

Near Infrared Wound Monitor Helps Clinical Assessment of Diabetic Foot Ulcers

Michael Neidrauer, B.S.,¹ Leonid Zubkov, D.Sc.,¹ Michael S. Weingarten, M.D.,²
Kambiz Pourrezaei, Ph.D.,¹ and Elisabeth S. Papazoglou, Ph.D.¹

Abstract

Background:

The efficacy of using diffuse near infrared spectroscopy (NIRS) in predicting wound healing in diabetic foot ulcers was demonstrated by conducting a pilot human study.

Method:

Sixteen chronic diabetic wounds were followed and assessed for subsurface oxyhemoglobin concentration using the NIRS device. Weekly measurements were conducted until there was wound closure, limb amputation, or 20 completed visits without healing. Wound size and degree of wound contraction were measured by image analysis of digital photographs, and results were compared to NIRS results.

Results:

In the 16 patients followed, seven wounds healed, six limbs were amputated, and three wounds remained opened after 20 visits. Initial values of subsurface hemoglobin concentration, in all wounds, were higher than in nonwound control sites. Healed wounds exhibited a consistent reduction of hemoglobin concentration several weeks prior to closure, and the absolute hemoglobin concentration approached the value at the control site. In wounds that did not heal or ended in amputations, the hemoglobin concentration remained elevated throughout the study. A negative slope for the rate of change of hemoglobin concentration was indicative of healing across all wounds.

Conclusions:

Evaluation of diabetic foot ulcers using NIRS may provide an effective and more complete measurement of wound healing compared to current clinical approaches.

J Diabetes Sci Technol 2010;4(4):792-798

Author Affiliations: ¹Drexel University School of Biomedical Engineering, Philadelphia, Pennsylvania; and ²Drexel University College of Medicine, Philadelphia, Pennsylvania

Abbreviations: (DPDW) diffuse photon density wave, (HbO₂) oxyhemoglobin, (Hhb) deoxyhemoglobin, (NIRS) near infrared spectroscopy, (RMSE) root mean square deviation, (Tot Hb) total hemoglobin

Keywords: chronic diabetic foot ulcers, diffuse photon density wave, frequency-domain near infrared spectroscopy, hemoglobin, wound healing

Corresponding Author: Elisabeth S. Papazoglou, Ph.D., 3141 Chestnut Street, School of Biomedical Engineering, Philadelphia, PA 19104; email address esp25@drexel.edu