Use of Chromophores in Wound Healing.

Nikolis A[1], Morissette C[2], Rastogi S[2], Loupis N[2], Piergallini R[2], Hebert L[2]

[1]Centre Hospitalier de l'Université de Montréal, Division of Plastic and Reconstructive Surgery; [2] KLOX Technologies Inc.

Abstract

Patients with chronic wounds are a challenge to treat, as their wound physiology, presence of non-cooperative cells and frequent comorbidities lead to a much different wound species. One of the major factors of difficult to treat wounds remains the inability to improve blood flow within such environments. Given the relative paucity of treatment regimens that will reproducibly improve blood flow in wounds, the use of wavelength specific chromophores in the delivery of a substrate is a plausible new method of stimulating vascular inflow in the management of wound healing.[1-3]

In this study, we have focused the ability of chromophores and wavelength specific light in enhancing delivery of a substrate by stimulating recruitment of collaterals in a rat flap model, thereby improving the loco-regional state of the wound.

Methods

Following scientific and ethics committees approval, ten male Wistar rats between 220 and 240g, had 3x9cm random-type flaps raised on their dorsum[4], with the treatment group receiving substrate, chromophores, and light, evaluated against controls not receiving any adjuvant treatment following surgery. A mechanical barrier was placed between the flap and the underlying tissues to prevent vascular in-growth Fig 2. Rats were evaluated with photography and serial weight measures. Rats were sacrificed on day 9 following fluorescein dye injection and evaluation with the Woods lamp (Fig 6,7). Biopsies were taken and surface area of necrosis was quantified using Image-pro plus® software. Data was entered and analyzed using SPSS v16.[5]

Fig 1. Dorsum prepped and standard template used to delineate flap margins

Methods

Fig 2. Flap dissection, barrier insertion and ligation of iliac branches of iliolumbar artery.

Fig 3. Gel applied to the rat dorsum

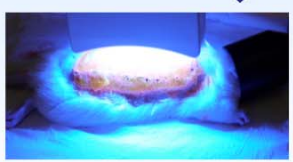

Fig 4. Light activation of chromophores

Fig 5. Dorsum following gel removal

Results

The results demonstrate a direct correlation of necrosis from fluorescein injection and direct visualization. Biopsies were evaluated for histology and immunohistochemistry. Data from the treated group demonstrate a clinically significant 1.5 times reduction in necrosis, (percent necrosis, mean, SD of 45.7 (±17.36) vs. 30.42 (±20.18), in the control and treatment groups respectively).

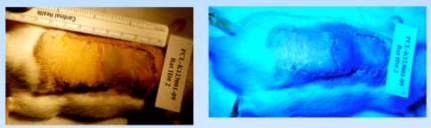

Fig 6. Clinical and Woods lamp evaluation of necrosis following flap surgery in the control group.

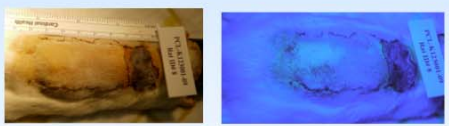

Fig 7. Clinical and Woods lamp evaluation of necrosis following flap surgery, in the treatment group (Light , chromophores and gel application).

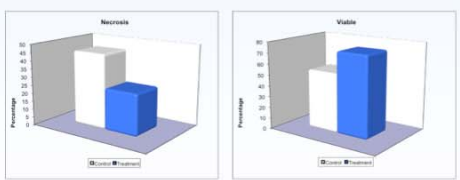

Fig 8. Percent necrosis vs. viable tissue day 9

Results

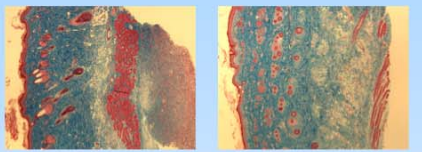

Fig 9. Masson Trichrome Staining for Assessment of Collagen Fibril Depositio (40X magnification), Control (Left) vs New collagen deposition in treatment group (Right)

Conclusion

A novel treatment regimen involving wavelength specific activation of chromophores and substrate placement will significantly impact outcomes in wound healing, through a refined delivery mechanism when evaluated against controls not receiving any adjuvant treatment. Improving loco-regional blood flow to complex wounds will impact wound healing favorably.

References

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For additional information please contact: Dr Lise Hébert at KLOX Technologies Inc., lhebert@kloxtechnologies.com