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SYMPOSIUM

Infrared Thermal Imaging for Automated Detection of Diabetic Foot Complications

Jaap J. van Netten, Ph.D.,[1] Jeff G. van Baal, M.D., Ph.D.,[1] Chanjuan Liu, M.Sc.,[2] Ferdi van der Heijden, Ph.D.,[2] and Sicco A. Bus, Ph.D.[1,3]

Abstract

Background:

Although thermal imaging can be a valuable technology in the prevention and management of diabetic foot disease, it is not yet widely used in clinical practice. Technological advancement in infrared imaging increases its application range. The aim was to explore the first steps in the applicability of high-resolution infrared thermal imaging for noninvasive automated detection of signs of diabetic foot disease.

Methods:

The plantar foot surfaces of 15 diabetes patients were imaged with an infrared camera (resolution, 1.2 mm/pixel): 5 patients had no visible signs of foot complications, 5 patients had local complications (e.g., abundant callus or neuropathic ulcer), and 5 patients had diffuse complications (e.g., Charcot foot, infected ulcer, or critical ischemia). Foot temperature was calculated as mean temperature across pixels for the whole foot and for specified regions of interest (ROIs).

Results:

No differences in mean temperature >1.5 °C between the ipsilateral and the contralateral foot were found in patients without complications. In patients with local complications, mean temperatures of the ipsilateral and the contralateral foot were similar, but temperature at the ROI was >2 °C higher compared with the corresponding region in the contralateral foot and to the mean of the whole ipsilateral foot. In patients with diffuse complications, mean temperature differences of >3 °C between ipsilateral and contralateral foot were found.

Conclusions:

With an algorithm based on parameters that can be captured and analyzed with a high-resolution infrared camera and a computer, it is possible to detect signs of diabetic foot disease and to discriminate between no, local, or diffuse diabetic foot complications. As such, an intelligent telemedicine monitoring system for noninvasive automated detection of signs of diabetic foot disease is one step closer. Future studies are essential to confirm and extend these promising early findings.

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Author Affiliations: [1]Diabetic Foot Unit, Department of Surgery, Hospital Group Twente, Almelo, the Netherlands; [2]Signals and Systems Group, Faculty of Electrical Engineering, Mathematics, and Computer Science, University of Twente, Enschede, the Netherlands; and [3]Department of Rehabilitation Medicine, Academic Medical Center, University of Amsterdam, Amsterdam, the Netherlands

Abbreviations: (ROI) region of interest, (SD) standard deviation

Keywords: automatic detection, diabetic foot, infrared imaging, prevention, telemedicine, thermography

Corresponding Author: Jaap J. van Netten, Ph.D., Zilvermeeuw 1, 7609 PP Almelo, The Netherlands; email address *jv.netten@zgt.nl*