Fluorescence Imaging-Guided Surgery: Using Objective Skin Perfusion Measures to Guide Managementin High-Risk Periarticular Tibia Fractures

***Aresh Sepehri MD**; Gerard Slobogean MD; Ida Leah Gitajn MD; John Alan Scolaro MD; Jonathan ElliottPhD; Nathan N O'Hara; Joshua Rudnicki BS; Phillip McKegg BA; Raymond A Pensy MD*
University of Maryland, Baltimore, MD, United States

Purpose: Laser-assisted indocyanine green angiography (LA-ICGA) is a novel method for objectively quantifying tissue vascularity and skin blood flow. This technique is US Food and Drug Administration (FDA)-approved and utilizes an intravenous injection of the indocyanine green (ICG) dye, followed by detection using a noninvasive laser camera. ICG concentration in the tissue, which is correlated with perfusion, is quantified in fluorescence units. Current clinical applications of ICG angiography include assessing cardiac perfusion following bypass and detecting graft failure following free tissue transfer. This technique was recently adopted at our center to assess soft-tissue perfusion surrounding high-risk tibial plateau and pilon fractures to help guide optimal timing of open surgical fixation.

Methods: In patients with soft-tissue injury surrounding periarticular tibia fractures, LA-ICGA was performed to assess skin perfusion over the surgical site prior to incision. This was performed intraoperatively at the time of definitive fixation and external fixation (if required). Ten mg of ICG dye was injected through peripheral IV and real time video was captured using the charge-coupled camera. Perfusion was quantified during the arterial phase of dye distribution in fluorescence units, assessing for the threshold of perfusion deficits within the injured area.

Results: Fig. 1 shows perfusion of a patient with a tibial plafond fracture with significant deficits at the time of external fixation. Repeat LA-ICGA measures at the time of definitive fixation demonstrate significant improvement of skin perfusion. Five patients with LA-ICGA perfusion measurements developed a postoperative infection. Early qualitative assessment of the skin perfusion measures demonstrated a significant deficit.
Conclusion: Fluorescence imaging-guided surgery is increasingly used across surgical specialties. Early case results suggest that skin perfusion as measured by LA-ICGA can predict postoperative wound complications and can potentially be used to guide surgical timing.

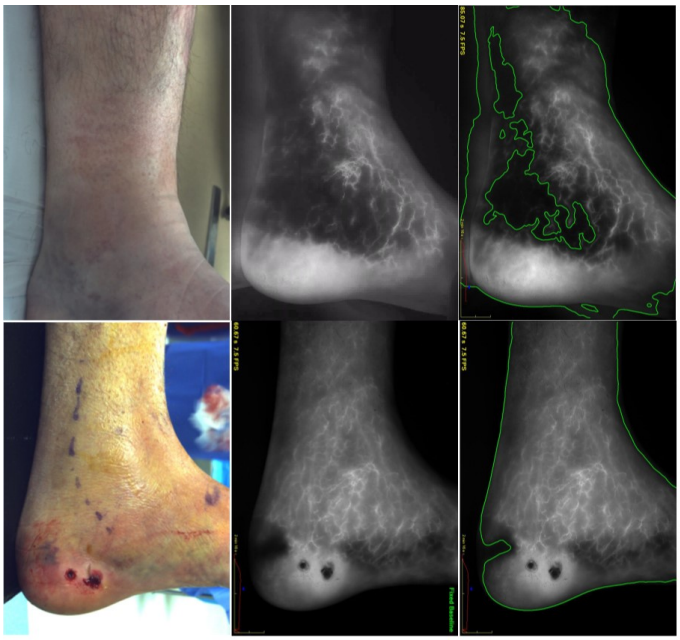

Figure 1. The top row from left to right shows a clinical picture, LA-ICGA perfusion image, and a LA-ICGA contour map set to 20 fu at the time of injury prior to external fixation in a patient with a tibial plafond fracture. The bottom row shows the same images 2 weeks later at the time of open definitive fixation. The perfusion deficit at the time of injury has improved.