The relationship between the mechanical properties of heel-pad and common clinical measures associated with foot ulcers in patients with diabetes.

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Abstract

AIM:
The present study aims at investigating the correlation between the mechanical properties of the heel-pad of people with type-2 diabetes and the clinical parameters used to monitor their health and ulceration risk.

METHODS:
A new device for the in-vivo testing of plantar soft tissues was built and pilot-tested. This device consists of an ultrasound probe connected in series with a dynamometer. Loading is applied manually using a ball-screw actuator. A total of 35 volunteers with type-2 diabetes were recruited and the thickness, stiffness of their heel-pads as well as the energy absorbed during loading were assessed. The participants with diabetes also underwent blood tests and measurements of Ankle Brachial Index and Vibration Perception Threshold.

RESULTS:
Pearson correlation analysis revealed strong correlations between triglycerides and heel-pad stiffness (r=0.675, N=27, p<0.001) and between triglycerides and energy (r=-0.598, N=27, p=0.002). A correlation of medium strength was found between Fasting Blood Sugar (FBS) and stiffness (r=0.408, N=29, p=0.043).

CONCLUSIONS:
People with type-2 diabetes and high levels of triglycerides and FBS are more likely to have stiffer heel-pads. Increased stiffness could limit the tissues’ ability to evenly distribute loads making them more vulnerable to trauma and ulceration.

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KEYWORDS:
Diabetic foot; FBS; Hypertriglyceridemia; In-vivo tissue stiffness; Ulceration risk; Ultrasound indentation

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