# Methods and systems for assessing peripheral arterial function

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## Technology description

Overview

PAGE SUMMARY

Microcirculation is essential for the proper supply of oxygen and nutritive substances to the biological tissue and the removal of waste products of metabolism. The determination of microcirculatory blood flow (mBF) is therefore of great interest to clinicians for assessing the tissue health, particularly for peripheral arterial disease (PAD), pressure ulceration, and wound healing. Unfortunately, currently there are no methods for assessing blood circulation in these tissues directly. Optical technologies such as Laser Doppler and Laser Speckle Contrast Analysis (LASCA) are capable of measuring microcirculatory blood flow, but only at superficial depths of less than 1 millimeter. Ultrasound can be used to measure blood flow in deep tissue, but typically only in large vessels.

Drexel University engineers and clinicians have developed a method and a non-invasive imaging device for assessing PAD, deep-tissue pressure ulceration and wound healing directly by measuring microcirculatory blood flow at depths of up to 1 cm using Diffuse Correlation Spectroscopy (DCS). DCS is a unique methodology for measuring the diffusion coefficient (Db) of red blood cells circulating through tissue, which optically is a multiple scattering environment. The diffusion coefficient calculated with DCS is used to determine a quantitative blood flow index (BFI) that represents mBF. DCS measurements can be obtained from tissue depths of up to 1 centimeter, completed in ~30 seconds, and do not require professional ultrasonographer like ABI measurements. The ease and low cost of DCS measurements may enable routine screening for early detection of PAD and pressure ulcers in high-risk patient populations.

The standard method for diagnosing PAD is measurement of the Ankle Brachial Index (ABI), which is defined as the ratio of blood pressures assessed at the ankle (along the femoral and popliteal arteries) to the blood pressure measured along the brachial artery on the arm. ABI is typically measured as part of a segmental compression arterial examination with ultrasound, which is a 1-hour procedure performed by a professional sonographer in a vascular lab. ABI can be measured in general practitioners’ offices, but takes ~15 minutes, is dependent on the experience of the operator, and often does not correlate with ABI measurements obtained from vascular labs. ABI is not routinely measured in patients who are asymptomatic of PAD, perhaps because of the cost and complexity of the test procedure. However, one study found that only 9% of patients with abnormal ABI reported

intermittent claudication (the most common symptom of ABI). Early detection of PAD, before clinical symptoms appear, would be valuable because the disease progression can be slowed in many cases by changes in lifestyle (diet, smoking cessation) and careful management of cholesterol and hypertension. Another issue with the calculation of ABI is that the segmental compression arterial examination is contraindicated in patients whose peripheral arteries have calcified and are not compressible. Arterial calcification is very common among diabetic patients, and studies have shown that ABI measurements in diabetic patients may be misleading because their arteries are less compressible than normal arteries. However, monitoring ischemia in diabetic limbs is critical because it often leads to ulceration and amputation. Therefore, a more reliable method of quantifying blood flow in diabetic patients may lead to improved care.
DCS enables easy and fast assessment of PAD and identification of deep pressure ulcers using specialized arrangements of fiber optic probes. Furthermore, DCS measurements are not affected by calcified arteries, enabling assessment of PAD is patients who cannot be assessed using ultrasound.

## Application area

Detection of PAD and emerging pressure ulcers
Differentiation between skin redness and a budding pressure ulcer
Assessment of PAD in diabetic patients

## Advantages

Non-invasive approach
Easy, fast procedure that does not require a trained sonographer
Allows PAD assessment in calcified arteries

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