

# An innovative thermometric "Stress Test" for early diagnosis of acute charcot

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## Background & Objectives:

Charcot neuroarthropathy (CN) is a devastating complication of diabetes. It has two-fold higher rate of major amputation compared to those without CN. Unfortunately, to date, there is no pathological marker or diagnostic criterion for it and diagnosis relies on pattern recognition and clinical intuition. Not surprisingly, the diagnosis can be missed up to 95% of the time and the average diagnostic delay has been estimated at almost 7 months. Recent studies reported asymmetric plantar temperature differences secondary to inflammation as a hallmark for the diagnosis and treatment response of Charcot foot syndrome. However, little attention has been given to temperature response to activity.

## Methods:

Fifteen individuals with acute CN and 17 age-matched non-CN participants with type 2 diabetes and peripheral neuropathy were recruited. All participants walked for two predefined paths of 50 and 150 steps. A thermal image was acquired at baseline after acclimatization and immediately after each walking trial. The plantar temperature (PT) response as a function of number of steps was examined using a validated wearable sensor technology. A custom image processing toolbox was designed to characterize the plantar temperature response to activity.

## Results:

During initial activity, the PT was reduced in all participants, but the temperature drop for the non-affected foot was 1.9 times greater than the affected side in CN group ( $p=0.04$ ). Interestingly, the PT in CN was sharply increased after 50 steps for both feet, while no difference was observed in non-CN between 50 and 200 steps.

## Conclusions:

The observed differential thermal response to walking initiation between Charcot and non-Charcot feet warrants future investigation to provide further insight into the correlation between activity dosing and thermal response. It may also lead to a valuable insight into identifying an "inflammatory trigger" that may ultimately provide an early warning sign or increased sensitivity for subsequent unilateral or bilateral CN development or clinical expression of foot ulcer. These results also support that managing modulating duration of continuous steps and or prolonged standing during daily activity could be helpful for reducing the trauma in patients with CN or patients at risk of diabetic foot ulcer.