



# The Use of Near-Infrared Spectroscopy in Assessment of Viability and Monitoring of Healing Trajectory in Traumatic Flaps



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## BACKGROUND

Patients are frequently treated in wound care for traumatic flaps. Often these acute wounds are covered by anatomically displaced skin which is removed by providers despite its ability to act as a skin graft. If flap tissue is still adequately perfused and there is no infection, the base of the wound should be cleaned, and the flap should be tacked in proper anatomical position with steri strips. This benefits the patient by protecting the wound with epidermal tissue that can adhere to intact dermis in lieu of creating an uncovered wound that must re-epithelialize. Before this tissue may remain, however, it must be assessed for viability. A necrosed flap introduces an infection risk to the wound bed and may delay healing, so it is essential to monitor the vitality of flap tissue each subsequent visit. This can be done primarily by clinical assessment, but visual inspection does not offer the precision of near-infrared spectroscopy (NIRS) which can give information on oxygenation and hemoglobin content of the tissue.

## OBJECTIVE

To identify and conserve any viable flap tissue, when possible, to accelerate time to heal. Once tissue is known to be adequately oxygenated the flap can be used as a biologic dressing to cover the dermis to prevent infection and minimize new epidermal growth needed.

## METHODS & RESULTS

Patients with a flap related wound were initially assessed for flap viability based solely on visual inspection. NIRS imaging was then performed to determine if advanced imaging provided additional information regarding flap perfusion. Any tissue with a deoxyhemoglobin (Hb) value greater than 0.5 or an oxygen saturation (StO<sub>2</sub>) value less than 50% with NIRS was classified as non-viable and was sharply debrided to reduce infection risk. All remaining flap tissue was adhered to the margins of the wound to act as a skin graft.

NIRS was able to detect non-viable tissue with greater sensitivity than clinical assessment alone. This is still an ongoing study. Currently in a cohort of 9 flaps of various etiologies 7/9 have been successfully conserved. Of these 7 conserved flaps 6/7 have gone onto heal. These 6 cases have a median time to heal of 33.5 days. Flaps that failed had insufficient oxygenation or became infected from external objects that created the wound before treatment. The majority of flaps were able to be conserved and decreased time to heal.

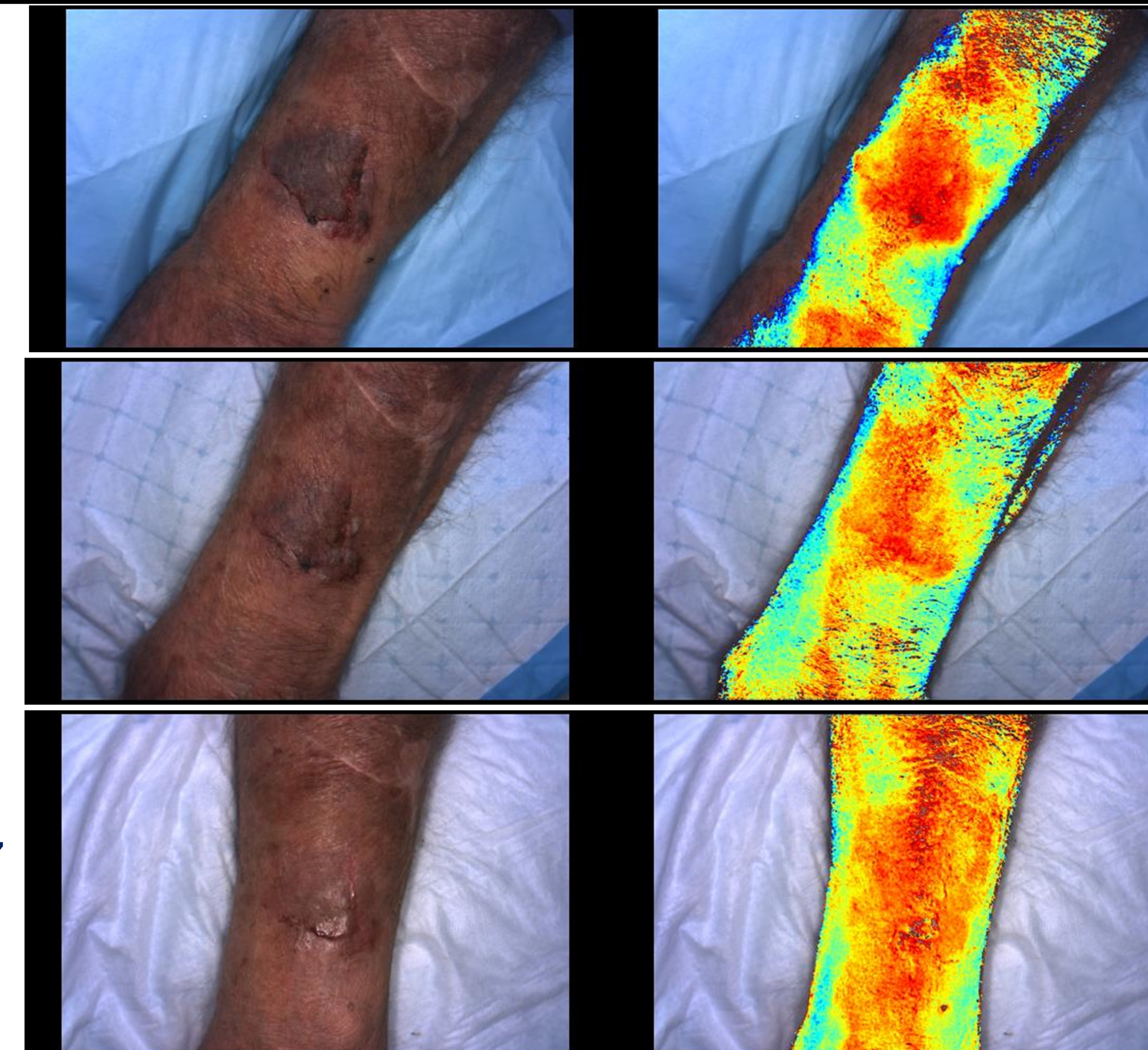


Figure 1. A representative case. This patient presented with a traumatic flap to his left radius. It was able to be conserved and tacked down with steri-strips. He went on to heal in only 16 days. (From top: Visit 1, Visit 2, Visit 3 healed)

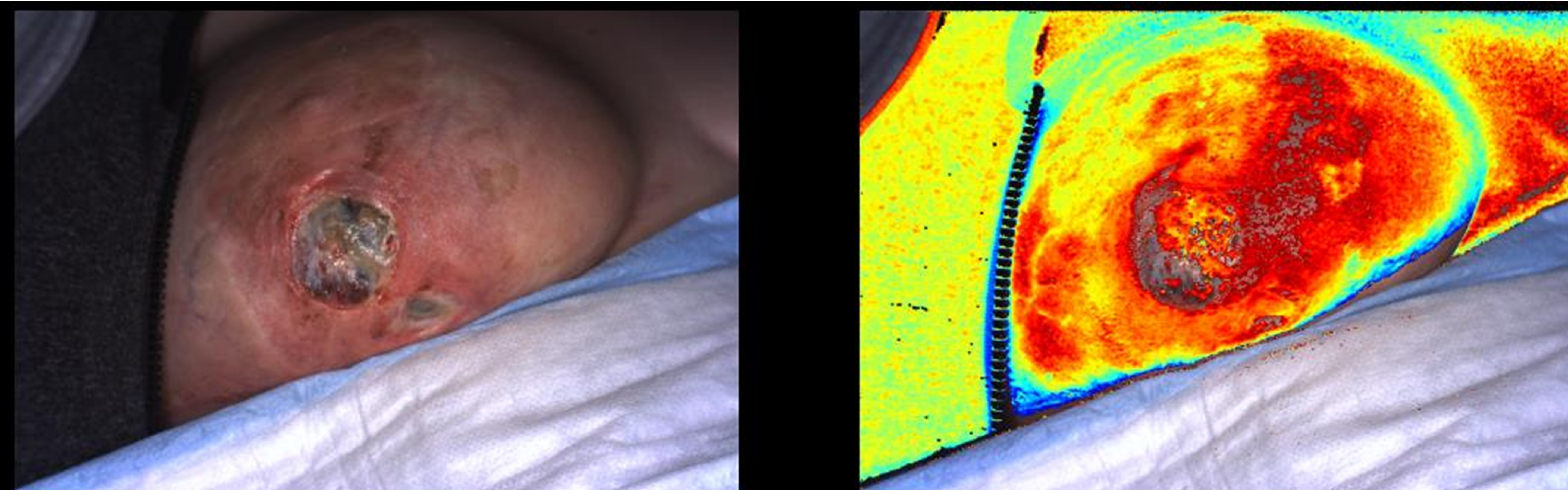


Figure 2. An example of a failing flap. Note NIRS unable to give an oxygen reading over the necrosed tissue. This case was a T-junction flap after a breast reconstruction operation for a recovering breast cancer patient. Unfortunately, due to the failure of the flap, her implant was at risk of infection and surgical removal was necessary.

## DISCUSSION

It is all too common for patients to present to the emergency room with traumatic flaps and these are promptly removed. This is a critical error especially in our aging population. Flaps that are removed can immediately turn what was initially a 75% covered wound into a wound with 0% epidermal coverage. The removal of any healthy tissue is a net loss as this tissue could have served as a sight for epidermal tissue growth as well as providing innate immune protection to infection of the wound. In this study the only failed flaps have been due to infection prior to an initial visit in the clinic or an individual with extraordinary health circumstances and a surgical flap with higher rates of dehiscence (T-junction). The unhealed flap that was conserved was a perineal advancement surgical flap and continues to progress. All other wounds were able to heal on average in just over a month and chronicity was able to be prevented. This study has shown and will continue to demonstrate that common practices and standards need to be updated in order to prevent unnecessary wound formation. Flaps must be conserved whenever possible if able monitored with NIRS to ensure oxygenation. Even if NIRS is unavailable it is likely that patients would more frequently be better served if flaps are conserved.

## CONCLUSION

NIRS is a significant aid in determining viability and vitality of flap tissue. A routine and thorough screening will promote faster re-epithelialization through preservation of live tissue and will detect any necrosed tissue needing removal. NIRS acts as a guide as well as an assessment of flap viability and risk.