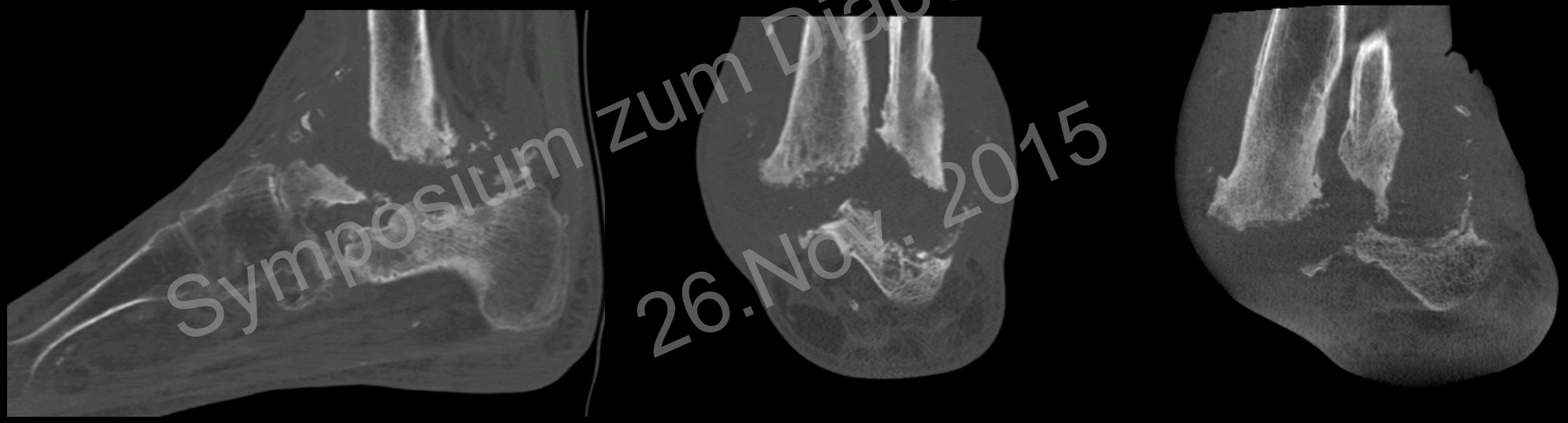
Case

58-year-old, male , IDDM Type I (26 years), polyneuropathy, left leg suddenly shorter

Case

58-year-old, male , IDDM Type I, polyneuropathy

CT

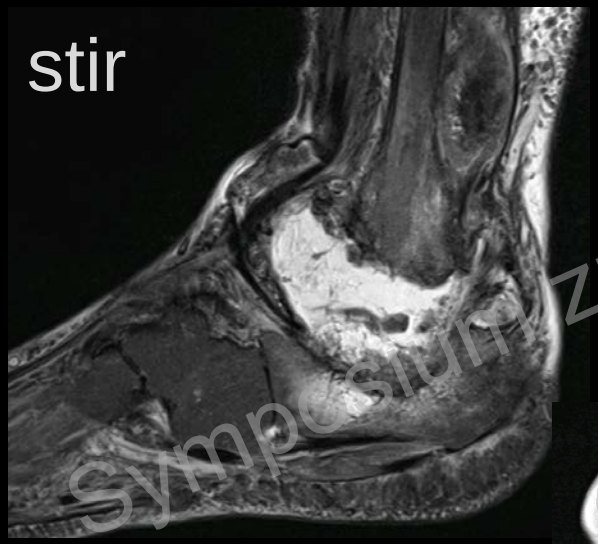


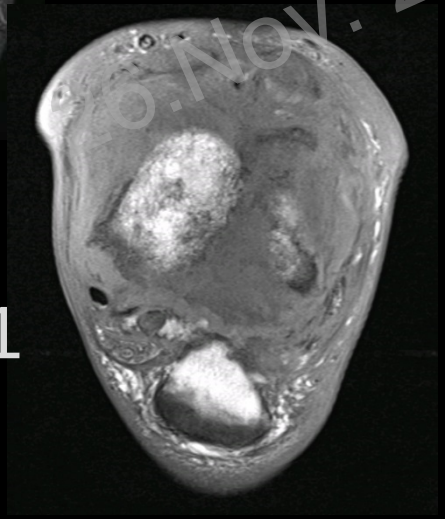
supine

standing

Case

58-year-old, male , IDDM Type I, polyneuropathy

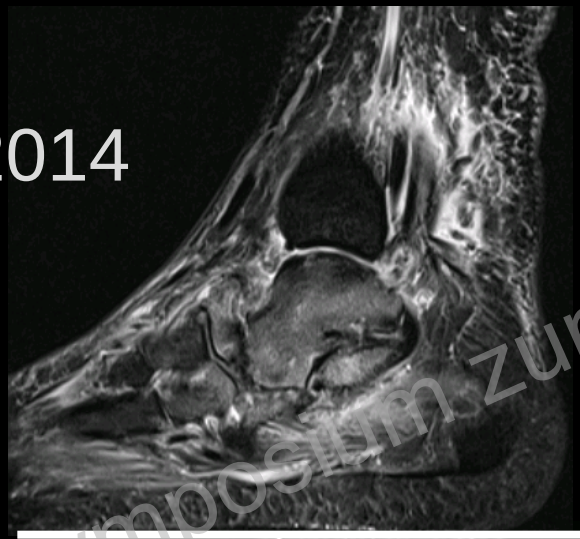




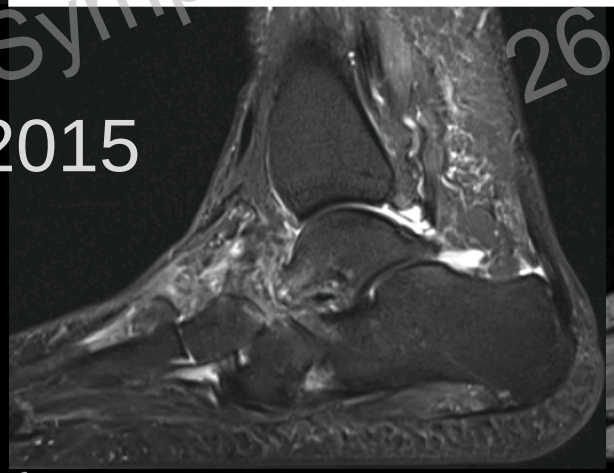
Benefit of MRI

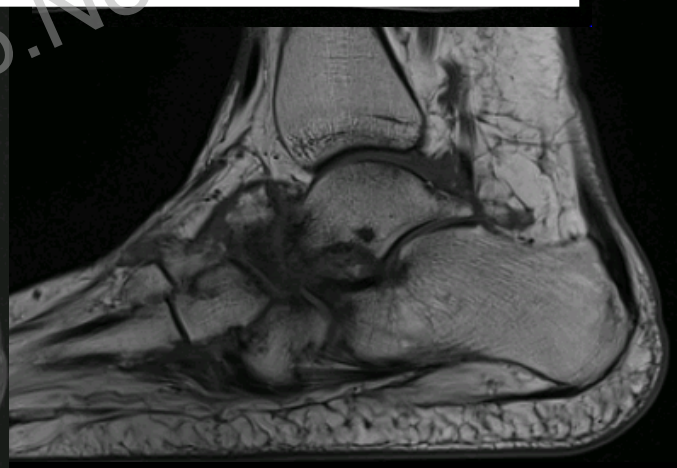
2. Monitoring: Active versus inactive disease

8/2014



3/2015





60-year old, female

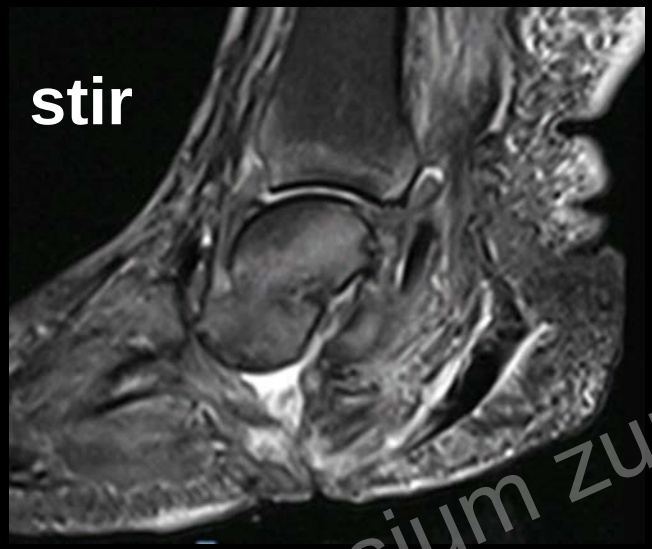
Benefit of MRI

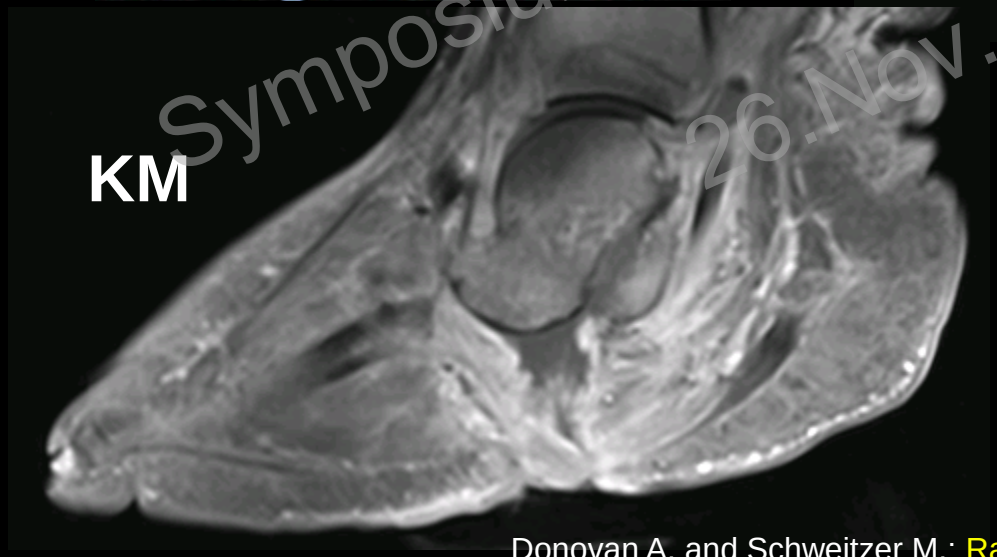
3. Complication: Infection/Osteomyelitis

- Infection by direct continuity
- Rocker bottom deformity
- Typical location: Cuboid bone

  (lowest part of foot)

Charcot with Osteomyelitis





- Loss of cysts
- Large fluid collections
- Progression of bone erosions
- «Ghost sign»

Donovan A. and Schweitzer M.: Radiographics 2010;30:723-736

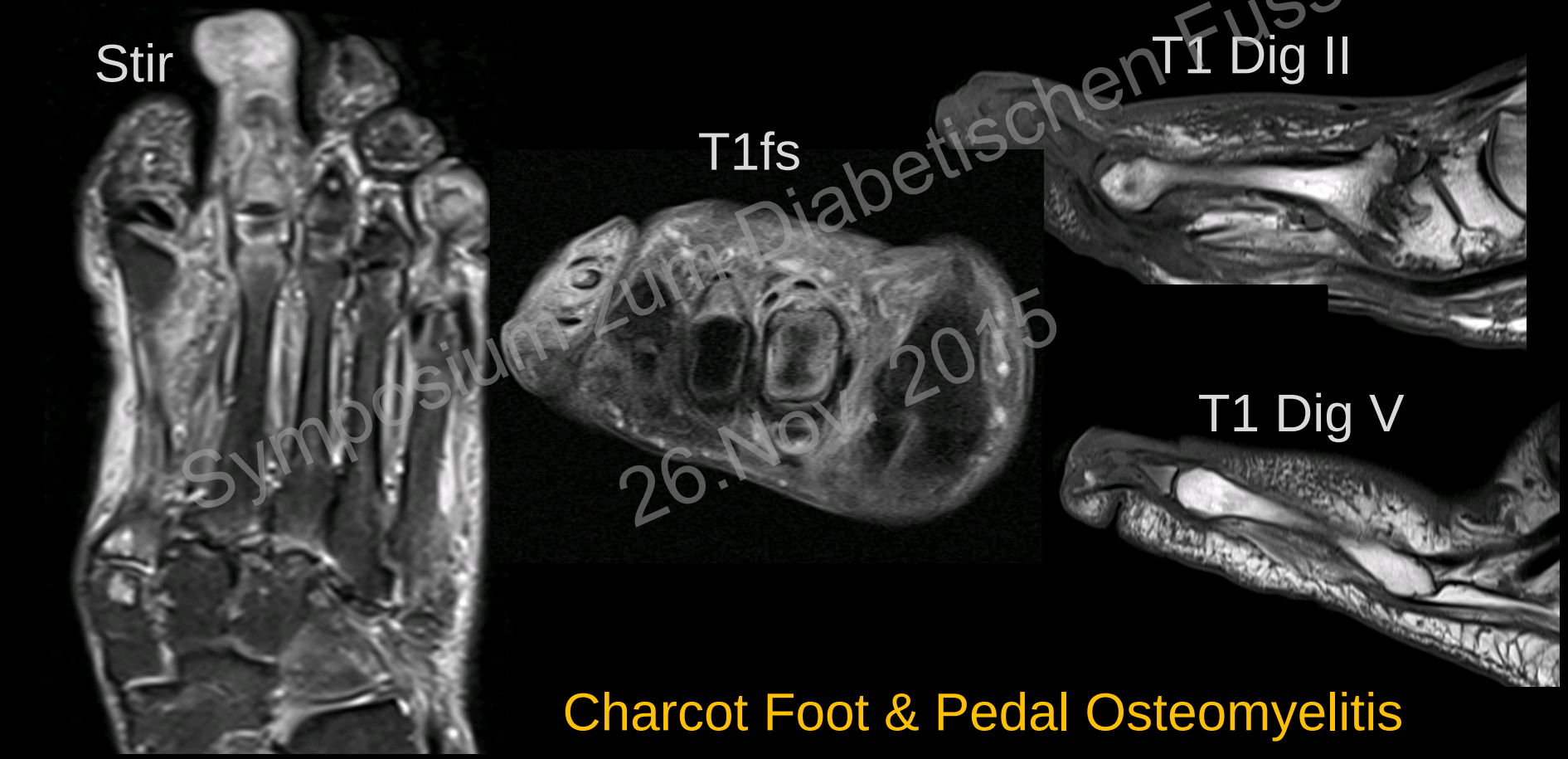
Toledano T. et al. Semin Musculoskeletal Radiol 2011; 15:257-268

Case

66-year-old, male – Charcot foot, IDDM Type II, new ulcus Dig II & V

Case

66-year-old, male – Charcot foot, new ulcus Dig II & V



Charcot Foot & Pedal Osteomyelitis

Summary

Pedal Osteomyelitis

- Plain radiographs and MRI for evaluation
- MRI: Confirm/exclude Diagnosis: Key sequence native T1
- MRI: Exact extent of infection in bone and soft tissue

Charcot Foot & Osteomyelitis:

- Plain radiographs & MRI for diagnosis & complications
- MRI: «ghost sign»

Thank you