


The Peripheral Artery Disease through the Thermogram and the Photoplethysmogram Before and After a Revascularization Surgery

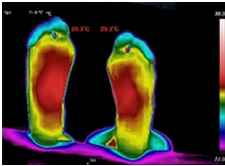


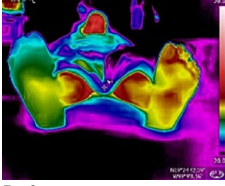
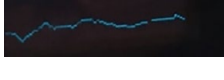
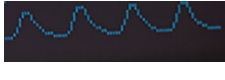
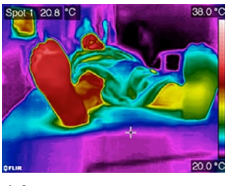

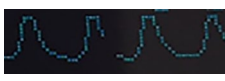
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Keywords

peripheral artery disease, angiosome, thermogram, photoplethysmogram

Table 1. The Thermograms and the PPG Signals of (a) Healthy Female Individual, 55 years old, No Signs of Symptoms of PAD, and a Female Patient, 66 years old, with T2DM Established 18 years ago, (b) The Day Before, and (c) After the Revascularization Surgery.

	Thermogram	$T_{(ang)}$ (°C) right foot	$T_{(ang)}$ (°C) left foot	PPG right	PPG left
a)		29.3	29.2		
b)	 Before surgery	24.7	26.0		
c)	 After surgery	30.7	25.3		

The thermography of the plantar skin has been used to assess the feet complications of the patient with Type 2 Diabetes Mellitus, T2DM,¹⁻³ particularly, for the follow up of the treatments of the Peripheral Artery Diseases, PAD.⁴ Furthermore, the photoplethysmogram (PPG), may be used to observe the blood flow on the toes.⁵ Then, as a complement to these results, in this communication, the thermograms and the PPG of a female patient with T2DM, at the before and after revascularization surgery were compared with those of a female with no signs neither symptoms of PAD.

The thermograms, acquired with a Flir® E6 thermal camera, were used to quantify the average temperature of the

angiosomes⁶ of the foot (T_{ang}). While, the PPG were photographed from the screen of an Hergon® pulse oximeter, located on the second toe of the assessed foot. Since the

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thermography is totally not-invasive, and, the pulse oximeter is almost zero invasive, at the time of the data acquisition (ie, thermograms and PPG photograph), the consent was obtained verbally.

The results are resumed in the Table 1, firstly, the row (a) shows the thermogram of the plantar skin and the PPG of the healthy individual. The thermogram showed the gradual decrement of the temperature, from the middle arc to the toes and the heel. The *Tang* were 29.2°C and 29.3°C for the right and left foot, respectively. The PPG, for the second toe of each foot showed the rhythmic slopes (abrupt up and down smooth), and the same number of peaks. In the row (b), the thermograms and the PPGs are from the female patient with T2DM at the day before a revascularization surgery, the *Tang* difference, between the feet, is just 1.3°C, the PPG is almost flat in the affected foot and normal in the other one. Finally, after the revascularization surgery, the row (c) shows that, the *Tang* difference, between the feet, is 5.4°C and the PPGs are normal for both toes.

The findings presented here, even when they come from very specific PAD events, show objective and relevant information for the health professional, that is, as the protocol to get a thermogram requires that the patient lay down, for 10 to 15 minutes, and a little of thermal stress the feet, hence, this technique provides information about the central nervous and the peripheral vascular system.² Furthermore, the PPG provides, specifically, evidence about the blood passing through the toes, very useful in the PAD. Thus, the evolution of the PAD can be assessed and followed up by these subclinical parameters (temperature distribution, the *Tang* and the form of the PPG). The main advantages of these techniques are, (1) qualitative, by knowing the temperature distribution and the form of the PPG, (2) quantitative, by the computation of the *Tang*, (3) no human-dependent.

Abbreviations

PAD, peripheral artery disease; PPG, photoplethysmogram; T2DM: type 2 diabetes mellitus.

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Declaration of Conflicting Interests

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