Preoperative Wound Bed Preparation Using Fluorescence Imaging to Optimize Outcomes in Complex Reconstruction

Michael N. Desvigne, MD, FACS, CWS, FACCWS[1], Misael C. Alonso, MD, FACP, CWSP, FAPWCA[2,3], Jody Wolfe, BSN, MBA, RN, CWOCN[2]

[1]Plastic & Reconstructive Surgery, Wound Care & Hyperbaric Medicine, Goodyear, AZ, [2]Abrazo West Campus, Goodyear, AZ, [3]MCA Medical, PLLC, Goodyear, AZ

Introduction

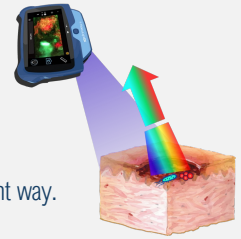
Preoperative infection management & wound bed preparation are outcome determinants in reconstructive surgery for chronic wounds[1,2].

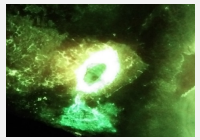
Current methods for assessing infection and biofilm (clinical evaluation, microbial cultures) are often subjective, delayed and inaccurate, causing delayed and incomplete interventions.

A real-time imaging tool for bacterial detection enables targeted bedside management in the preoperative and intraoperative periods of complex wound reconstruction. It has been validated as a predictor of graft success/failure thus helping determine graft timing objectively[3].

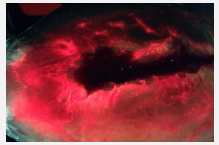
Fluorescence imaging offers a solution to these shortcomings through its validated, real-time, objective method of bacterial detection.

This technology uses a safe violet light to expose the fluorescence of endogenous bacterial components (porphyrins and pyoverdines) and captures, organizes and displays those signals in a clinically relevant way.

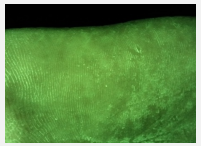




Cyan fluorescence (glowing white center with blue/green halo) indicates *Pseudomonas*[1]



Red/blush/pink/orange fluorescence indicates most gram positives, negatives, aerobes and anaerobes



Green fluorescence shows non-bacterial tissue components

This study aims to evaluate the impact of preoperative fluorescence imaging in optimizing wound bed preparation before complex reconstruction.

Methods

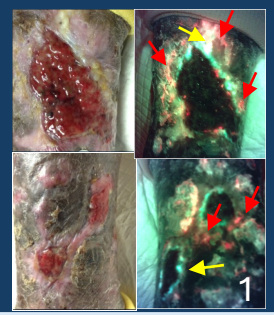
- 17 patients with chronic, non-healing wounds (pressure ulcers, DFUs, VLUs, non-healing surgical wounds) were evaluated using fluorescence imaging preoperatively in anticipation of a reconstructive procedure.
- Fluorescence imaging in the preoperative workflow:

Assess bacterial presence at pathologic loads (10^4 CFU/gr) in the wound and surrounding tissue. → Targeted debridement to reduce bacterial loads (fluorescence). → Re-image to determine the need for additional measures (antibiotics, etc.) and to guide timing of reconstruction.

- Aspects of preoperative care and surgical outcomes were evaluated in this cohort.

Case Example

- A 71-yo female with a VLU and a history of venous insufficiency, HTN & lupus, presented for surgical treatment including operative debridement and staged split-thickness skin graft (STSG).
- Positive fluorescence signals (Red arrows: gram +/- and yellow arrows: *Pseudomonas*) on arrival (Fig 1).
- Fluorescence guided debridement and NPWTi-d for 48 hrs until negative fluorescence was achieved; this indicated bioburden decreased below levels that could lead to poor outcomes (Fig 2).
- STSG performed on fluorescence-negative wound with placement of placental allograft to optimize healing (Fig 3).
- NPWT continued at recipient site and donor site NPWT continued with classic granufoam dressing on RLE with Peel &Place dressing to LLE recipient site and donor site.
- Excellent results at week 5 (Fig 4).



Results

1. Fluorescence imaging findings:
   - Bacterial contamination and biofilm were detected in all 17 cases, guiding targeted debridement and antibiotic therapy preoperatively.
2. Treatment algorithm:
   - Outpatient serial debridement and surgical debridement in the OR when needed.
   - NPWT with and without instillation.
   - Antibiotics (initiated in any case showing evidence of acute infection).
3. Postoperative outcomes:
   - **No infection-related complications.**
   - **No infection recurrence or surgical site infections (SSIs) in any case.**

When was fluorescence imaging needed in the decision-making process for wound reconstruction?

- Preoperative infection control
- Determining timing of surgical closure
- Flagging need for urgent surgical debridement
- Postoperative infection control

Conclusions Fluorescence imaging is an advantageous addition to the surgical preparation protocol in reconstructive surgery. It offsets shortcomings of standard of care practices with more objective and actionable data provided at the bedside that positively impacts outcomes.

1. Barrette, LX et al. Does preoperative wound infection impact outcomes of lower extremity salvage via microvascular free flap reconstruction? A cohort study. Orthoplastic Surg. **6**,11-4 (2021). 2. Gao, X et al. Preoperative irrigation and vacuum sealing drainage with antibiotic-containing drainage fluid of foot and ankle wounds improves outcome of reconstructive skin flap surgery. *J Orthop Surg Res* **14**, 374 (2019). 3. Hanson-Viana E, Rojas-Ortiz JA, Rendón-Medina MA, Luna-Zepeda BL. Bacterial fluorescence imaging as a predictor of skin graft integration in burn wounds. Burns. 2024 Sep;50(7):1799-1811.