Photochemical Tissue Passivation Prevents Contracture of Full Thickness Wounds in Mice

Rachel L. Goldstein, DO,[1] Jane M. Tsui, MD, [1] Gem Runyan, BS, MS,[1] Mark A. Randolph, MAS,[1,2] Michael C. McCormack, MBA,[1] Martin C. Mihm, Jr. MD,[3] Robert W. Redmond, PhD,[2] and William G. Austen, Jr. MD, FACS[1*]

[1]Division of Plastic and Reconstructive Surgery, Department of Surgery, Harvard Medical School, Massachusetts General Hospital, 55 Fruit Street, Boston, Massachusetts, 02114

[2]Wellman Center for Photomedicine, Harvard Medical School, Massachusetts General Hospital, 55 Fruit Street, Boston, Massachusetts, 02114

[3]Department of Dermatology, Harvard Medical School, Brigham and Women's Hospital, 75 Francis St, Boston, Massachusetts, 02115

Background and Objectives: Wound contracture formation from excessive myofibroblast activity can result in debilitating morbidities. There are currently no treatments to prevent contracture. Photochemical tissue passivation (PTP), an established, safe, and user‐friendly treatment modality, crosslinks collagen by a light‐activated process, thus modulating the wound healing response and scarring. We hypothesized that PTP treatment would reinforce wounds by blunting the fibrotic response thus limiting contracture.

Study Design/Materials and Methods: Full‐thickness, 1 cm× 1 cm excisional wounds were created on the dorsum of 32 C57BL/6 mice. Treated wounds were painted with photosensitizing dye and exposed to visible light. Wounds were serially photographed over 6 weeks to measure wound contracture. At 7, 14, 21, and 42 days after wound creation, mice were euthanized and wounds were harvested for histologic review by a dermatopathologist.

Results: By Day 7, control wounds had significantly more contracture than those treated with PTP (33.0 ± 17.1% and 19.3 ± 9.0%, respectively; $P = 0.011$). PTP‐treated wounds maintained approximately 20% less contracture than controls from Day 14 and on ($P < 0.05$). By Day 42, wounds had contracted by 86.9 ± 5.5% in controls and 64.2 ± 3.2% in PTP‐treated wounds ($P < 0.03$). Histologically, PTP wounds had earlier growth and development of dermal collagen, neovascularization, and development of skin appendages, compared with control wounds.

Conclusions: PTP significantly limits contracture of full thickness wounds and improves wound healing. PTP‐treated wounds histologically demonstrate more mature structural organization than untreated wounds and closely resemble native skin. PTP treatment may be applicable not only for excisional wounds, but also for wounds with a high incidence of contracture and associated morbidity.