

## Correlation between Plantar Foot Temperature and Diabetic Neuropathy: A Case Study by Using an Infrared Thermal Imaging Technique

Subramnaiam Bagavathiappan, B.Sc.,<sup>1</sup> John Philip, Ph.D.,<sup>1</sup>  
Tammana Jayakumar, Ph.D.,<sup>1</sup> Baldev Raj, Ph.D., FNAE, FASc., FNASc.,<sup>1</sup>  
Pallela Narayana Someshwar Rao, M.B.B.S, M.S., M.R.C.S., FPS,<sup>2</sup>  
Muthukrishnan Varalakshmi, M.B.B.S., F.Diab,<sup>2</sup>  
and Viswanathan Mohan, M.D., Ph.D., D.Sc., FRCP, FNASc.<sup>2</sup>

### Abstract

#### Background:

Diabetic neuropathy consists of multiple clinical manifestations of which loss of sensation is most prominent. High temperatures under the foot coupled with reduced or complete loss of sensation can predispose the patient to foot ulceration. The aim of this study was to look at the correlation between plantar foot temperature and diabetic neuropathy using a noninvasive infrared thermal imaging technique.

#### Methods:

Infrared thermal imaging, a remote and noncontact experimental tool, was used to study the plantar foot temperatures of 112 subjects with type 2 diabetes selected from a tertiary diabetes centre in South India.

#### Results:

Patients with diabetic neuropathy (defined as vibration perception threshold (VPT) values on biothesiometry greater than 20 V) had a higher foot temperature (32–35 °C) compared to patients without neuropathy (27–30 °C). Diabetic subjects with neuropathy also had higher mean foot temperature (MFT) ( $p = .001$ ) compared to non-neuropathic subjects. MFT also showed a positive correlation with right great toe ( $r = 0.301$ ,  $p = .001$ ) and left great toe VPT values ( $r = 0.292$ ,  $p = .002$ ). However, there was no correlation between glycated hemoglobin and MFT.

#### Conclusion:

Infrared thermal imaging may be used as an additional tool for evaluation of high risk diabetic feet.

*J Diabetes Sci Technol* 2010;4(6):1386-1392

**Author Affiliations:** <sup>1</sup>Indira Gandhi Centre for Atomic Research, Kalpakkam, India; and <sup>2</sup>Dr.Mohan's Diabetes Specialities Centre & Madras Diabetes Research Foundation, WHO Collaborating Centre for Non Communicable Diseases Prevention & Control, IDF Centre of Education, Gopalapuram, Chennai, India

**Abbreviations:** (CPT) current perception threshold, (HbA1c) glycated hemoglobin, (IR) infrared, (IRT) infrared thermography, (MFT) mean foot temperature, (NCV) nerve conduction velocity, (NIR) near-infrared, (PC) personal computer, (SD) standard deviation, (VPT) vibration perception threshold

**Keywords:** diabetic neuropathy, infrared thermal imaging, mean foot temperature, serum cholesterol, type 2 diabetes

**Corresponding Author:** Dr. John Philip, Ph.D., Head, SMART Section, NDE Division, Indira Gandhi Centre for Atomic Research, Kalpakkam-603 102, India; email address [philip@igcar.gov.in](mailto:philip@igcar.gov.in)