Pedal Acceleration Time (PAT)

Richard Rounsley, DMU (Vasc)

Jill Somerset, RVT, Peach Health, Washington, USA

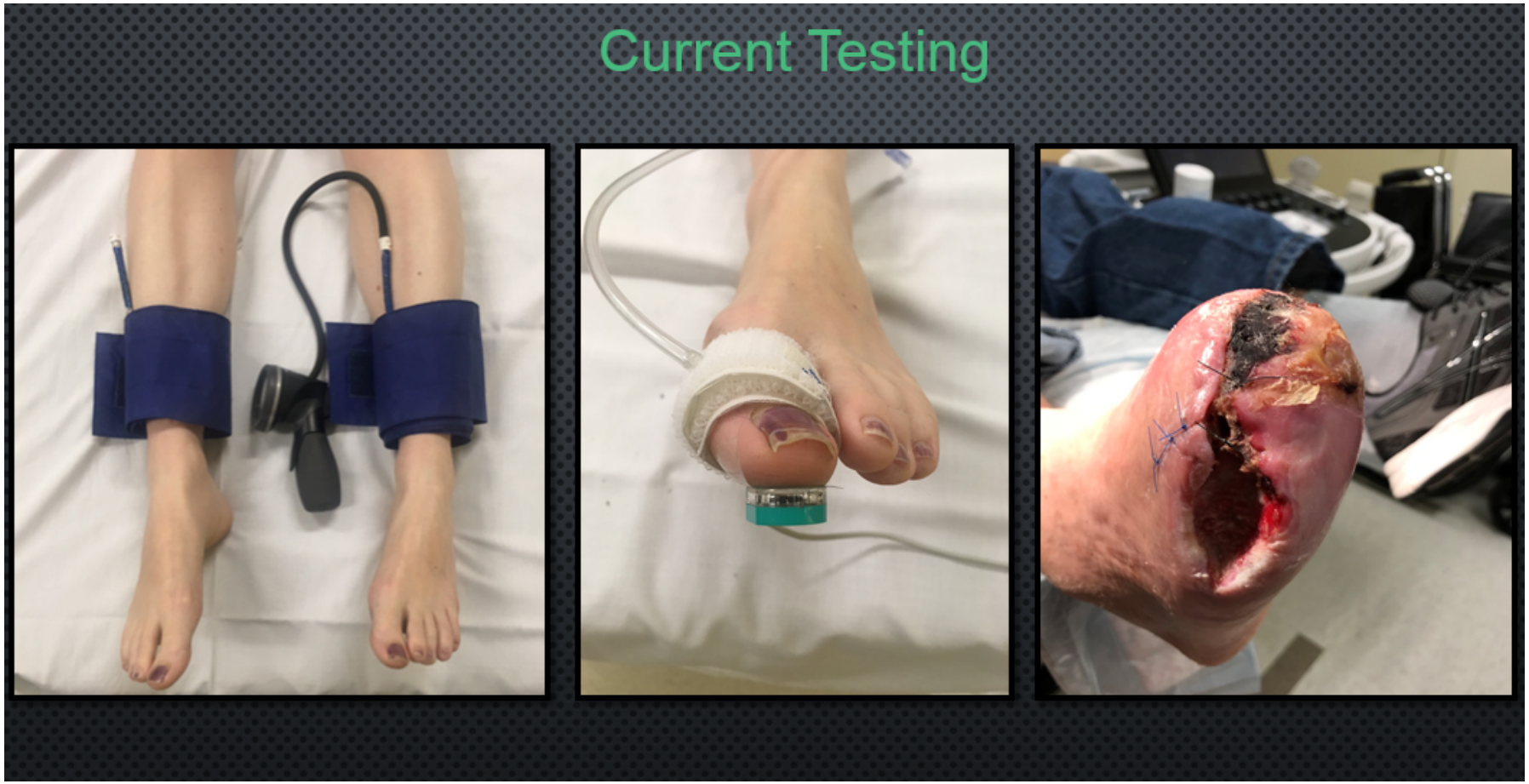
Dr Peta Tehan, PhD, University of Newcastle

Vascular HealthCare, Newcsatle

What is PAT?

- PAT – Pedal Acceleration Time
- Involves insonating the plantar arteries of the foot with Duplex Ultrasound (DUS) and measuring the acceleration time to predict wound healing and perfusion.
- Acceleration Time (AT) is time from beginning to peak of Systole on Doppler waveform. Long term application in renal arteries. Measured in milliseconds.
- Offers an alternative approach that directly studies the angiosome supply of the foot.[1]

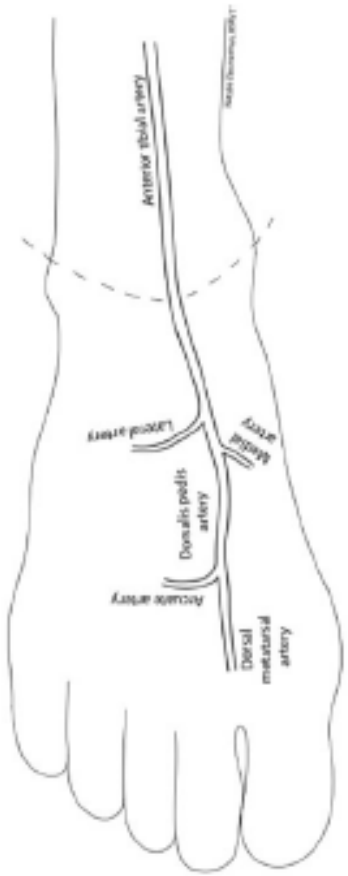
Why perform PAT?



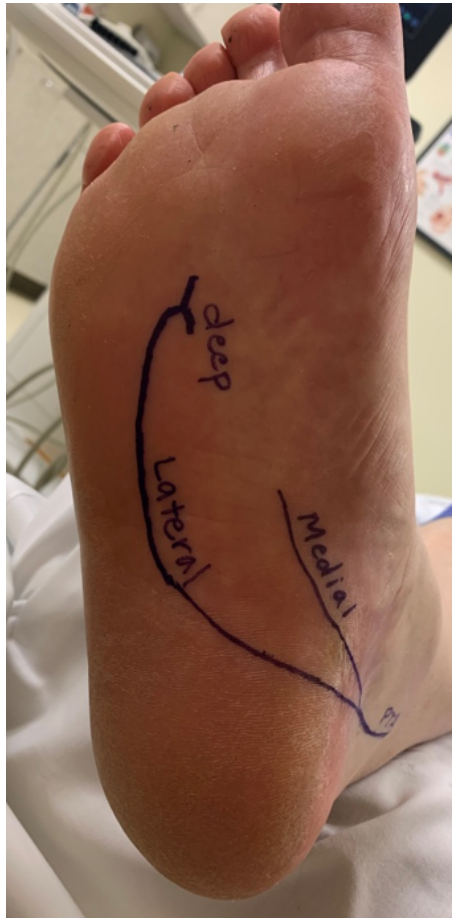
Why perform PAT?

- Indications for performing PAT include claudication, rest pain, non-healing ischaemic ulcers, diabetic patients with erroneous ABIs (Ankle-Brachial Indices) and TPs (Toe pressures), and reviewing arterial status of venous patients for suitability for compression.[3]
- Based on research so far by Jill Sommerset and colleagues, PAT appears to be a reliable adjunct to calf artery DUS, ABI and TP in patients with erroneous ABIs and TPs due to arterial calcification - especially diabetics. [1]

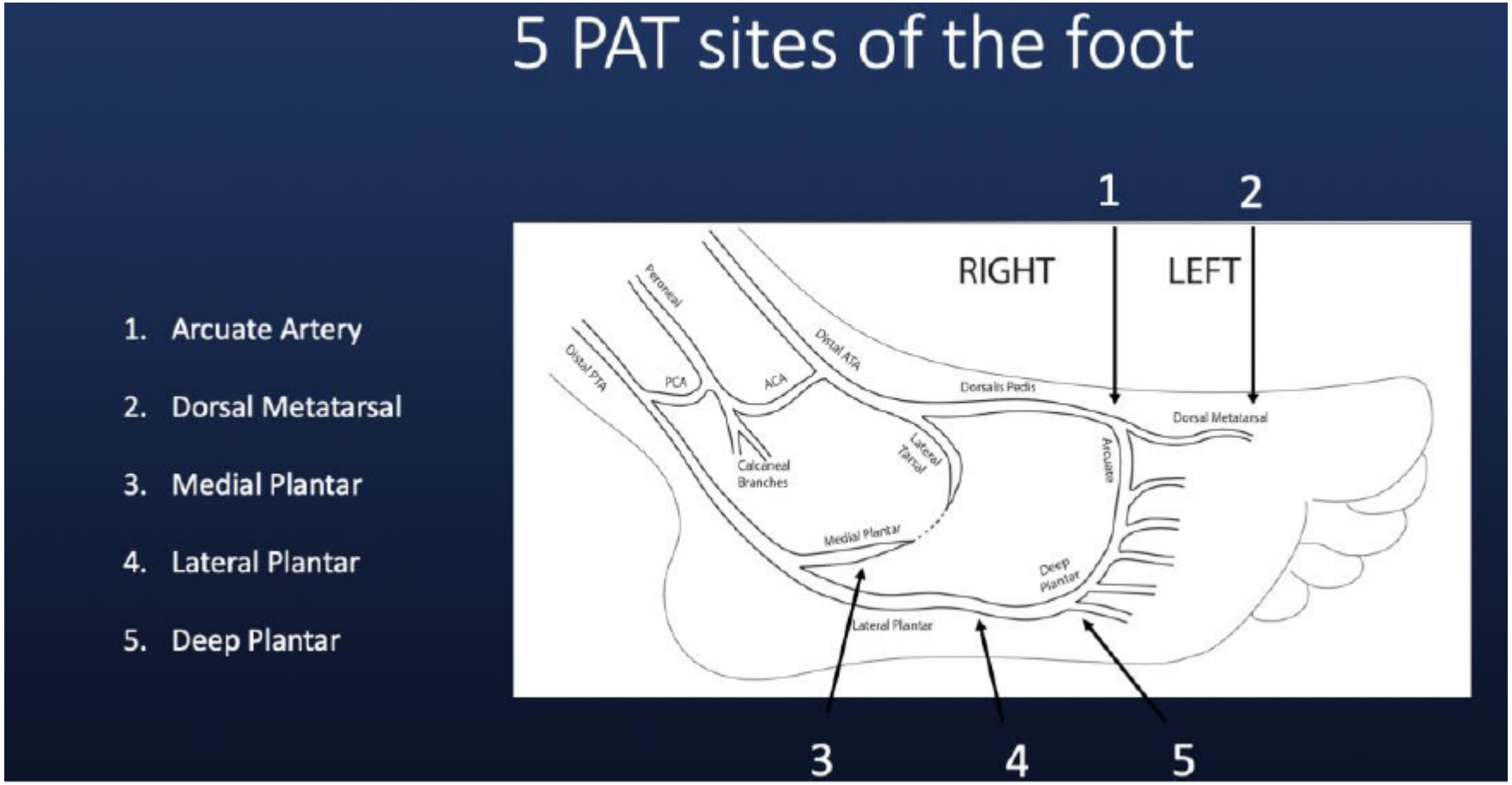
Anatomy – Dorsal Surface of Foot



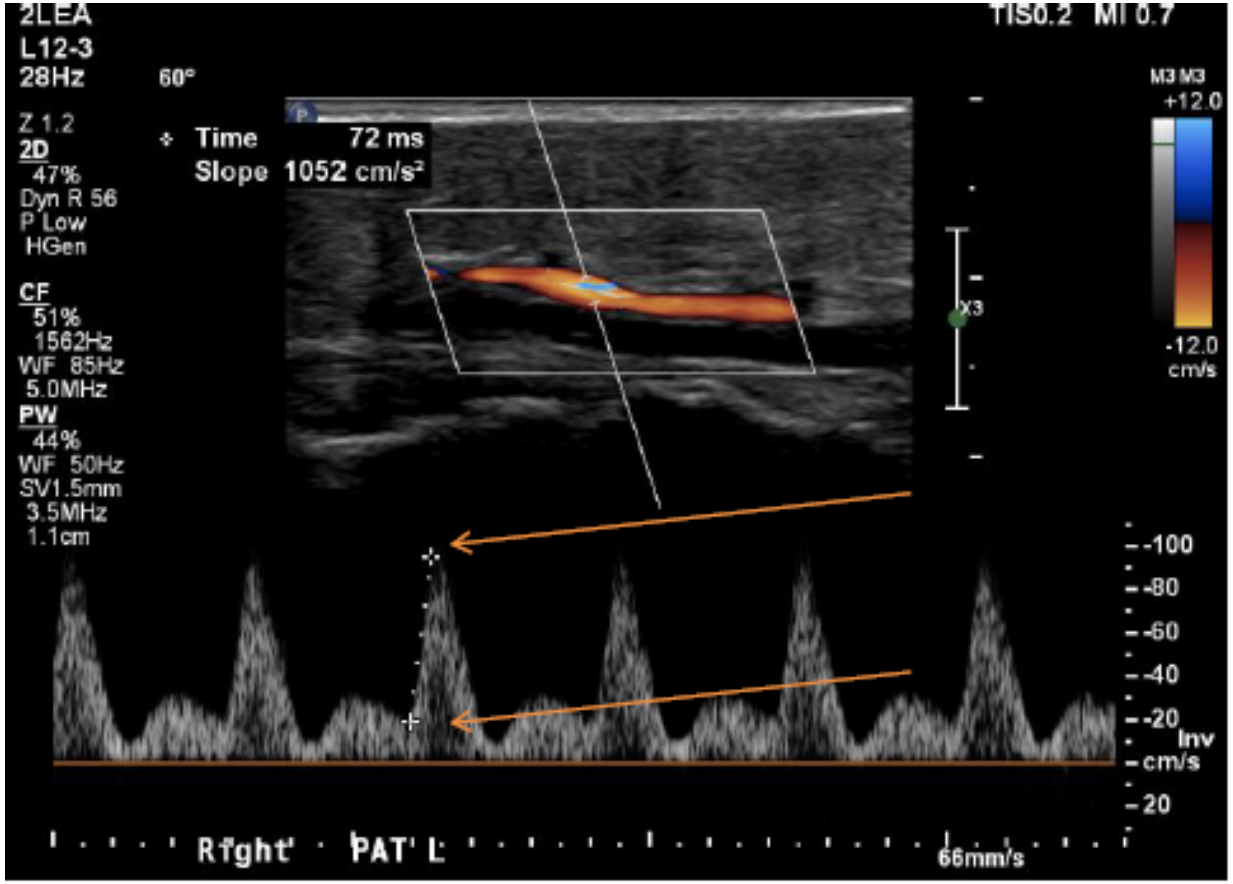
Anatomy – Plantar Surface of Foot



Examination protocol – sites of sampling



Measuring Acceleration Time



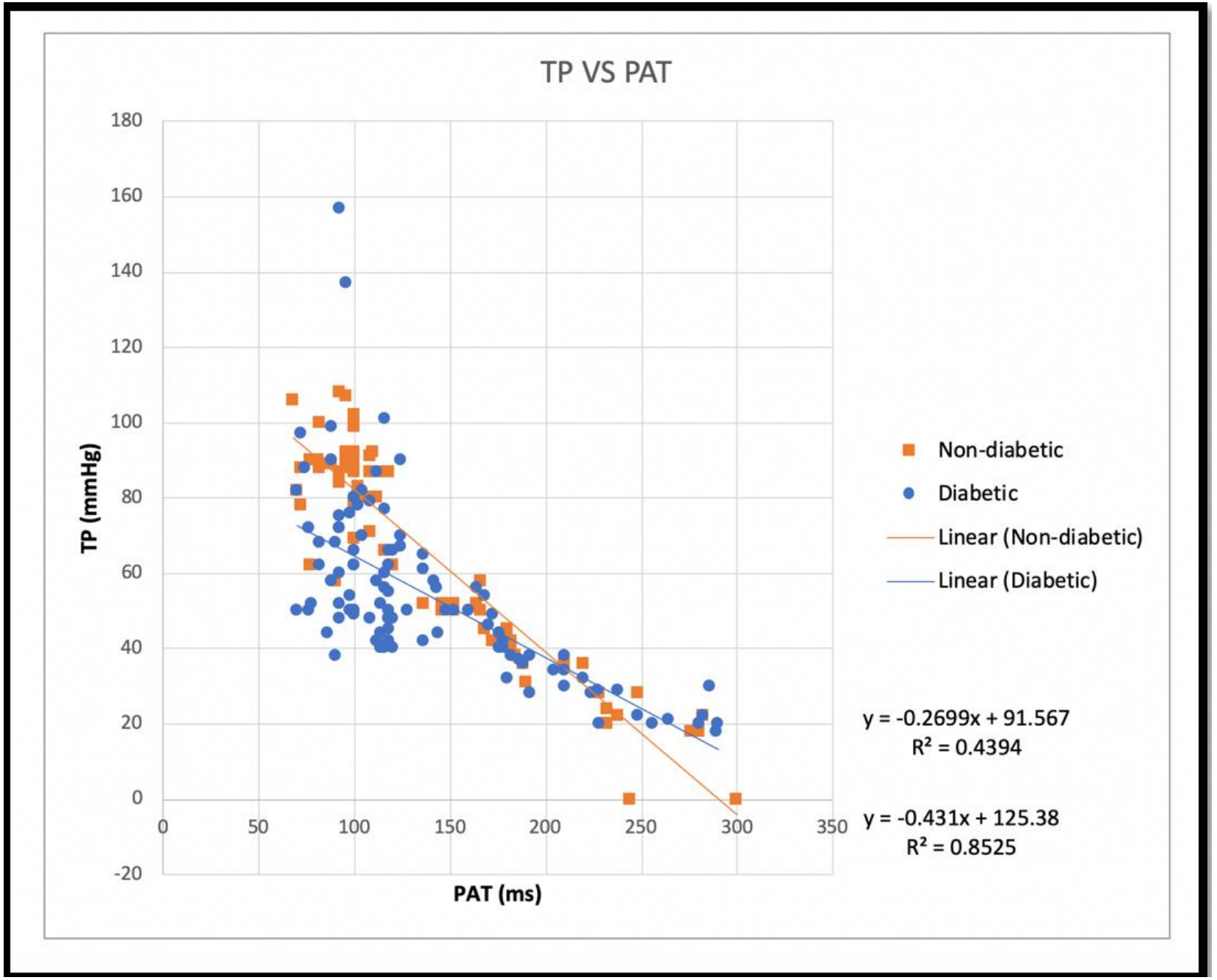
- From beginning of systole (upstroke) to peak of systole.
- Flatter the curve, longer the AT.

Reference Ranges

	No Ischemia Class 1	Mild Ischemia Class 2	Moderate Ischemia Class 3	Severe Ischemia Class 4
Clinical Symptoms	Asymptomatic	> 2 blocks claudication	< 2 blocks claudication	Limb Ischemia (Tissue loss, rest pain)
PAT	20-120ms	121-180ms	181-224ms	Greater than 225ms
ABI	1.3 – 0.90	0.89 – 0.69	0.68 – 0.50	0.49 – 0.00

Aim of Study

- Primary Aims
  - To determine diagnostic accuracy of PAT for identifying PAD and CLTI, and further refine reference ranges
  - Explore different interpretations of PAT (using 5 sites, vs 1 site)
- Secondary aims
  - To further establish the predictive capacity of PAT for outcomes including wound healing and amputation
  - To further explore the correlation between other non-invasive tests (ABI, TBI, TP) and PAT
  - Ascertain the prevalence of pedal disease in a cross section of people with suspected PAD/CLTI, and explore the impact of pedal disease on TP/TBI values
  - Determine the impact of diabetes on the accuracy of PAT


TP VS PAT
TP (mmHg)
PAT (ms)
180
160
140
120
100
80
60
40
20
0
-20
0
50
100
150
200
250
300
350
Non-diabetic
Diabetic
Linear (Non-diabetic)
Linear (Diabetic)
y = -0.2699x + 91.567
R² = 0.4394
y = -0.431x + 125.38
R² = 0.8525

Our Study[4]

Inclusion:
- participants 50 years and over who have diabetes and/or who currently smoke cigarettes
- participants 65 years and over
- participants with suspected peripheral arterial disease (referred by their general practitioner)
- participants with active foot ulceration
- participants with signs or symptoms of peripheral arterial disease

Exclusion:
- participants with known vasospastic disorders or connective tissue disorders such as scleroderma or Raynuad's phenomenon
- participants who have undergone bilateral mastectomy preventing any brachial blood pressure measurement
- known allergy to coupling gel
- inability to lie still for up to 60 minutes

Protocol[4]

- 2 sonographers.
- Sonographer 1 performs DUS (AIF), ABI and TP.
  - 75-90 minutes
- Sonographer 2 performs PAT (1 foot)
  - 30 minutes
  - Blind to DUS findings

Example Case[1]

Table 1. PAT Criteria.

	No ischemia	Mild ischemia	Moderate ischemia	Severe ischemia
	Category 1	Category 2	Category 3	Category 4
Clinical symptoms	Asymptomic	>2 block claudication	<2 block claudication	Critical Limb Ischemia (Tissue loss, Rest Pain)
Pedal acceleration time	20-120 ms	121-180 ms	181-224 ms	Greater than 225 ms
Ankle-brachial index	1.3-0.90	0.89-0.69	0.68-0.50	0.49-0.00

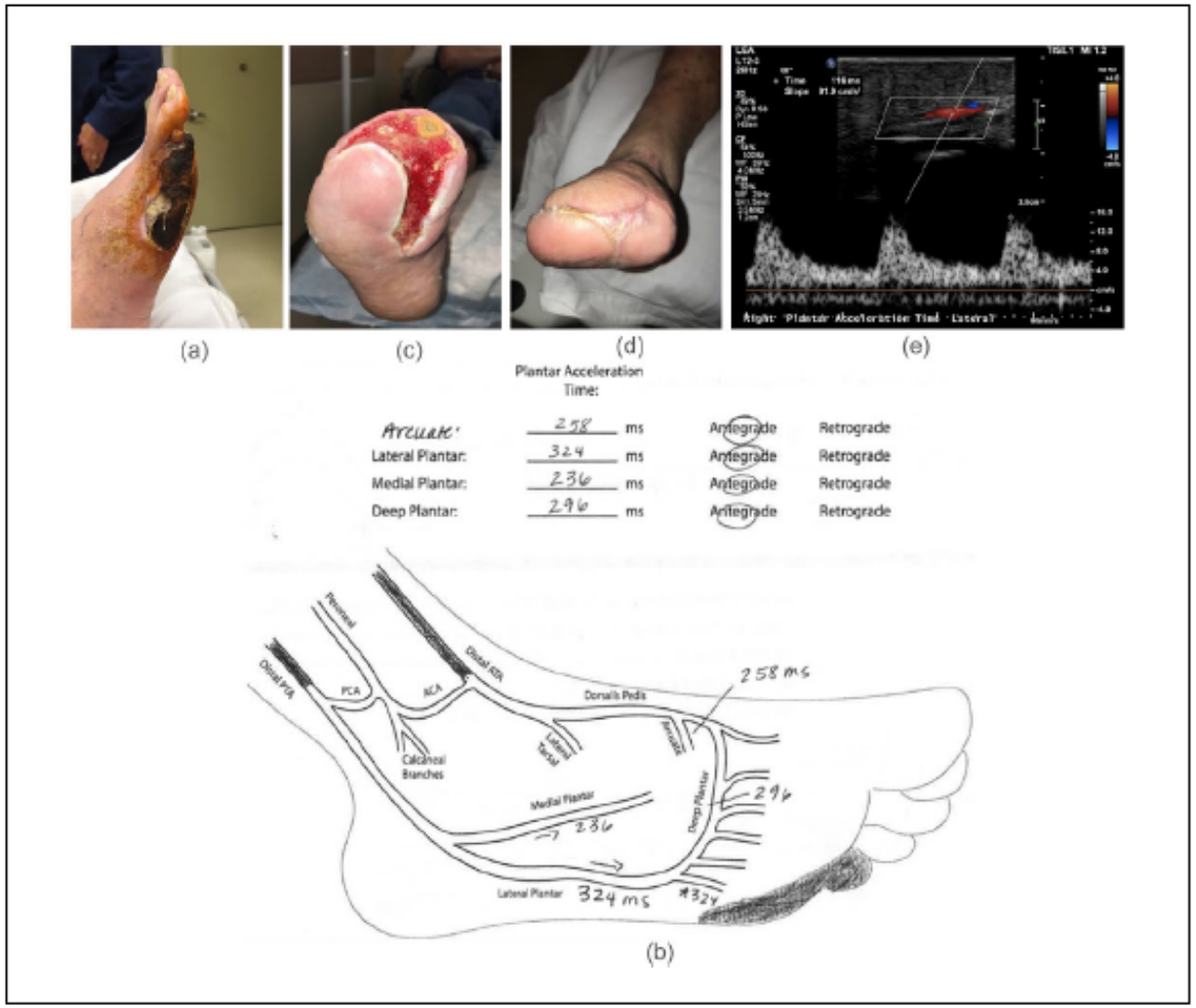


Figure 10. Illustrative case.

References

- 1. Somersett J, et al. Innovative Arterial Duplex Examination: A Guide to Evaluate Flow in the Foot Using Pedal Acceleration Time. J. Vasc. Surg. 2019; 43(1) 11-17.
- 2.PAT Tech Lecture, Somersett, Peace Health Group, Oregon, USA.
- 3. Pedal Artery Duplex method, Peace Health Group, Oregon, USA.
- 4. Vascular Healthcare Ultrasound PAT protocol.