



ORIGINAL ARTICLE

# Evaluation of diabetic foot osteomyelitis using probe to bone test and magnetic resonance imaging and their impact on surgical intervention



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## KEYWORDS

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**Abstract** *Objectives:* To evaluate the role of probe to bone test (PTB) and magnetic resonance imaging (MRI) in assessing the surgical intervention in diabetic foot.

*Study design:* 102 diabetic patients were included; 42 males and 60 females, mean age was  $52 \pm 6$ , all patients were subjected to PTB test followed by MRI, the presence of osteomyelitis was assessed in relation to histopathological examination.

*Results:* We had 80 (75.5%) feet of osteomyelitis, PTB test was true positive in 66 (82.5%), false negative in eight and false positive in 6 feet. MRI was true positive in 78, false positive in three and false negative in two feet. Other MRI finding include abscess in 37, tenosynovitis in 69, neuropathic changes in 20 feet, and all cases had cellulites. Sensitivity, specificity, PPV and NPV were 82.5%, 76.9%, 91.7%, and 58.8% for PTB test and 97.5%, 88.5%, 96.3% and 92% for MRI respectively.

*Conclusion:* PTB test is a simple, minimally invasive, low cost test and can be done at outpatient clinic. Its sensitivity and specificity are good when compared to those of MRI, but when we need to diagnose associated soft tissue infection and planning the surgical management MRI was the image of choice.

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## 1. Introduction

Diabetes is a complex disease, it affects various organs resulting in a group of related complications (1), approximately 15% of diabetic patients complain of foot complication, and about one fifth of those patients are being hospitalized (2).

Effective management of diabetic foot disorders is imperative, because delay in diagnosis or inadequate treatment can lead to serious complication such as loss of life or limb. Complications of diabetic foot problems account for from 50% to 60% of all non-traumatic foot or leg amputations, the majority of which are due to infectious complications (3).

The diagnosis of diabetic foot osteomyelitis is usually a challenge to the clinician and radiologist, the major diagnostic difficulty is to differentiate between bone infection and acute neuroarthropathic bone lesion (4).

The probe to bone (PTB) test has been used worldwide since its introduction for evaluating diabetic patients with a foot ulcer. Palpation of bone with a metal probe is a simple bedside technique, the diagnosis of osteomyelitis is based on the idea that if the probe can reach the bone, thus will the infectious bacteria (5).

Imaging plays the key part in the identification of diabetic foot soft tissue, bony, and articular complications, plain films and computed tomography (CT) scan supply helpful bony anatomic information, but their soft tissue detail is lacking, and their sensitivity and specificity for detecting infection are low, particularly within the early stages of infection (6). Bone scintigraphy is also sensitive but lacks specificity (7).

Magnetic resonance imaging is the most sensitive and most specific imaging technique for the diagnosis of osteomyelitis and provides excellent anatomic detail and additional accurate information on the extent of the infectious process and associated soft tissues' involvement (8).

The aim of this study to evaluate the efficacy of probe to bone test and MRI examination on the early diagnosis of osteomyelitis and its impact on surgical decision in patients with diabetic foot.

## 2. Research design and methods

This prospective study was performed during the period from September 2011 to October 2013, and included 108 diabetic patients complaining of foot infection, the patients were referred from the vascular surgery department and diabetic outpatient clinic in Zagazig university hospital, the inclusion criterion was the presence of foot ulcers associated with sign of infection in patient with normal plain X-ray (no radiological changes suggesting osteomyelitis), and the patients were scheduled for surgical management.

Exclusion criteria were patients with recurrent or long standing osteomyelitis with evident X-ray changes, ischemic foot ulcers (diagnosed by performing duplex ultrasound for all patients), minor abrasion or laceration, presence of contra-indication to surgery (hepatic or renal failure and ischemic heart disease) or MRI examination.

Foot ulcer was defined as a full thickness lesion involving any portion of the foot or ankle (9).

The study was approved by local ethics committee and a written consent was obtained for each patient.

### 2.1. Study design

The study was carried out on 102 diabetic patients (either type 1 or type 2); who completed the whole research, they were 60 (58.8%) females and 42 (41.2%) males, their age ranged from 21 to 74 (mean  $52 \pm 6$ ). The included patients were hospitalized and a written consent was obtained from each patients. The demographic data of the patients are shown in (Table 1).

All patients were subjected to full history taking (including treatment for diabetic control and any associated condition) and full clinical examination with routine laboratory investigation (CBC, liver and kidney function tests). The blood glucose level (fasting, 2H. postprandial and HBA1c) was estimated at the time of admission and preoperative diabetic control was done.

The patients were examined first by PTB test at the initial evaluation, followed by MRI examination of the affected foot, and then the patients were subjected to surgical interference according to the obtained finding.

### 2.2. PTB test

All PTB tests were conducted by an experienced surgeon using a sterile blunt metal probe, which passed gently through the depth of the wound in order to feel the bone. Test was considered positive when the probe palpating a hard or gritty substance that was presumed to be bone or joint space.

### 2.3. MRI examination

MRI was performed using 1.5-T superconductive magnet (Intera Achiva Nova Dual system, Philips Medical System, Best, the Netherlands), all patients were scanned by dedicated extremity coil, the patient is placed in supine position with feet first. The examined foot was positioned in the midline of the table, which corresponding to the center of the magnet.

Examination time was ranged from 20–30 min with the mean time being  $20 \pm 4$  min. The protocol included: fast spin-echo T1-weighted (FSE T1); 700/12 ms (repetition time/echo time); field of view, 15–20 cm; and matrix,  $256 \times 256$  and T2-weighted images with fat-saturation were obtained with the following parameters: fast spin-echo sequence with

**Table 1** Demographic data and symptoms at presentation of the patients.

Characteristics	Value	%
Sex (F:M)	60:42	58.8:41.2
Mean age (years)	$52 \pm 6$	
Mean duration of diabetes (years)	$18 \pm 2$	
Diabetes type		
Type 1	28	27.5
Type 2	74	72.5
Diabetic control medication		
Insulin	84	82.4
Oral medication	18	17.6
Duration of foot symptoms (days)	$5 \pm 4$ (3–15)	
Pain	22	21.6
Erythema	80	78.4
Purulent discharge	59	57.8
Fetid odor	73	71.5

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