

# OPTICS ARE THE ASTRONOMY OF WOUND HEALING

For years I have marvelled at the images of brilliant galaxies and hidden planets relayed from the Hubble Space Telescope to my humble laptop screen. I jealously wished that research studies and general practice in wound healing could incorporate such eloquent technology. In reviewing articles published in the *Journal of Wound Care* over the last year, several manuscripts caught my attention. In these publications, researchers repurposed the optical physics that bring supernovas into view to visualise haemoglobin and bacteria in hard-to-heal wounds and devise light-based therapies to accelerate healing.

In comparison to NASA's massive telescope technology, woundologists have progressed only to a Galilean level; however, these first generation instruments allow visualisation of previously unseen causes of wound failure. The first series of articles evaluates the use of fluorescence imaging to detect bacteria in hard-to-heal wounds, burns and in patients receiving negative pressure wound therapy (NPWT).<sup>1-3</sup> The procedure entails illuminating the wound with violet light at 405nm. Bacteria contain porphyrins and pyoverdines that are excited at this wavelength and emit a red or cyan light. Filters in the device allow detection of this fluorescence. If the bacterial load equals or exceeds 10<sup>4</sup> bacteria/gram of tissue, the clinician can identify areas of red and or cyan fluorescence in the wound bed or surrounding skin. The pilot study confirmed that the fluorescence correlated with bacterial load.<sup>1</sup> The second publication applied this technology to burns with similar success in detecting bacteria in acute wounds.<sup>2</sup> The third manuscript revealed the large amount of bacteria present in the sponges used in NPWT.<sup>3</sup> This fascinating finding will guide further investigation into the role of bacteria in wounds treated with NPWT.

The fourth article demonstrated the benefit of fluorescence biomodulation in healing venous leg

ulcers. The investigators employed a unique dual fluorescence biomodulation system consisting of a topical photoconverter gel applied to the wound bed. The gel contains chromophores that, when illuminated by a light emitting diode (LED) activator, emit light in a broad spectrum of wavelengths in the visual spectrum. The light is bactericidal, but does not harm human tissue.<sup>4</sup>

The final article compares a novel diagnostic, near infrared spectroscopy (NIRS), to transcutaneous oxygen (TCOM) in measuring tissue oxygenation. NIRS uses several wavelengths of near infrared and visual light to illuminate the wound and surrounding skin. These wavelengths are preferentially absorbed by haemoglobin. The ratio of oxygenated to deoxygenated haemoglobin is a measure of oxygenation. The pilot study suggested a favorable comparison between NIRS and TCOM.<sup>5</sup>

## References

- 1 Serena TE, Harrell K, Serena L, Yaakov RA. Real-time bacterial fluorescence imaging accurately identifies wounds with moderate-to-heavy bacterial burden. *J Wound Care* 2019; 28(6): 346–357. <https://doi.org/10.12968/jowc.2019.28.6.346>
- 2 Pijpe A, Ozdemir Y, Sinnige JC et al. Detection of bacteria in burn wounds with a novel handheld autofluorescence wound imaging device: a pilot study. *J Wound Care* 2019; 28(8):548–554. <https://doi.org/10.12968/jowc.2019.28.8.548>
- 3 Raizman R. Fluorescence imaging guided dressing change frequency during negative pressure wound therapy: a case series. *J Wound Care* 2019; 28(Sup9): S28–S37. <https://doi.org/10.12968/jowc.2019.28.sup9.s28>
- 4 Dini V, Janowska A, Davini G et al. Biomodulation induced by fluorescent light energy versus standard of care in venous leg ulcers: a retrospective study. *J Wound Care* 2019; 28(11):730–736. <https://doi.org/10.12968/jowc.2019.28.11.730>
- 5 Serena TE, Yaakov R, Serena L et al. Comparing near infrared spectroscopy and transcutaneous oxygen measurement in hard-to-heal wounds: a pilot study. *J Wound Care* 2020; 29(Sup6):S4–S9. <https://doi.org/10.12968/jowc.2020.29.Sup6.S4>



**Thomas E Serena**  
 MD FACS FACHM MAPWCA  
 Founder and Chief Executive  
 Officer, SerenaGroup Inc.,  
 Cambridge MA, US.  
 Director, SerenaGroup  
 Research Foundation  
 Emeritus President and  
 Master, American  
 Professional Wound Healing  
 Society (APWCA)  
 Board member,  
 International Surgical  
 Wound Complications  
 Advisory Panel