

Investigating Reasons for Healing and Non-Healing Ulcers Using Multispectral Near-Infrared Imaging: A Case Series

Matthew Regulski*, DPM, FFPM RCPS (Glasg), ABMSP, FASPM and Karen Cross**, MD PHD FRCSC



*Medical Director of the Wound Care Institute of Ocean County, LLC and Partner of Ocean County Foot and Ankle Surgical Associates, Toms River, NJ, USA

**Adjunct Professor, Department of Surgery, Dalhousie University and Innovator in Residence, Nova Scotia Health Authority, NS, Canada

Objective

Explore the utility of mobile multispectral NIRS in understanding the factors contributing to the healing or non-healing status of ulcers.

Introduction

Ulcers pose a significant challenge in healthcare, often leading to prolonged suffering, increased healthcare costs, and reduced quality of life for patients. The ability to accurately assess tissue oxygenation and identify factors influencing ulcer healing is crucial for implementing appropriate treatment strategies. Mobile multispectral near-infrared spectroscopy (NIRS) has emerged as a promising non-invasive tool for evaluating tissue oxygenation levels and investigating the reasons behind healing and non-healing chronic ulcers. This case series aims to explore the utility of mobile multispectral NIRS in understanding the factors contributing to the healing or non-healing status of ulcers.



^MIMOSA Pro.
MIMOSA Diagnostics Inc.
Toronto, ON, Canada

Methods

A retrospective case series design was employed, involving patients with ulcers who underwent evaluation using multispectral NIRS. A hand-held multispectral NIRS imaging device^ that measures tissue oxygenation was used. The device also measured temperature. Patient demographics, clinical characteristics, NIRS findings, wound characteristics, and subsequent healing outcomes were collected and analyzed.

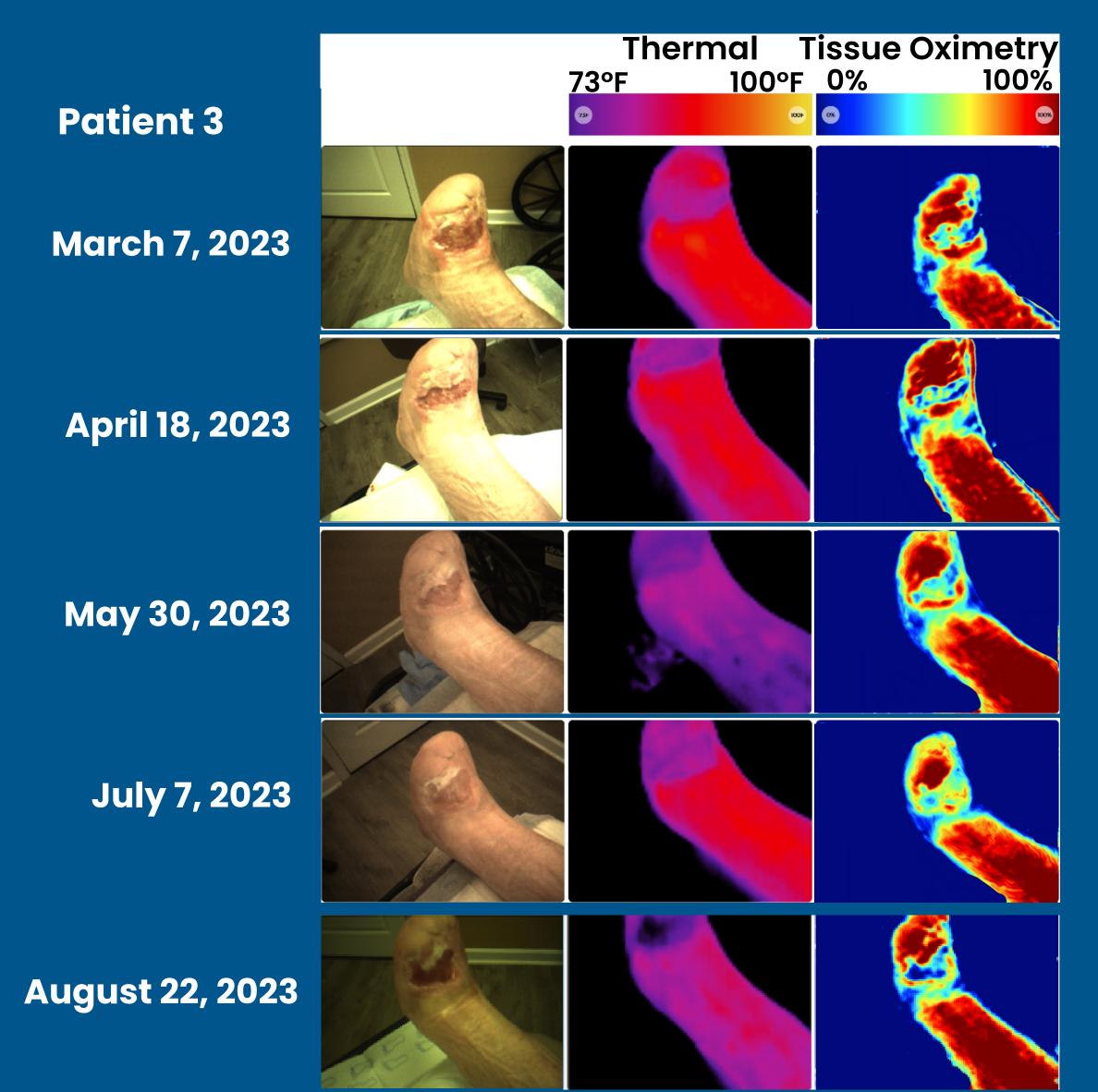
Discussion

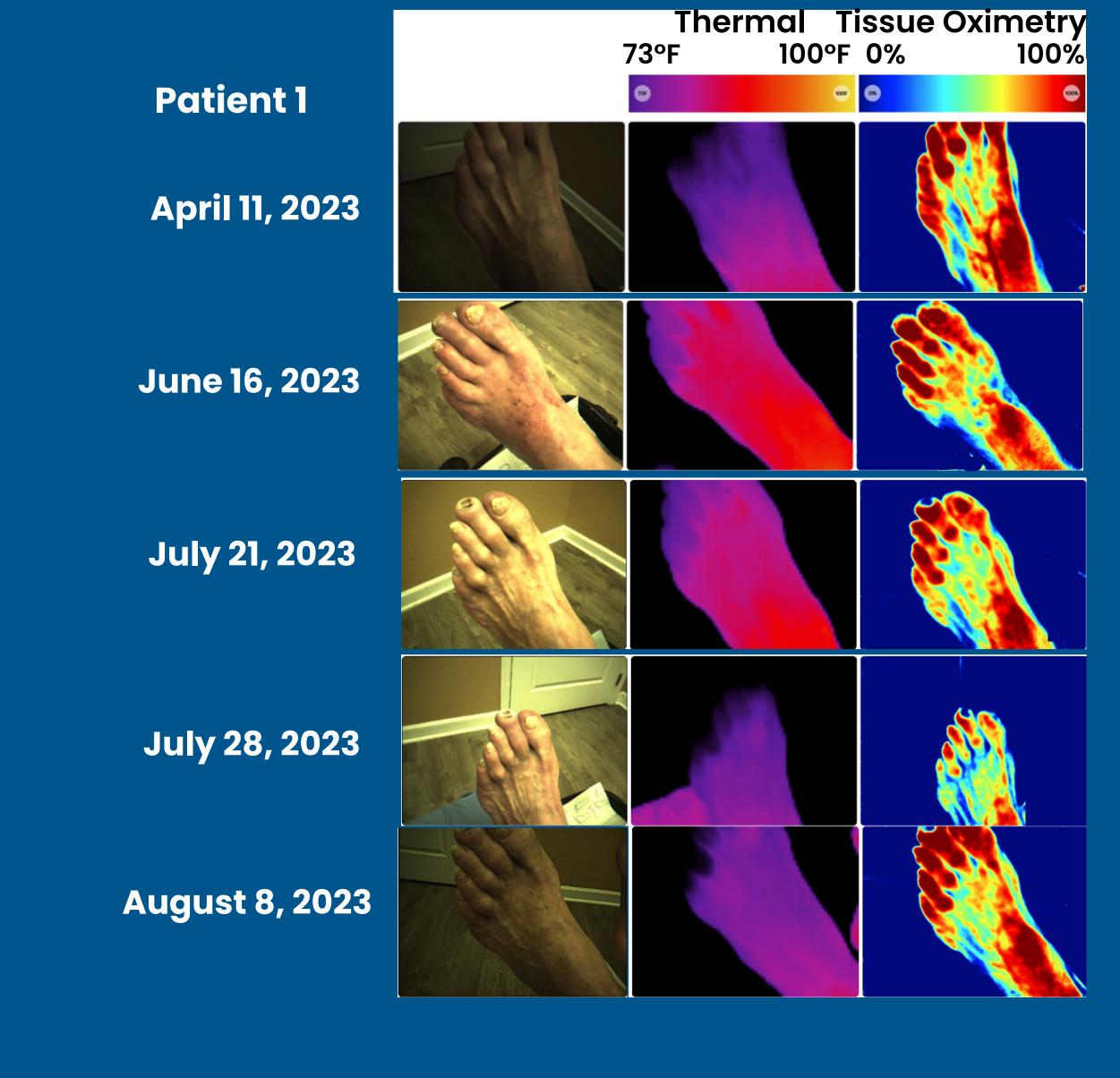
The findings from this case series highlight the potential of mobile multispectral NIRS in investigating the reasons behind healing or non-healing chronic ulcers. By providing real-time and objective information on tissue oxygenation, NIRS aids in identifying underlying factors that influence ulcer healing outcomes. This knowledge enables clinicians to implement targeted interventions, such as optimizing perfusion and modulating oxygenation levels, thereby promoting wound healing and improving patient outcomes. Furthermore, the portability and ease of use of mobile NIRS devices allow for convenient monitoring of tissue oxygenation at various stages of ulcer care.

RESULTS

The case series included four patients with ulcers of varying etiologies, sizes, and durations. Multispectral NIRS analysis demonstrated significant differences in tissue oxygenation levels between healing and non-healing ulcers. The results revealed factors such as impaired tissue perfusion and compromised oxygenation with non-healing ulcers. Additionally, NIRS data provided valuable insights into the effectiveness of ongoing treatment interventions by monitoring changes in tissue oxygenation over time.

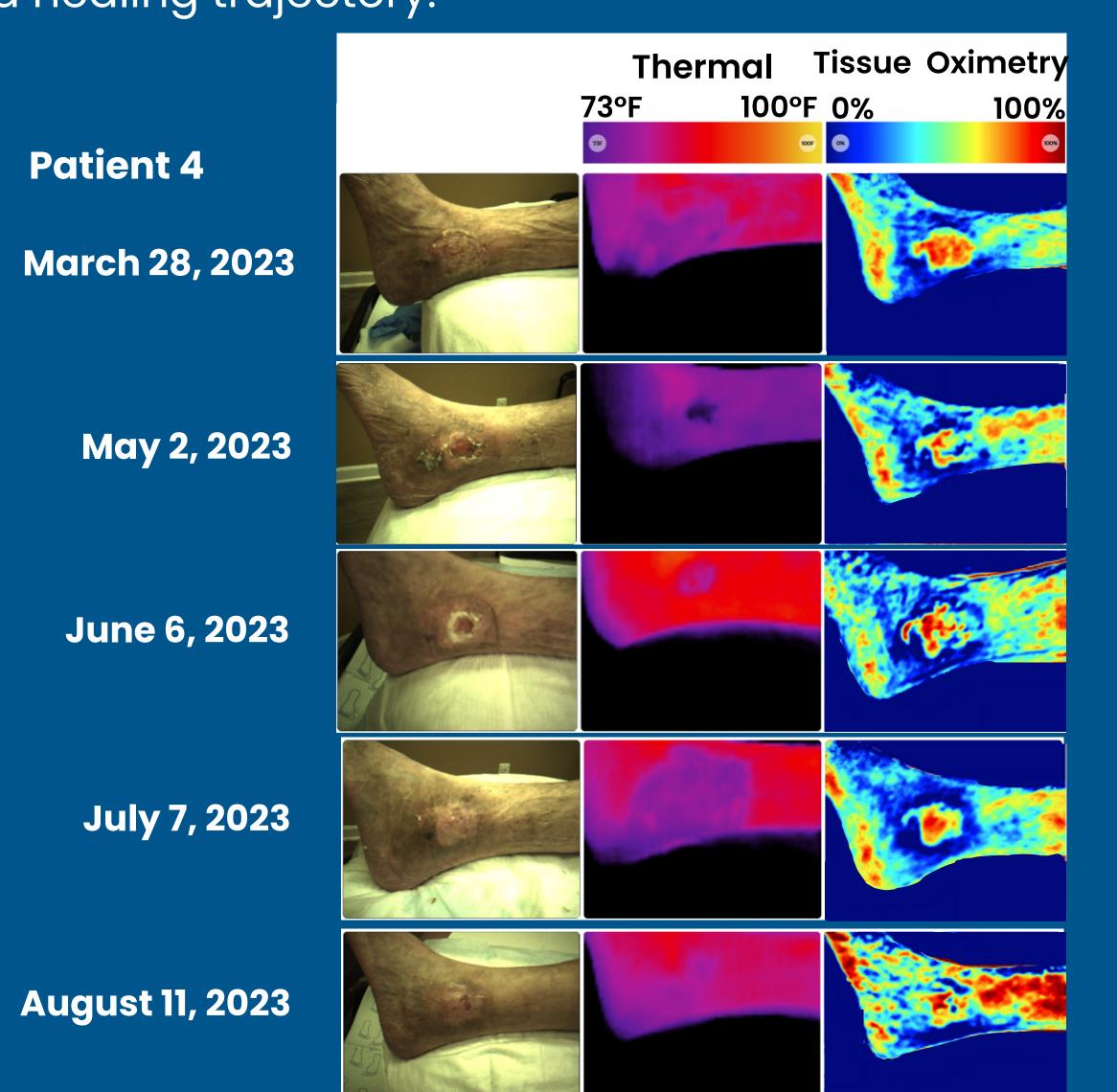
Patient 1 – A 63 year-old man presented with a callus on the tip of the 2nd toe caused by his diabetes, hammer toe and a history of neuropathy, venous insufficiency and PVD. A wound eventually formed. The patient is receiving radiation and chemotherapy for pre-existing lung cancer. The patient is a smoker. The foot was revascularized on June 4th and July 20th. Though the second toe continued to show adequate oxygenation, the wound still persists.

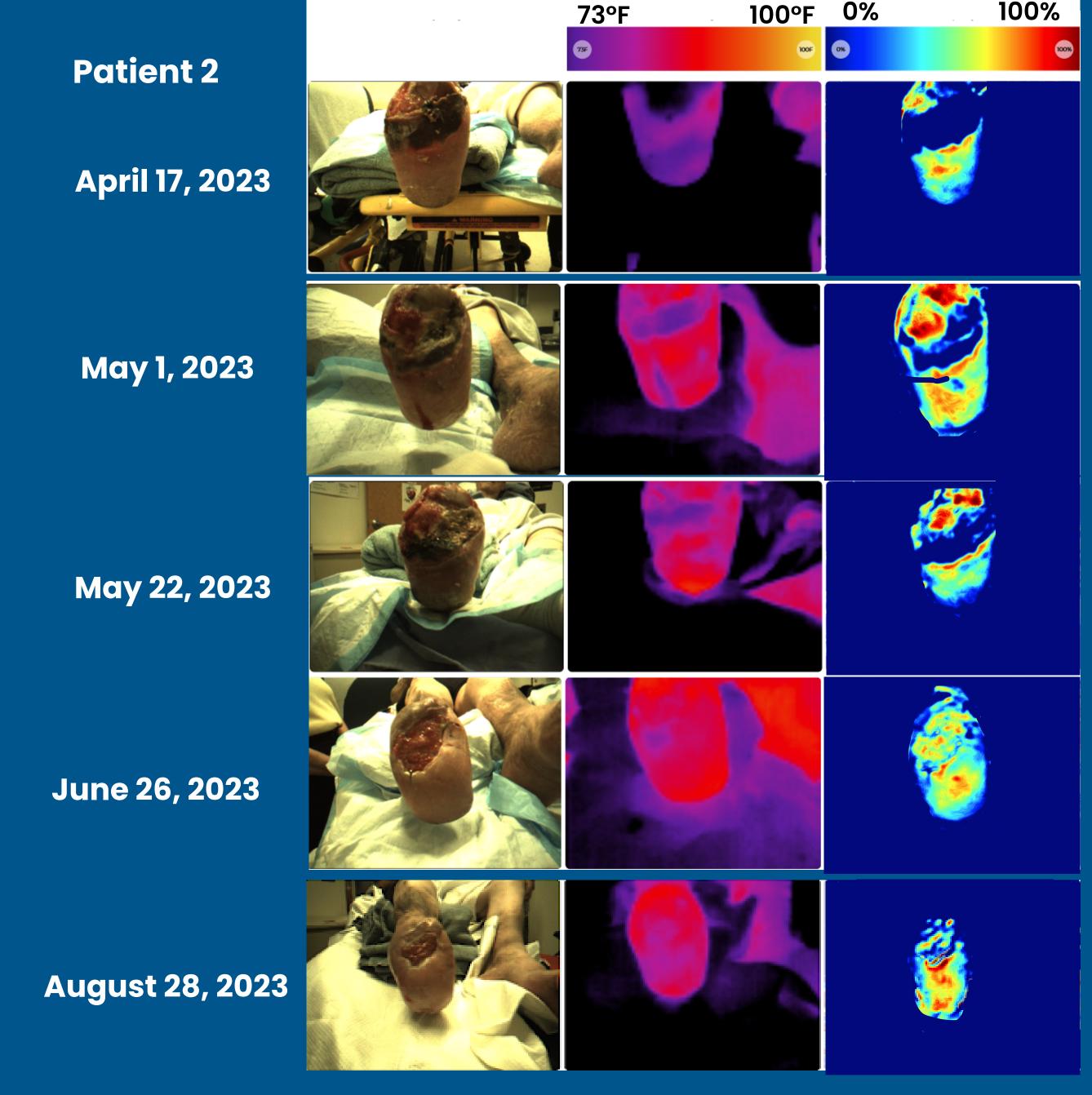




Patient 3 – A 64-year-old man with a wound caused by his diabetes. The patient is a smoker. As a result of gangrene, he required a transmetatarsal amputation (TMA). Post amputation he presented with a diabetic foot ulcer, just above his TMA. Blood flow and his AIC were good. His oxygenation levels fluctuated but were adequate overall. The wound above the TMA site was slow to heal, even with healing ultimately plateauing.

Patient 2 – A mid-70s male with a history of diabetes, chronic kidney disease, and small vessel disease presented with a gangrenous helix with exposed bone. The patient was revascularized and subsequently underwent a toe amputation. Post the toe amputation, a secondary midfoot amputation was necessary. Due to continued healing issues the patient was admitted to the hospital for a proximal Chopart's procedure. The patient received a graft and began hyperbaric oxygen therapy, supported by Vacuum–Assisted Closure (VAC) and total contact casting. The patient then underwent an open Achilles tenotomy and subsequent wound VAC. The patient just completed 40 hyperbaric oxygen treatments and is on a healing trajectory.





Patient 4 – A 62-year-old man with a history of smoking, alcoholism, significant PVD and venous insufficiency presented with a foot ulcer over his left lateral malleolus (March 28th, 2023). The patient was revascularized on June 26th. Treatments included use of an antimicrobial gel, hydroconductive dressing with multilayered compression, and offloading. The wound progressed well and is close to healing.