Proceedings of the 2nd

CONFERENCE 2005

Thursday 1st December 2005
Hartley Suite, Highfield Campus
University of Southampton

Editors: Cheryl Metcalf & Alessandro Beda

Thermographic Measurement on Plantar Foot Using Thermochromic Liquid Crystals for Early Detection of Risk of Ulceration

M.BHARARA, J.E.COBB, D.J.CLAREMONT, mbharara@bournemouth.ac.uk
ABERG, Bournemouth University, Poole House, Talbot Campus BH12 5BB

Research Project

This project aims to develop a simple, safe and low cost temperature measurement system to be used for screening diabetic patients at higher risk of foot ulceration.

Abstract

Neuropathic foot ulcers are a major complication of type 2 diabetes mellitus. Progressive degeneration of sensory nerve pathways is thought to affect thermoreceptors and mechanoreceptors equally. The neuropathic foot is characterised by heightened colouration and increased foot temperature. However, clinical evidence in literature suggests that foot temperature and response of thermoreceptors is not assessed routinely. Thermological techniques such as infrared thermography, liquid crystal thermography (LCT) and electronic thermometry may be useful for screening neuropathic foot. The choice depends on the cost, spatial resolution, temperature resolution, simplicity and clinical significance of results. Recent improvements in liquid crystal technology combined with low cost, fast video acquisition now offer potential for routine thermographic assessment of the diabetic foot. Our main aim is to develop a low cost LCT system capable of dynamically monitoring microvascular response to induced thermal stimulus. There are good physiological reasons to expect correlation between our technique and current techniques such as Semmes Weinstein monofilaments and biothesiometer. Evidence of a positive correlation between impaired thermoregulatory responses and the degree of sensory neuropathy may indicate common degenerative mechanisms. Research using three physical forms of thermochromic liquid crystal (TLC) materials suggests that TLC polyester sheets will be most suitable for use in our system. TLC sheets offer higher stability, better colour response and have uniform distribution of liquid crystals. Previous studies used supine measurements which do not replicate normal loading conditions. An important advance offered by the proposed system is feature extraction and temporal measurements from full field plantar images using novel image processing algorithms. Whole field thermal images can be used to measure mean temperature at sites of increased risk of ulcers and assess response of thermoreceptors by measuring factors such as warm up period, cold immersion recovery and repetitive stress effect. This poster describes development of the system, in vitro calibration and initial in vivo results from healthy subjects. The next stage of this project is to carry out a small study to compare thermoregulatory response times between a study group of diabetic patients with sensory neuropathy and a non diabetic control group.