



Preventing Pressure Injuries Using Near-Infrared Spectroscopy Imaging

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BACKGROUND

- Deformities and/or altered biomechanics result in areas at risk for pressure injury.
- Pressure injuries can lead to major complications including infections, sepsis, and minor/major amputations.
- Inflammation over boney prominences (e.g., hammer toes, bunions, boney prominences associated with charcot foot) can lead to injury.
- Early detection of inflammation and proactive offloading can prevent injury and associated complications. Near-infrared spectroscopy (NIRS) imaging is a tool that can quickly measure superficial oxygenation.
- A focal increase in oxygenation is a surrogate marker for inflammation.
- We explored utilizing NIRS for identification of areas at-risk followed by focused offloading to prevent ulceration.

OBJECTIVE

To evaluate if point-of-care near-infrared spectroscopy (NIRS) can be used as an objective measure of tissue inflammation related to pressure followed by proactive offloading to prevent ulceration.

METHODS & RESULTS

Patients with intact skin who had boney prominences due to deformities were imaged with NIRS in areas that were identified as high risk for ulcer development. If areas of significantly elevated tissue oxygen saturation (StO₂) were identified on the image, proactive off-loading was provided to the patient. Patients were followed to determine if a wound developed in the area identified as high risk.

Within patients studied, areas of inflammation over boney prominences were identified. Areas of boney prominences included as follows: hammer toes, hallux abducto valgus, and metatarsal heads. Within the areas of inflammation, there was significantly higher StO₂ ($79.6 \pm 10.5\%$) over the boney prominences compared to the StO₂ in the surrounding tissue ($55 \pm 6.6\%$; $P < 0.001$). On follow-up after proactive off-loading was provided, recurrence was significantly decreased.

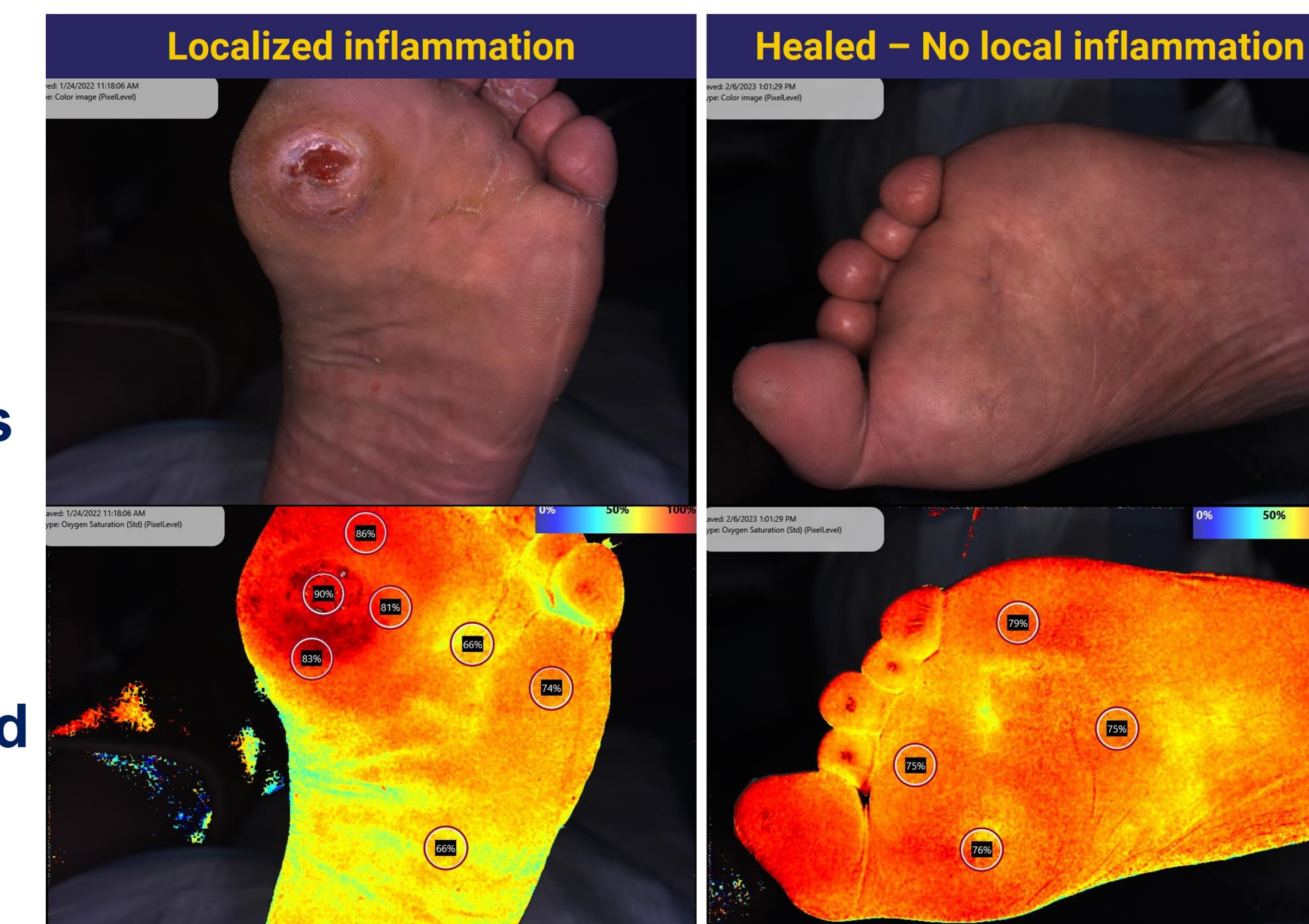


Figure 1. A male patient who was treated with a total contact cast and underwent a tenotomy. Offloading was continued until his wound was closed then patient was custom fitted for a diabetic shoe. The patient has a boney prominence but now they properly protect themselves from repeated pressure by proactively offloading

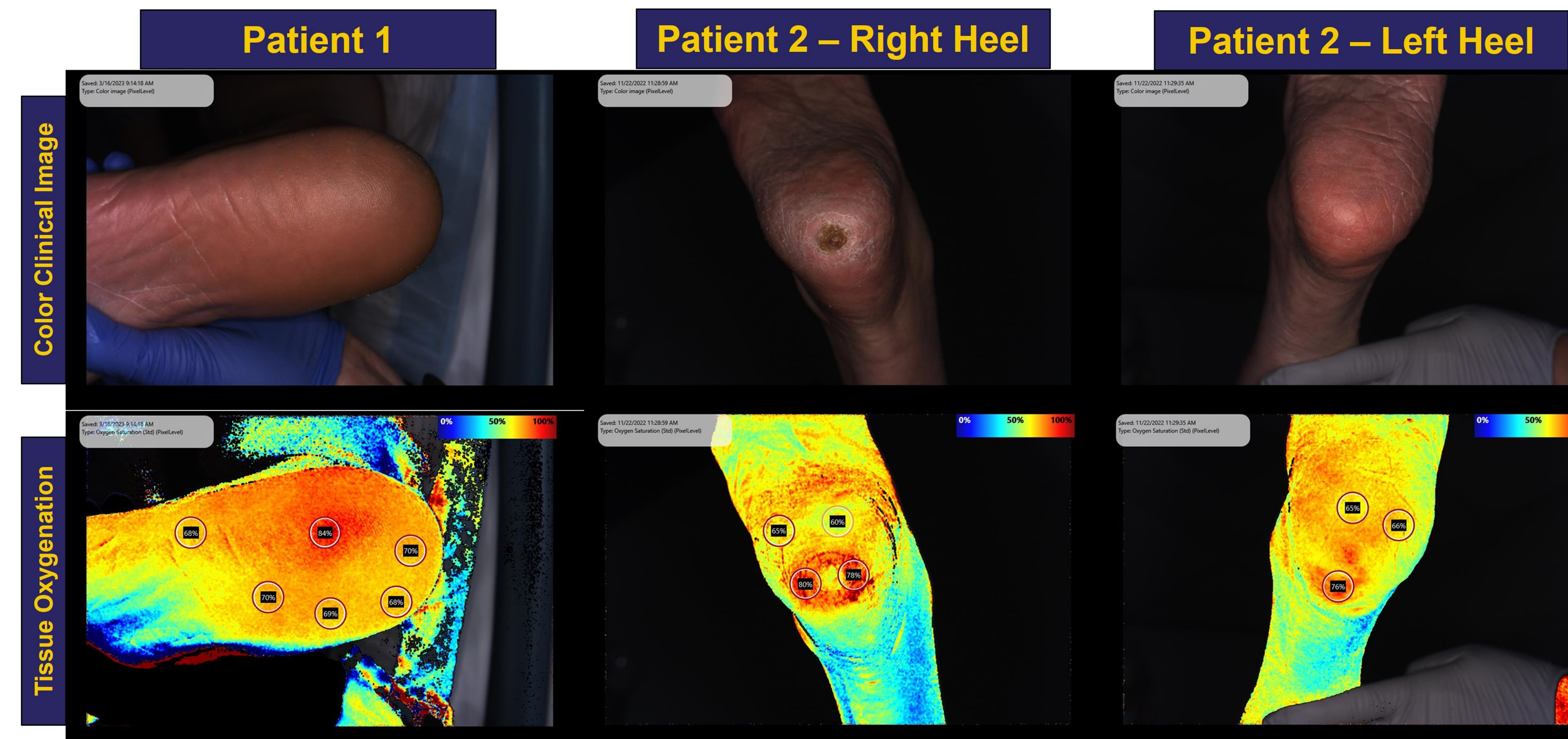


Figure 2. Clinical images (top) and tissue oxygen saturation (bottom) images of feet being screened for inflammation. Patient 1 had no visible erythema but showed an inflamed heel visible with NIRS. Patient 2 had an affected right heel and an unaffected left heel. Ulceration of the left heel was prevented with offloading.

DISCUSSION

- NIRS was able to identify areas of increased oxygenation (induced by inflammation) over boney prominences.
- Being able to identify the area of inflammation prior to ulceration facilitated a proactive approach of offloading to prevent ulceration.
- NIRS was also used in serial visits to track the effectiveness of offloading in reversing inflammation.
- This process of serial imaging and reviewing images with patients can be an excellent educational tool to reinforce the importance of offloading and thus potentially improving compliance.
- NIRS may be a fast, non-invasive, and valuable educational tool in preventing recurrent ulceration in patients and empowering patient autonomy.

CONCLUSION

These cases demonstrate the utility of NIRS as a preventative screening measure for ulceration. With a fast and non-contact way to screen patients, ulceration rates and overall healthcare burden may be lessened with a focus on prevention and proactive responses.