

## **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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