

# Diabetic Foot Ulcer Resulting in a Transmetatarsal Amputation

Presented by: Ronald Ray, DPM, FACFAS, WCC, PT

**PATIENT HISTORY:**

A 52-year-old male presented to the emergency room with multiple areas of Wagner IV dry ulcerations. The patient had a history of type II diabetes, neuropathy, peripheral vascular disease, hypertension, and was an active smoker of more than 1 pack of cigarettes per day. He had no prior history of ulcerations. The patient reported that the discoloration and ulceration started about a month prior. The ulcerations were present on the heel, D1-2 to the midfoot and various other scattered sites of the left lower extremity.



Fig 1. Baseline image of a dorsal foot with Wagner IV dry ulcerations.



Fig 2. Clinical image and X-ray scan of the patient's foot following a femoral-popliteal bypass, 36 hyperbaric oxygen treatments, aggressive wound debridement, and amputation of D1-2 with exposed metatarsal heads.

**CASE DETAILS:**

The patient had non-palpable popliteal, dorsalis pedis and posterior tibial artery pulses, with a delayed capillary fill time of 5-6 seconds. A doppler was used to assess waveforms, finding the PT monophasic, DP absent, peroneal absent along with absent sensory exam findings. A CTA was performed and demonstrated a patent common and deep femoral artery with complete occlusion of the superficial femoral artery. There was filling of the popliteal artery via multiple collateral arteries. These collaterals did not provide adequate pressure for anterior tibial and posterior tibial perfusion. The patient underwent a femoral popliteal bypass. He also underwent 36 hyperbaric treatments and repeated weekly debridements.

**Ron Ray, DPM**

Dr. Ray is a Podiatrist at the Benefis Foot and Ankle Clinic in Great Falls, Montana. His expertise is in Ankle and Foot reconstructive surgery and management of chronic non-healing wounds. He is Past-President of the Montana Podiatric Medical Association and current Chair of the Surgical Skills Committee, American College of Foot and Ankle Surgeons.



**OBSERVATIONS:**

**Pre-operative:** SnapshotNIR was used to assess the tissue oxygen saturation ( $S_tO_2$ ) of the area to be amputated. NIR images were captured from the dorsal, medial, lateral, and plantar surfaces of the left foot. All the images captured reported  $S_tO_2$  measurements ranging from the high 60s to the low 80s.

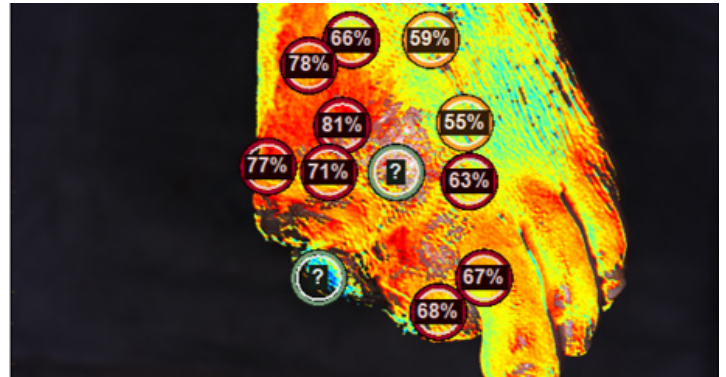
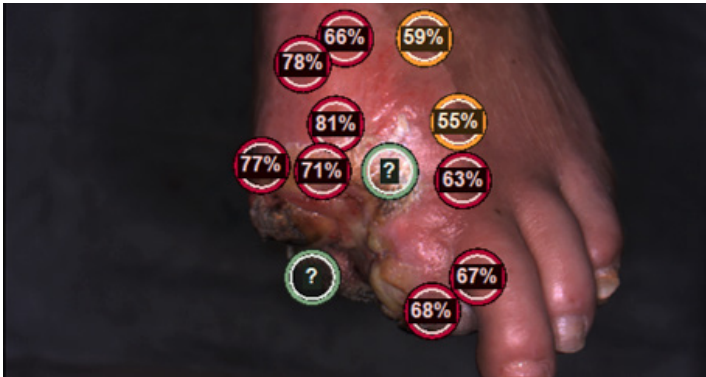


Fig 3. Pre-op images of the dorsal surface of foot.

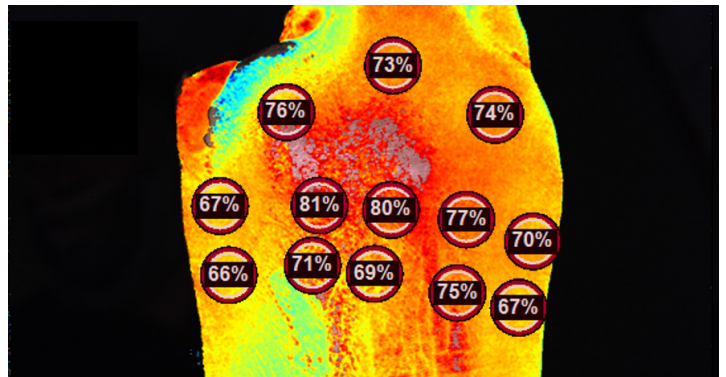


Fig 4. Images of the dorsal surface of the left foot.

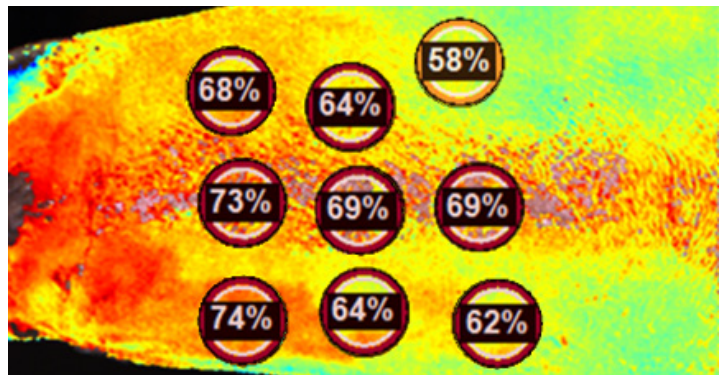


Fig 5. Pre-op images of medial surface of the foot.

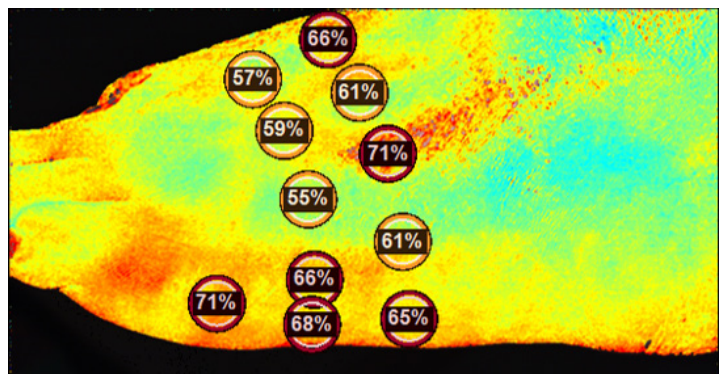
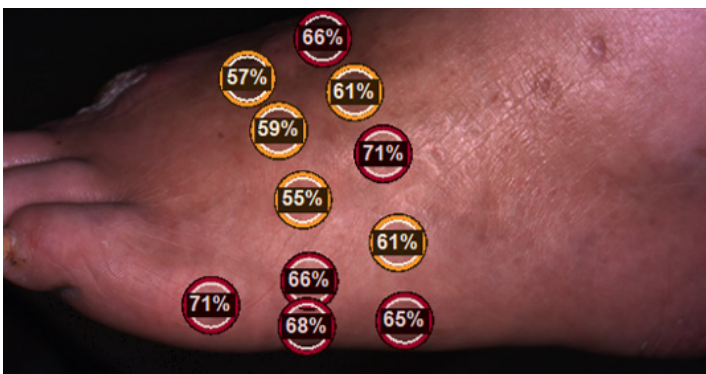


Fig 6. Pre-op lateral surface of the foot.

**Intra-operative:** SnapshotNIR images were captured to assess the  $S_tO_2$  levels of the dorsal and plantar areas of the amputation. The images taken immediately after the amputation demonstrated higher  $S_tO_2$  values in the plantar aspect of the foot compared to the dorsal aspect. In addition, it was noted that the dorsal aspect of the lateral side of the incision had better  $S_tO_2$  levels than the medial aspect. Antibiotic beads were placed to mitigate infection risk and help facilitate better closure with a low-tension subcutaneous suture used for closure.

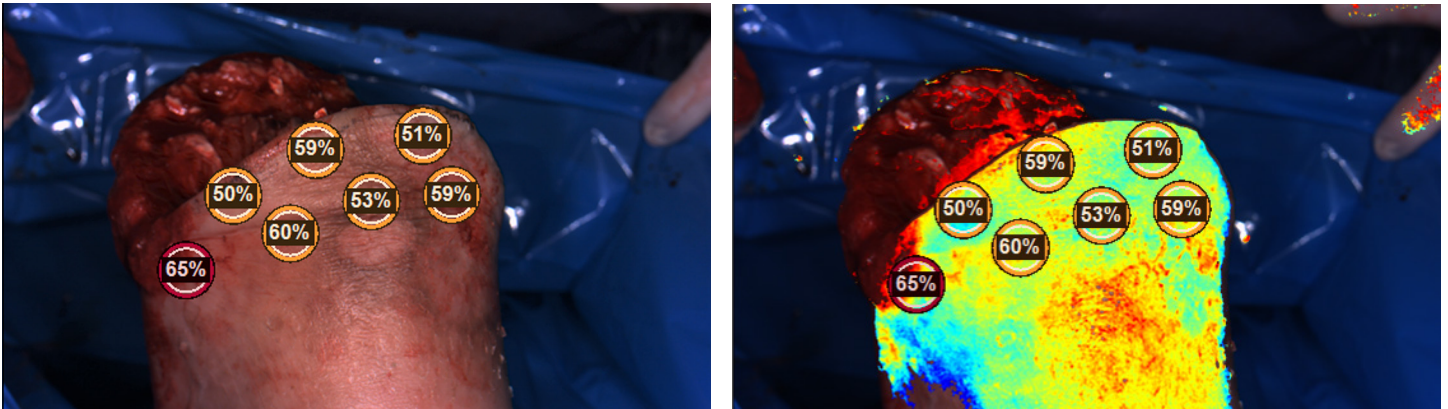


Fig 7. Intra-op images of the dorsal surface of the foot.

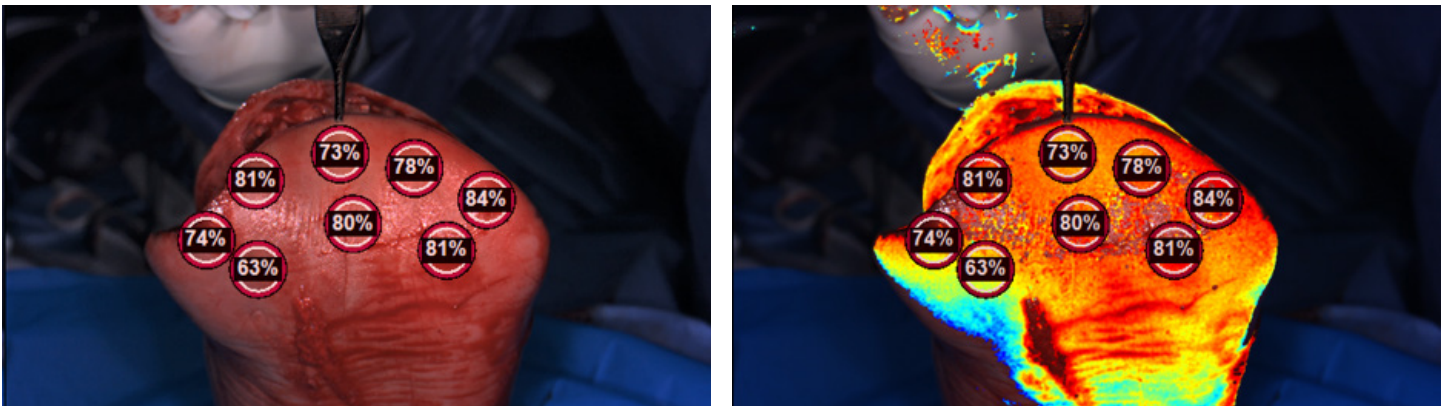


Fig 8. Intra-op images of the plantar surface of the foot.

**IMPACT:**

SnapshotNIR was used multiple times during this case. Pre-operative, the images taken verified that the area where the amputation took place had adequate  $S_tO_2$  (as demonstrated by values ranging from the high 60s to low 80s). When a patient presents with  $S_tO_2$  values below 60% before an amputation, more consideration must be taken to ensure a positive patient outcome. The patient's blood flow and tissue oxygenation need to be maximized to achieve the best possible outcome.

In the intra-operative setting, images taken by SnapshotNIR were used to assess oxygenation and perfusion of the skin margins around the amputation site prior to closure. The trauma inflicted by amputations onto the surrounding tissue needs to be considered when deciding how to close the surgical site. Aggressive closure of an already traumatized area can lead to poor outcomes in amputations and other surgical interventions. Whereas a non-aggressive closure can allow for more perfusion and lead to better long-term outcomes. The images taken at this stage can start to provide some predictive value as well. SnapshotNIR images taken from the dorsal view show that the  $S_tO_2$  values along the lateral side of the incision were higher than the medial side. The images from the plantar side of the foot show that there was higher  $S_tO_2$ , indicating that the posterior tibial artery had a significantly better flow than the dorsalis pedis and peroneal arteries.

*"SnapshotNIR provides both an immediate assessment of the  $S_tO_2$  of a given area and a level of predictability about how a wound will likely heal when deciding on different treatment options. When considering an amputation for a patient, low  $S_tO_2$  values suggest poor healing capabilities for that area. Therefore, alternative treatment options should be pursued and more aggressive treatments should be postponed until the poor oxygenation levels have been addressed."*

**-Ron Ray, DPM**

**Post-operative:** SnapshotNIR images were also taken on the dorsal and plantar surfaces of the foot. The  $S_tO_2$  values obtained on the lateral aspect were in the 50s to 60s, and the values from the plantar aspect were in the high 40s. On the plantar surface, the  $S_tO_2$  values on the medial aspect were also in the high 40s and the values on the lateral aspect ranged from the high 50s to 60s. A superficial dehiscence developed on the medial aspect of the incision which was previously suggested by the low  $S_tO_2$  values of that area obtained from the post-operative NIRS images. Negative pressure wound therapy was used to facilitate closure.

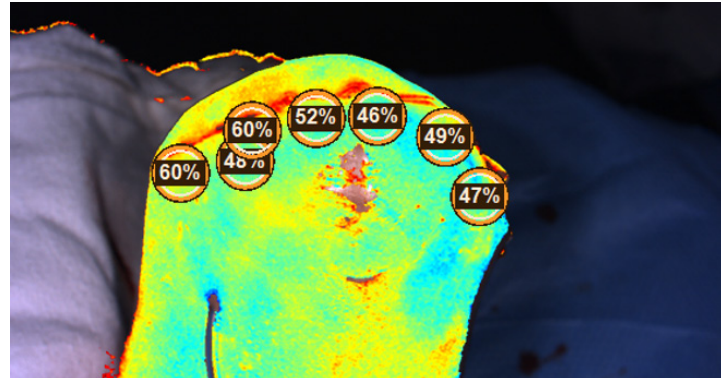
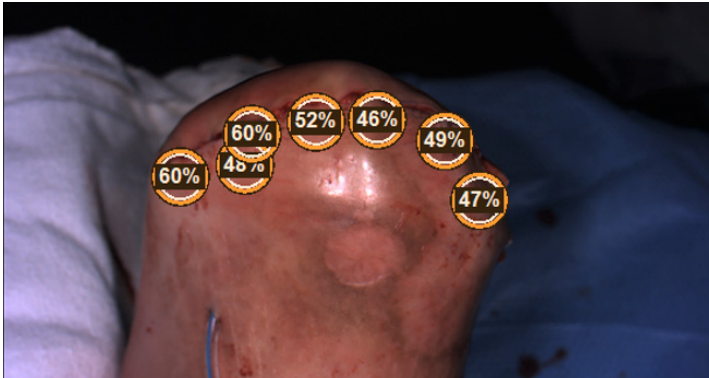


Fig 9. Intra-op closure of dorsal surface of the foot.

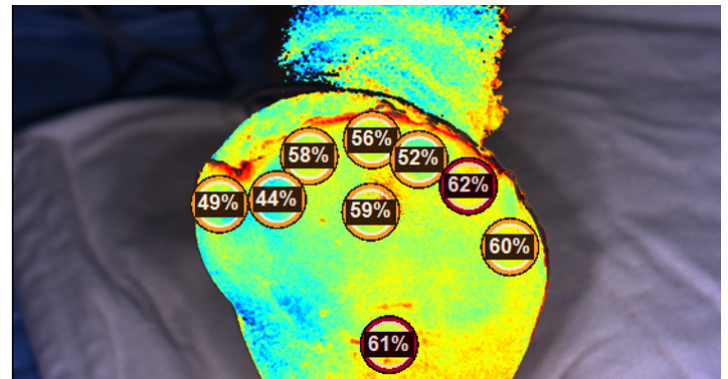
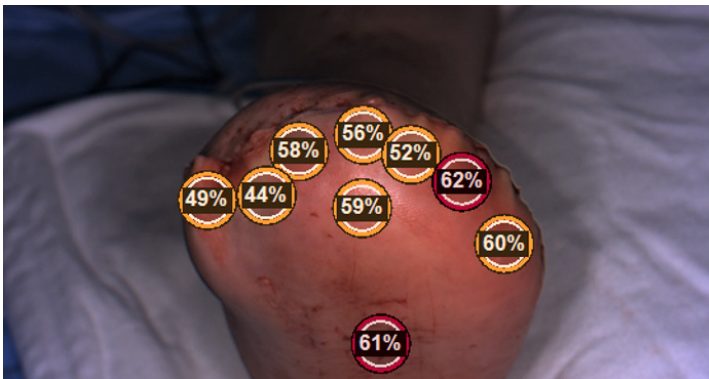


Fig 10. Intra-op closure plantar surface of the foot.

**IMPACT:**

In the closure and post-operative stage of the procedure, the images taken with SnapshotNIR provided another example of instantaneous actionable information as well as predictive information. Following the closure of the amputation site, SnapshotNIR images showed that the medial area of the suture site on both the dorsal and plantar aspects of the foot had markedly lower  $S_tO_2$  values compared to the lateral aspect of the surgical site. The predictive value of these images was validated when the patient returned to the clinic for a follow-up. Upon inspection of the surgical site, a superficial dehiscence had formed at the area of depressed  $S_tO_2$ . Negative pressure wound therapy was used to fully close this dehiscence.



Fig 11: Image of foot after six weeks post-op with a superficial dehiscence.