The Role of MRI in Diagnosing Osteomyelitis

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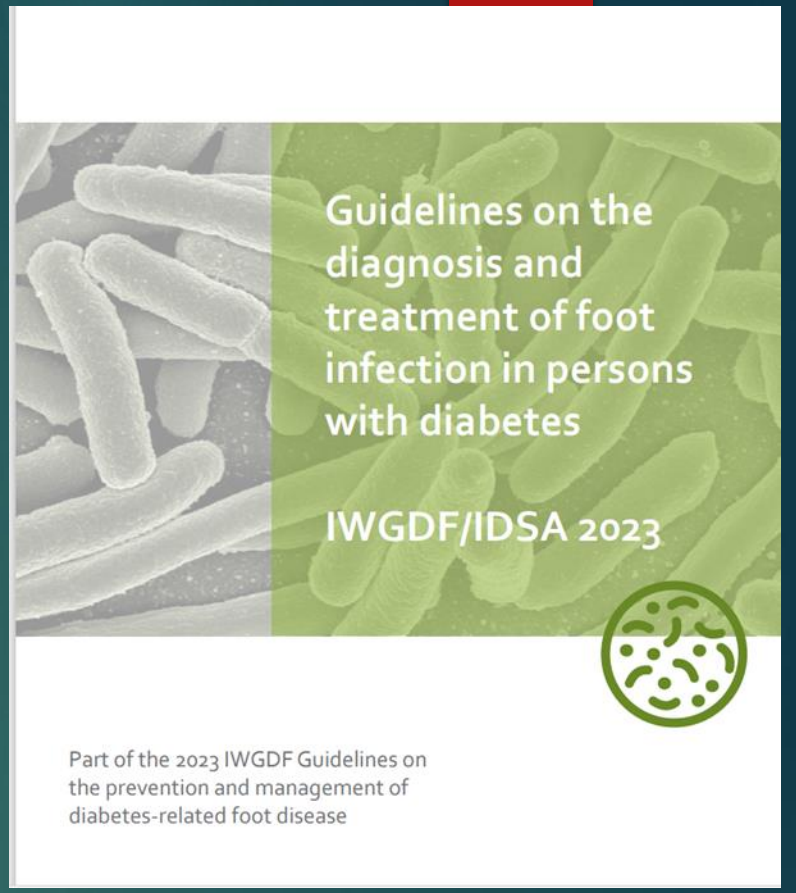
Rena Francis FRCPodS

Specialist Registrar in Podiatric Surgery

Derbyshire Community Health NHS Trust

Buxton Hospital

Evidence: IWGDF/IDSA 2023



Recommendation 7: In a person with diabetes, consider using a combination of probe-to-bone test, plain X-rays, and erythrocyte sedimentation rate, or C-reactive protein, or procalcitonin as the initial studies to diagnose osteomyelitis of the foot. (Conditional; Low)

Recommendation 8: Perform magnetic resonance imaging when the diagnosis of diabetes-related osteomyelitis of the foot remains in doubt despite clinical, plain X-rays and laboratory findings. (Strong; Moderate)

Evidence: NICE NG19 updated 2019

1.6.2 Consider an X-ray of the person's affected foot (or feet) to determine the extent of the diabetic foot problem. **[2015]**

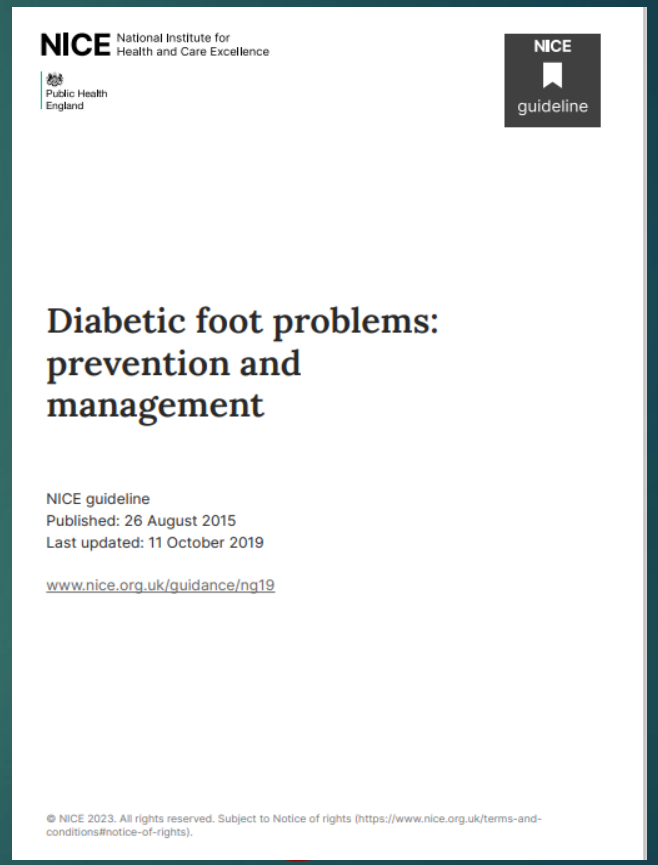
1.6.3 Think about osteomyelitis if the person with diabetes has a local infection, a deep foot wound or a chronic foot wound. **[2015]**

1.6.4 Be aware that osteomyelitis may be present in a person with diabetes despite normal inflammatory markers, X-rays or probe-to-bone testing. **[2015]**

1.6.5 If osteomyelitis is suspected in a person with diabetes but is not confirmed by initial X-ray, consider an MRI to confirm the diagnosis. **[2015]**

Treatment

1.6.6 Start antibiotic treatment for people with suspected diabetic foot infection as soon as possible. Take samples for microbiological testing before, or as close as possible to, the start of antibiotic treatment.



Rational for **STRONG** recommendation IWGDF

- MRI is most studied advanced imaging modality IWFDF 2023
- Lower cost than other advanced modalities IWGDF 2023
- MRI gives a good overview of the anatomy of soft tissues as well as bones and joints, aiding pre-operative evaluation of purulent collections or the extent of bone involvement. (Dinh et al 2009, Cohen et al 2009)


The End

Importance of the whole clinical picture

- Cannot solely rely on imaging for OM diagnosis
- Medical/medication history
- Level/stage of infection
- Wound evaluation/exposed bone
- Microbiology/wound biopsy/bone samples
- Haematology

- This is paramount to the patient's successful treatment

MRI

- Excellent soft tissue and bone contrast and multiplanar imaging capabilities (Harmer 2011)
- Precise anatomical detail of sequestra, sinus formation and abscess expansion useful for surgical planning (Harmer, 2011).
- It follows the path of an ulcer or sinus tract to the bone
- Readily available/low cost/no ionising radiation (Harmer 2011)
- Changes in bone marrow signal intensity as early as 3 days after the onset of infection (Lew, 2004)
- Sensitivity reported 77-100% for soft tissue and bone infection , Specificity is 67-96% (Tsang et al 2016, Kapoor et al 2007, Malcius et al, 2009, (Kocher et al, 2006, Conolley et al, 2002)
- Application of gadolinium on T1 w increases accuracy of OM to 89% (Morrison et, al 1995)

Other advantages

100% negative predictive value for excluding OM (Harmer, 2011) positive predictive is 70-80% (Enderle et al, 1991)

Supports antibiotic stewardship, no need for prolonged or unnecessary use of antimicrobials

-Resistance

-Liver and kidney issues

-Gastrointestinal effects

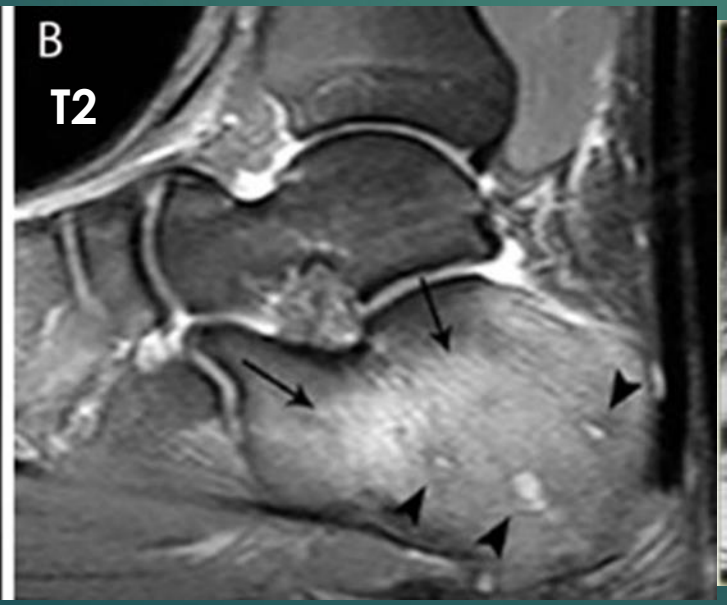
This is pertinent in the diabetic cohort where we see in the highest incident of OM who are at risk of nephropathy and gastroparesis

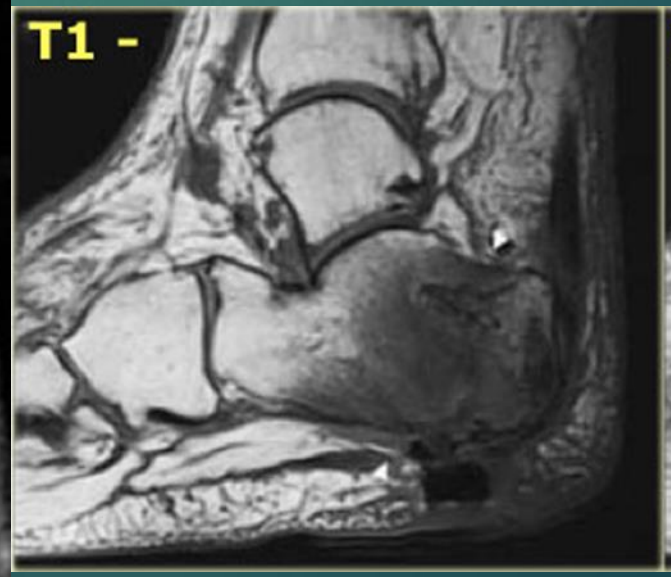
MRI features of acute OM

- Low signal intensity in marrow on T1 W and high signal intensity on T2 w images adjacent to an ulcer or sinus tract is primary sign of OM

(Pineda et al, 2011)

The "ghost sign" refers to poor definition of the margins of a bone on T1-weighted images, which become clear after contrast administration.





Plain film make a LOW recommendation IWGDF/IDSA

- Low sensitivity and specificity for detecting acute osteomyelitis, Subtle periosteal changes 5-7 days at risk of being missed through inter observer variability (Christman, 2015) Sensitivity 60% specificity 80% (Donovan, 2008)
- As many as 80% of patients who present in the first two weeks of infection onset will have a normal radiograph. (Jaramillo et al, 2011)
- Bone marrow oedema, which is the earliest pathological feature, is not visible on plain films (Pineda, 2011)
- Low accuracy results reported at 50-60%. (Hartemann-Heurtier, 2008)

- Poor soft tissue contrast and will not show abscess/sinus tract/purulence (Daneshvar, 2022)
- 10-14 days before bony changes become apparent in acute OM meaning crucial delay in dx leading adverse clinical outcome (Konstantinos , 2010; Hogan 2013)
- Boutine et al (1998) reported that radiographs were diagnostic in as few as 3-5% of culture positive cases of complicated OM

Hence

- Reliance on plain films leads to in delay in therapy as disease progresses and results in further osseous destruction
- It is unreliable in detecting early OM
- Limited place in limb salvage/preservation

MRI differentiation

- Contrast enhanced with gadolinium assesses extent of soft tissue disease, track ulcer or sinus to bone (Schweitzer et al, 2008)
- Ghost sign distinguishes acute neuroarthropathy from OM. The presence of ghost sign confirms OM and absence excludes OM. (Donovan, 2010)
- In Neuroarthropathy bone marrow oedema is primarily peri articular with no adjacent ulceration as pathology is joint centred. (Donovan, 2010)
- Metallic artefact/Flare suppression software addresses image distortion with orthopaedic hardware
- Newer MRI sequences

-MR angiography/neurography/ Dynamic contrast enhance may be better for distinguishing Charcot from OM

In conclusion MRI is KING

- MRI is the recommended imaging for early diagnosis and management of acute OM
- If you have a wound with positive clinical signs and biomarkers of infection but baseline plain films are inconclusive MRI should be requested
- With appropriate sequences/contrast material and flare suppression software It aids surgical planning for I&D and surgical debridement and may limit extent of resection (Durham et al 1991, Horowitz et al 1993)
- why wouldn't you?
- Its win win situation either positive or negative
- No brainer

- Thank you

References

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Lavery et al 2019
Xu et al 2021

- Recent two large retrospective single centred studies found
- ESR >60 mm/hr and CRP >80 had high positive predictive value for OM but modest negative
- ESR >45 mm/hr with positive Probe to Bone test (PTB) showed high correlation with having positive bone culture/histology result