Measure to make the difference – the role of tissue viability in managing the diabetic foot

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Diabetic foot ulcers (DFU)

- Over 15% of all diabetics get foot ulcers or wounds (DFU).
- DFU caused by neuropathy and or ischaemia.
- DFU result from trauma (mechanical, thermal, excess pressure insults).
- Healing is slow and variable.
- Recurrence is common.
- Mainstay of treatment for DNFU is offloading.
- Mainstay of treatment for ischaemic DFU is revascularisation.
- Wound care

Chronic wounds healing is slow and unpredictable

Lecomte & De Nouy 1916

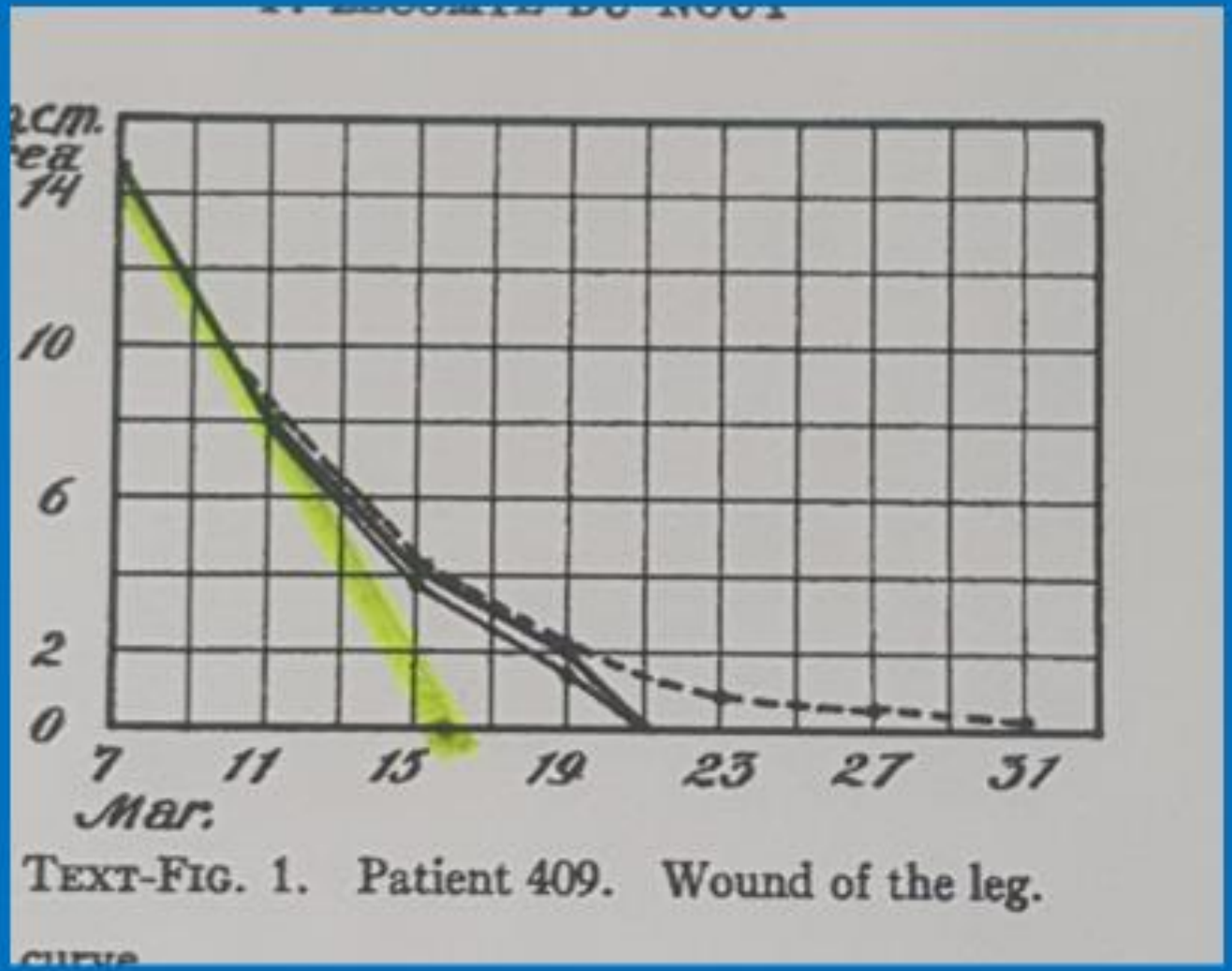
Figure shows actual reduction in wound area over 24 days of a single patient's wound (from war).

Note that healing occurs in 3 stages:

Rapid change (yellow highlight) over first 8 days

Slower over next 8 days

Very slowly to the end



TEXT-FIG. 1. Patient 409. Wound of the leg.

Wound Outcomes

- A ‘healed wound’ is generally accepted as the outcome for chronic wound studies. Mani R et al Int J Lower Extremity Wounds 2016; 15(2): 1-18.
- Technology-based evidence of healing may be derived from dimensional assessments of area/perimeter/axial length, and in the case of diabetic neuropathic wounds, volumes. Gellfand JM, Hoffstadt O, Margolis DJ. Surrogate end points for the treatment of venous leg ulcers. J Invest Dermatol 2002; 119: 1420-125.
- When measurements are fed back, this has positive influence on management. Kuird SK et al Wound Repair 2009; 17: 318-325.

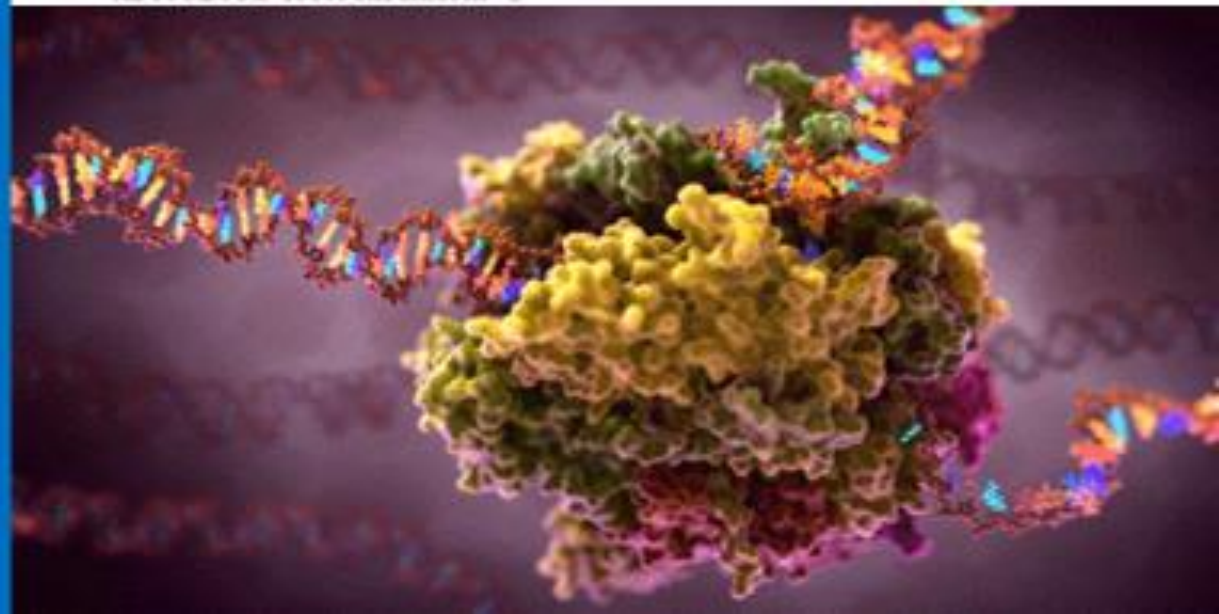
Small differences are difficult to characterise

A characteristic feature of chronic wounds is the variable nature of healing.

Measurements to diagnose

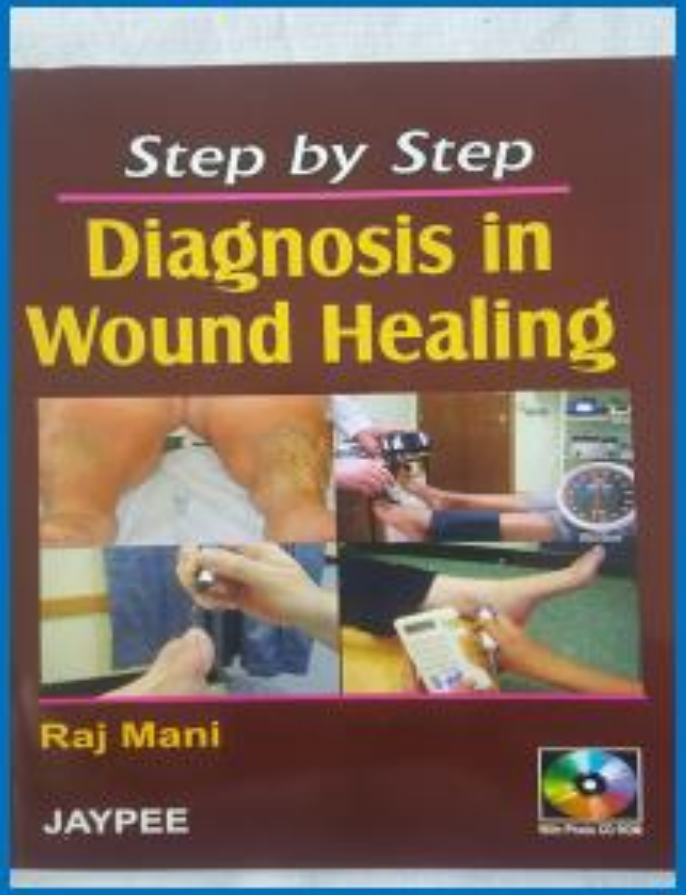
Measurements of outcomes

Measurements of complications



Measurements in DFU

- Diagnosis



- Semmes – Weinstein monofilament is a simple, effective tool to exclude neuropthy.
- ABPI
- Foot pressures were measured and have led to offloading devices being developed. Evidence continues to favour the use of total cast compression (TCC) though other irremovable devices are reported.

ABPI is recommended in major guidelines

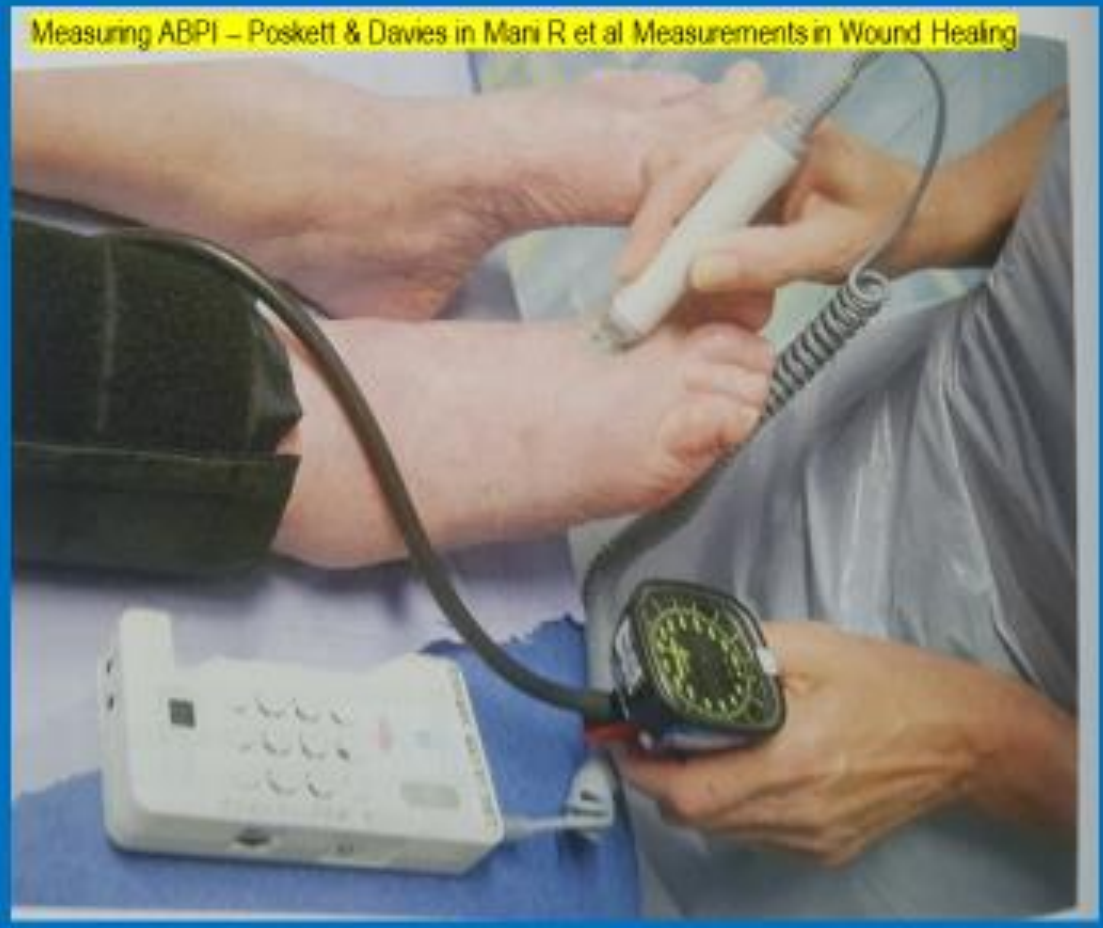
- Rooke TW, Hirsch AT et al. ACCF/AHA 2005 Guidelines for the management of peripheral arterial disease (update of 2005). J Am Coll 2011: 58; 2020-2045.
- Scottish Intercollegiate Guidelines 2010.
- Mani R et al IJLEW 2016; 15(2): 1-18.
- Rerkasem K, Kosachuhanun N, Sony K, Ipankaew N and Mani R . Under recognized peripheral arterial disease im patients with diabetes mellitus in Thailand. Int J Lower Extremity Wounds 2015; 14(2):6-10.

DFU management

- The mainstay of management is offloading (NDFU) and revascularisation.
- DFU is the most common cause of amputation.
- The level of amputation continues to present a difficult choice for surgeons.
- Advances in tissue viability measurements offer benefits. These include measurement of ankle systolic pressure, toe brachial index (TBI) and transcutaneous oxygen pressures.

Majority of Lower Extremity Wounds implicate the vascular system

- The measurement of ankle-brachial systolic pressure index permits easy, reliable diagnosis of arterial disease.
- >0.9 – 1.2 exclude arterial disease.
- <0.5-0.85 minimal to moderate arterial disease.
- <0.5 usually consistent with the presence of significant lower limb ischaemia.
- > 1.3 incompressible arteries? Watch word in diabetic patients. Aneurysmal disease

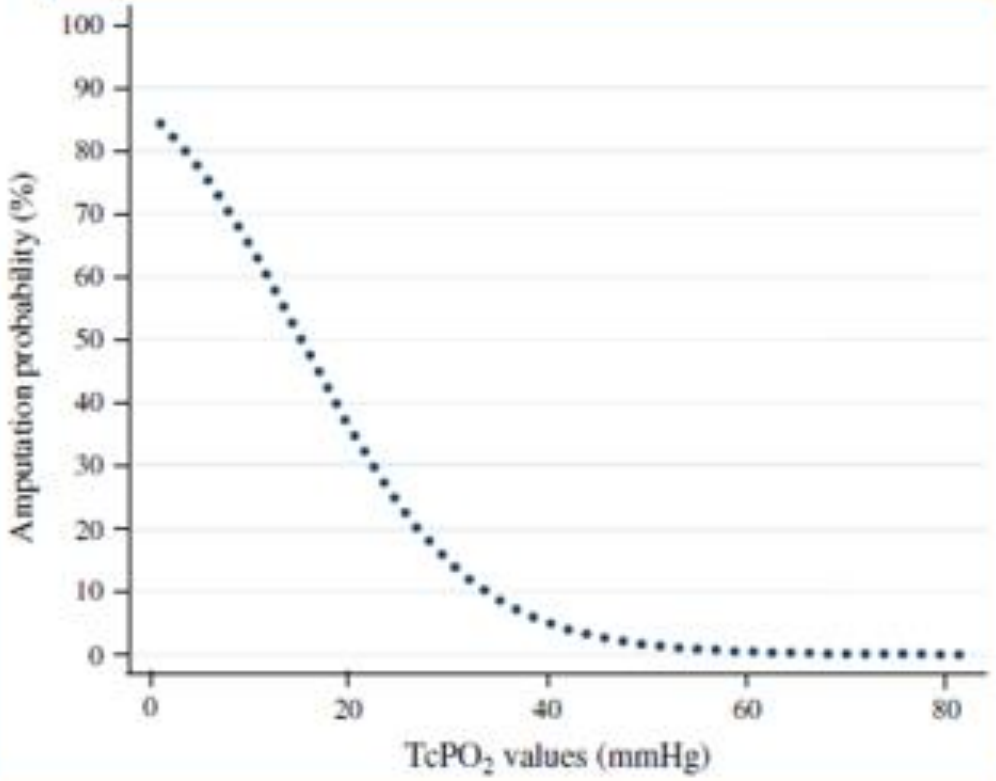


Measuring tissue viability

Figure 1：Transcutaneous oxygen tension (TCPO2)

a)

b)

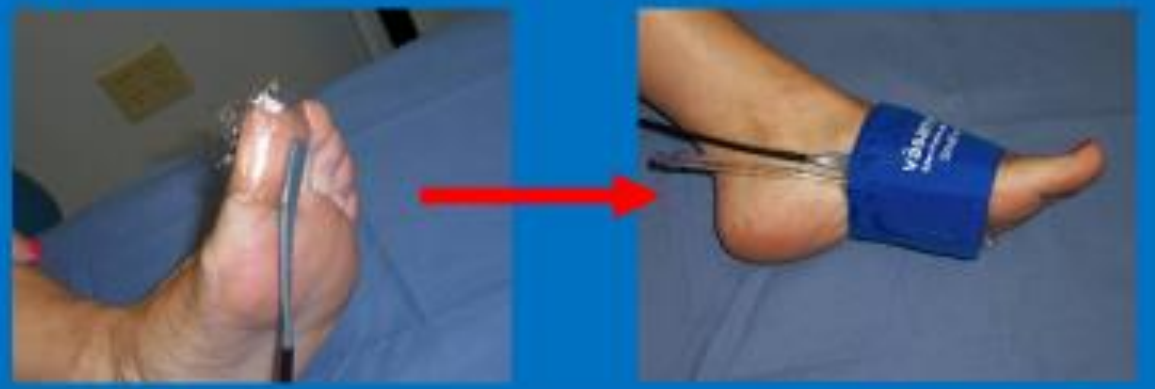


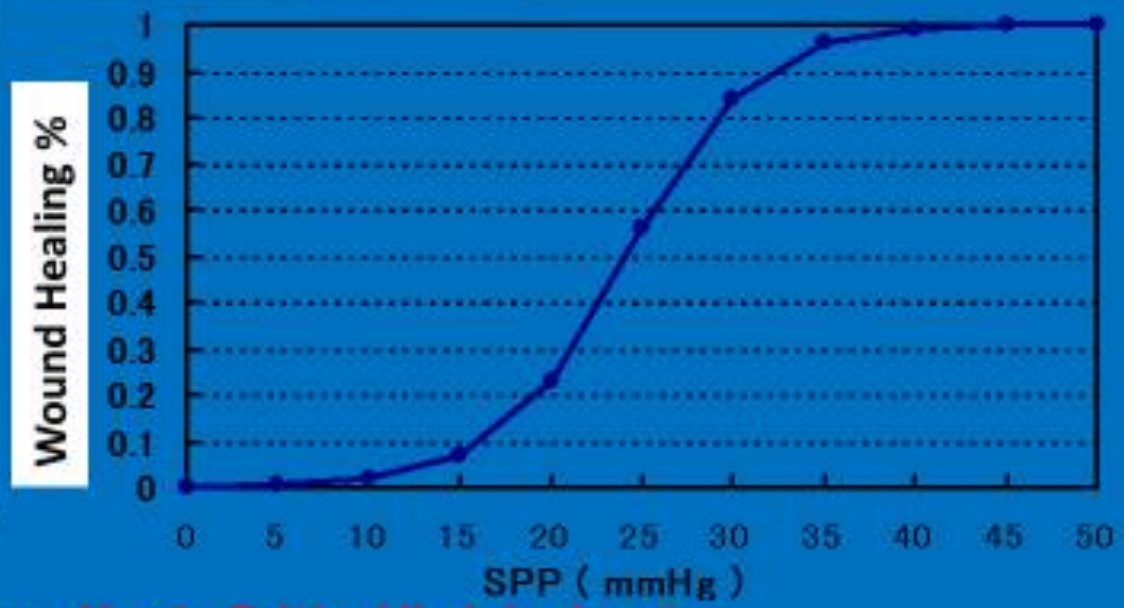
Faglia E et al. European journal of vascular and endovascular surgery : 2007;33:731-736

Figure 2 : Skin Perfusion Pressure (SPP)

a)

b)



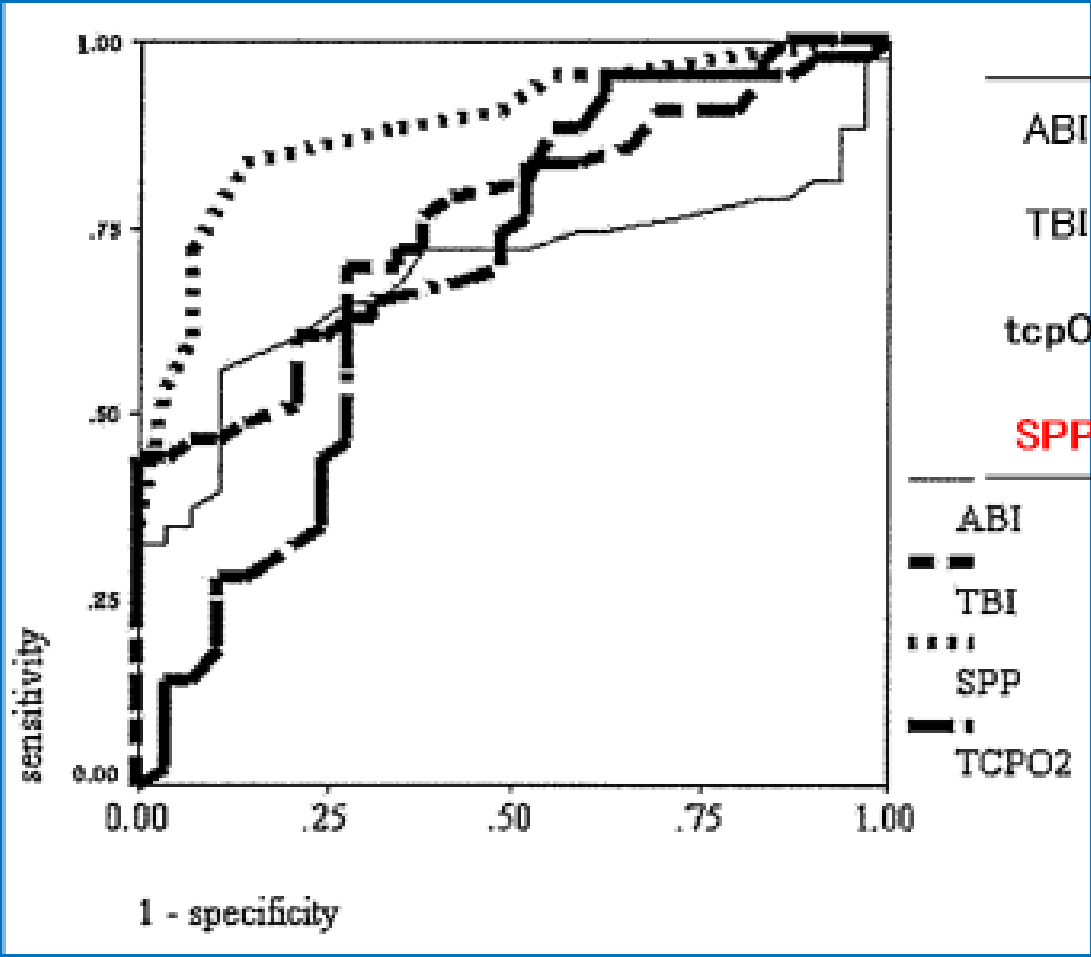


SPP ＜ 30 mmHg ： Critical limb ischemia

J. J. Castronuovo et al. J. Vasc. Surg., 1997, 26, 629–637

Figure 3: Comparison of clinical reliability of noninvasive diagnostic methods.

a)



b)

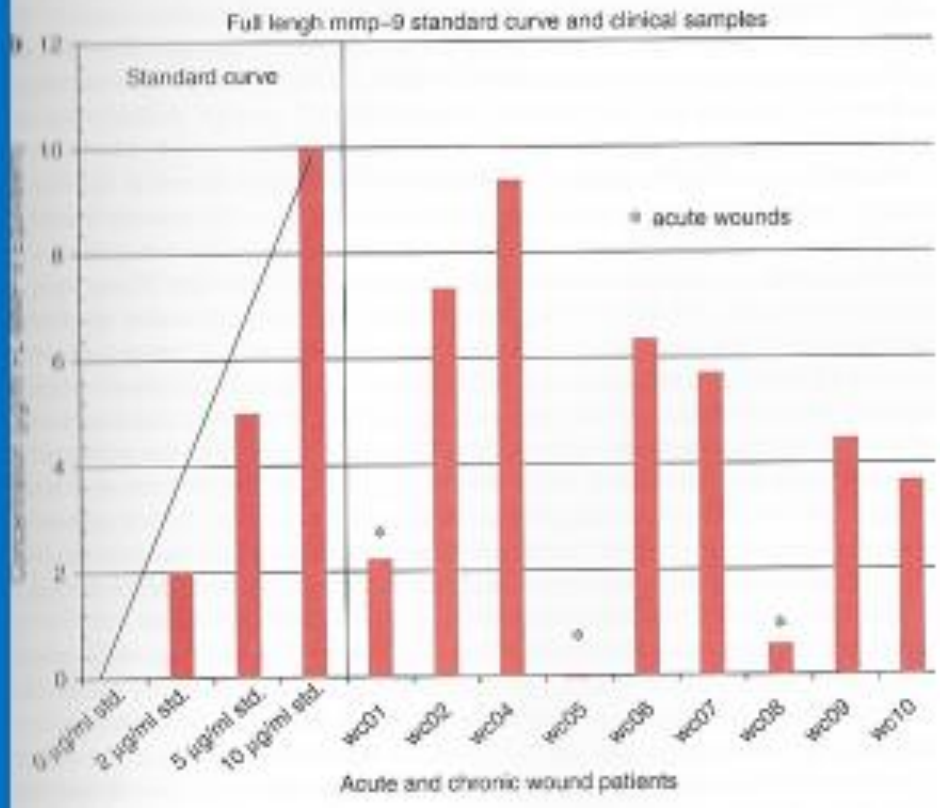
	Cut-off-value	Sensitivity (%)	Specificity (%)
ABI	0.9	29.9	100
TBI	0.6	45.2	100
$tcpO_2$	50	61.1	70
SPP	50	84.9	76.6

K. Okamoto et al.,Am J Kidney Dis. 2006 Aug;48(2):269-76.

Complications in chronic wounds

- Infection
- Exudate
- Singh K, Agrawal NK, Gupta SK, Singh K. A functional single nucleotide polymorphism -1562C>T in the matrix metalloproteinase-9 promoter is associated with type 2 diabetes and diabetic foot ulcers. Int J Low Extremity Wounds. 2013;12:199- 204. doi:10.1177/1534734613493289


Snap valve: releases buffer and
substrate solution to the swabbed sample.
Foil seal, separates
reaction chamber
Wound swab
Proteinase inhibitor to stop
reaction after specified time.


Full lengh mmp-9 standard curve and clinical samples
Standard curve
acute wounds
12
10
8
6
4
2
0
0 µg/ml std.
2 µg/ml std.
5 µg/ml std.
10 µg/ml std.
wc01
wc02
wc04
wc05
wc06
wc07
wc08
wc09
wc10
Acute and chronic wound patients

Small differences are difficult to characterise

A characteristic feature of chronic wounds is the variable nature of healing.

Measurements to diagnose

Measurements of outcomes

Measurements of complications