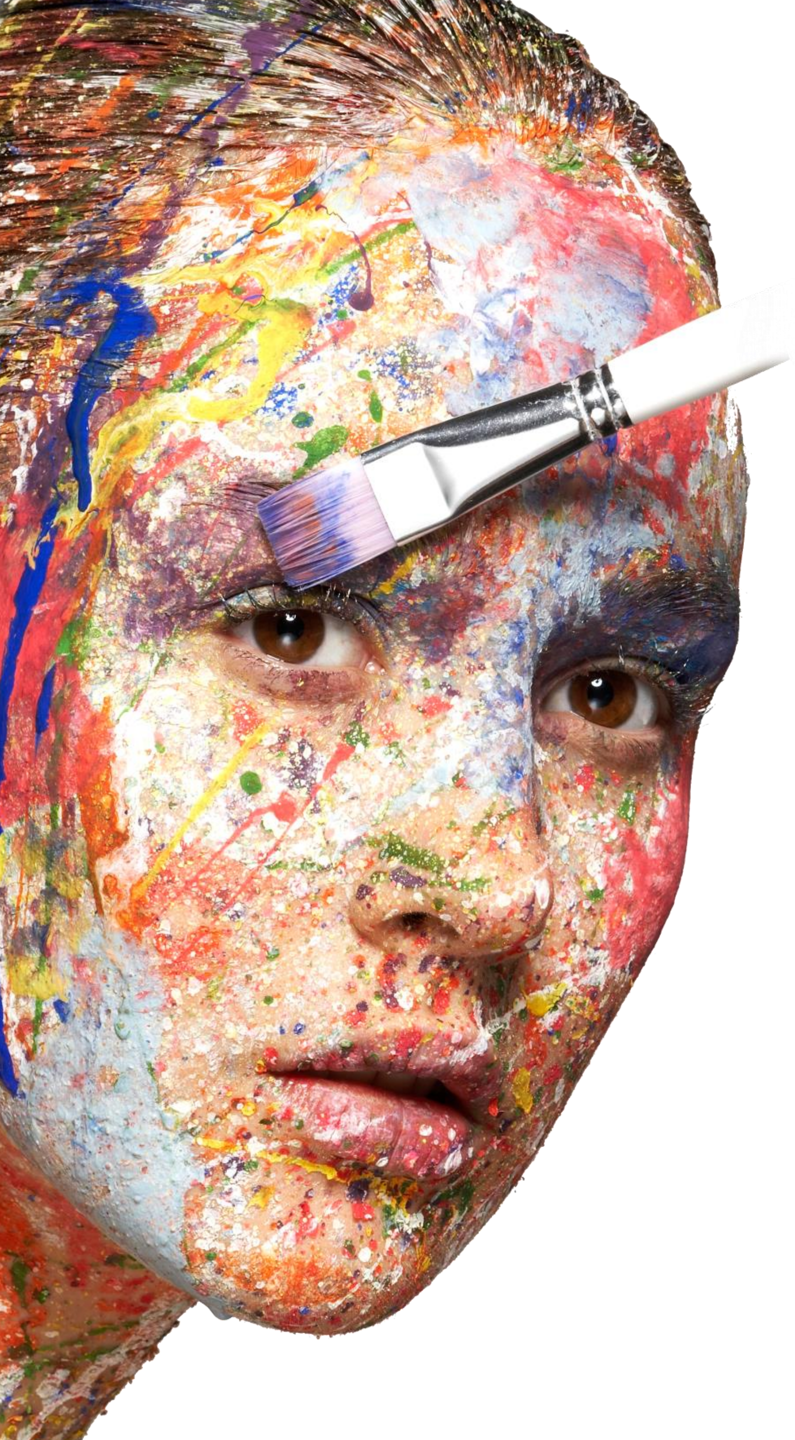

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Lasers in Surgery and Medicine

Ablative Fractional Resurfacing With Laser-Facilitated Steroid Delivery for Burn Scar Management: Does the Depth of Laser Penetration Matter?

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Background and Objective: To investigate whether the depth of ablative fractional CO_2 laser (CO_2-AFL) penetration of pathological burn scars influences clinical outcomes.
Study Design/Materials and Methods: All patients presenting to the Concord Repatriation General Hospital (CRGH) Scar Clinic received ultrasound measurement at the thickest point of their burn scars. Subsequently, the effect of various CO_2-AFL settings (energy which correlates to penetration depths) on different outcome parameters was analysed. Patients were divided into five groups depending on minimal scar penetration depth.
Results: Seventy-eight patients (158 scars) had complete data allowing for analysis. Median scar thickness was 3,400 µm and median laser scar penetration depth was 900 µm. Scar penetration categories were as follows: 0–25% ($n = 40$), 25–50% ($n = 67$), 50–75% ($n = 31$), 75–100% ($n = 8$), >100% ($n = 3$) of scar thickness. The median reduction in maximum scar thickness was 800 µm following one treatment ($P < 0.001$). However, this effect depended on scar penetration depth, whereby scars that were penetrated ≥75% showed no significant improvement in scar thickness and those penetrated >100% indicated a tendency to become worse. Other assessed outcome parameters included: the Vancouver Scar Scale, the Patient and Observer Scar Assessment Scale, a neuropathic pain score (DN4 Pain Questionnaire), and a pruritus score (modified D4 Pruritus Score). All these factors showed significant improvement in the categories up to 75% scar penetration depth.
Conclusions: CO_2-AFL scar penetration depth significantly influences subjective and objective pathologic burn scar modulation. The penetration depth of 51–75% achieves the greatest reduction in scar thickness. Lasers Surg. Med. © 2019 Wiley Periodicals, Inc.

Key words: burn scars; ablative fractional CO_2 laser; depth of laser penetration; scar thickness; scar assessment scores

INTRODUCTION

With increased survival rates of burn victims, severe burn scarring remains a modern clinical challenge [1]. The addition of ablative fractional laser resurfacing to routine burn scar management seems promising and provides an excellent treatment modality complementing, if not replacing, the traditional reconstructive surgical approaches [1–3].

Ablative fractional laser devices, such as the ablative fractional CO_2 laser (CO_2-AFL), apply the laser beam to fractions of the skin surface. On the basis of water absorption and bulk heating, epidermal and dermal structures are removed, resulting in microscopic ablative zones (MAZ) [4]. High energy and a short pulse duration in CO_2-AFL facilitate precise effects with minimal side effects so that islands of undamaged skin can serve as reservoirs to trigger small wound healing reactions and subsequent scar remodeling [5]. CO_2-AFL devices ablate micro-columns vertically through epidermis and dermis [4]. The effective depth of these MAZs depends on the amount of energy applied and skin conditions, such as hydration and surface temperature [4]. The SCAAR™ mode of the ablative fractional 10,600-nm wavelength CO2 Ultrapulse® laser (by Lumenis®), for example, can penetrate to reach a depth of up to 4.0 mm with a narrow

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and have disclosed the following: The authors declare that there is no source of financial or other support, or any financial or professional relationships, which may pose a competing interest. Lumenis Australia has paid for one of the corresponding authors conference attendances (ANZBA Australian & New Zealand Burn Association) 2018 in Brisbane Australia.

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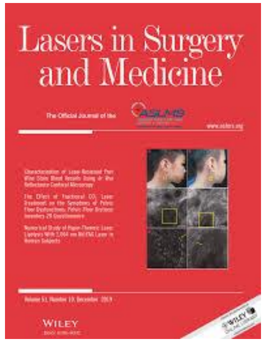

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Lasers Surg Med. 2019 Sep 30

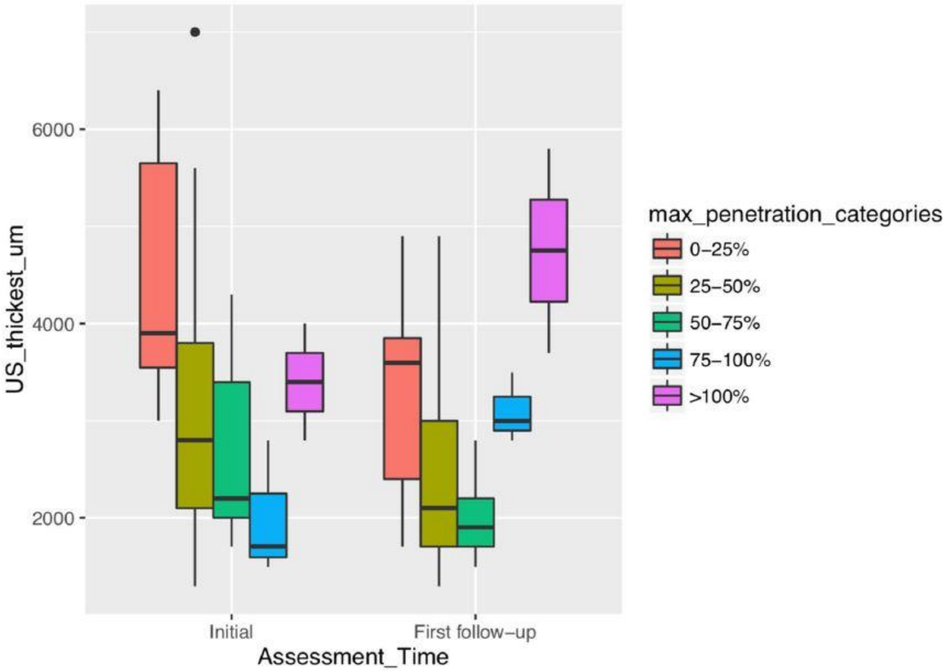
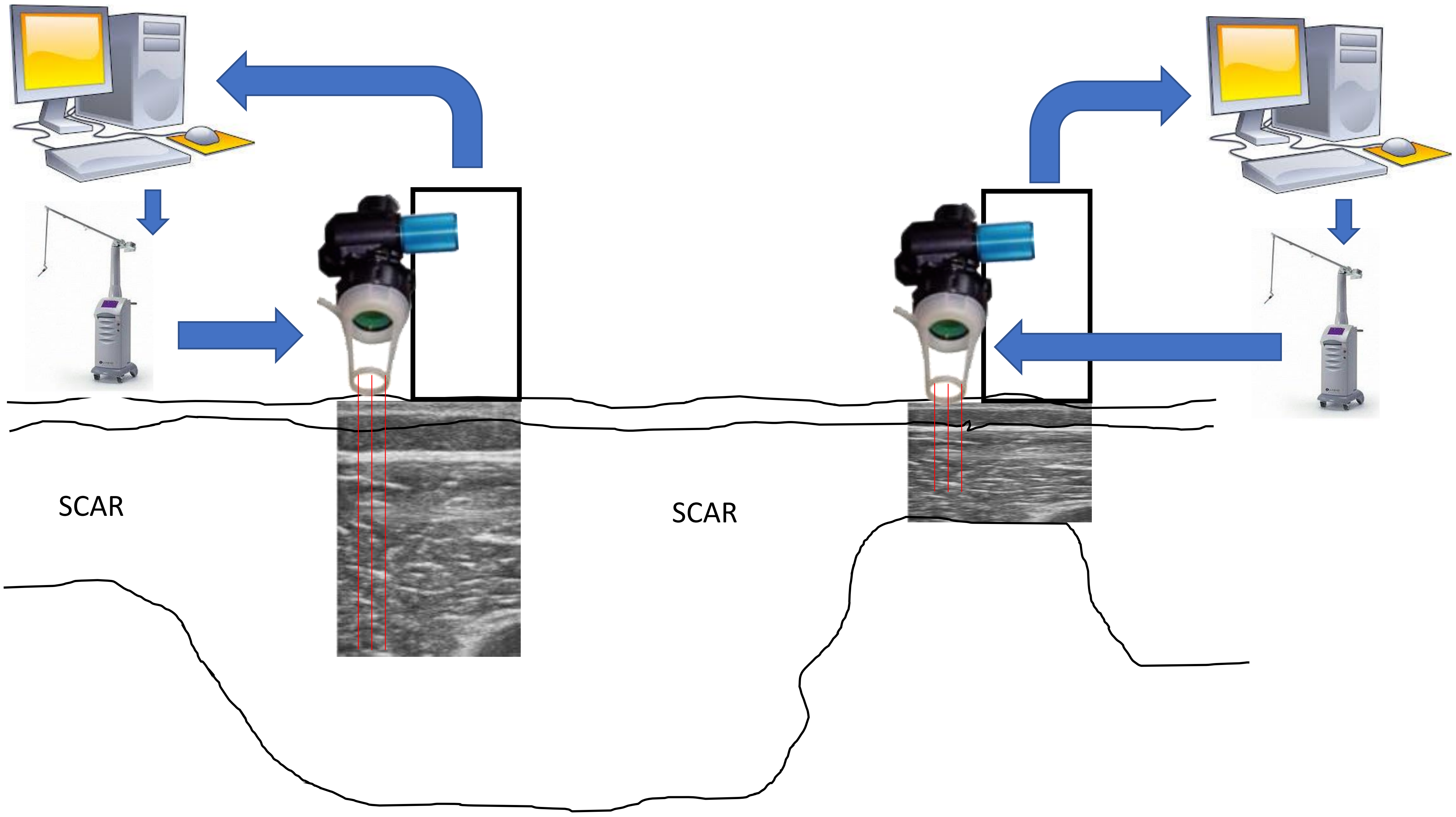
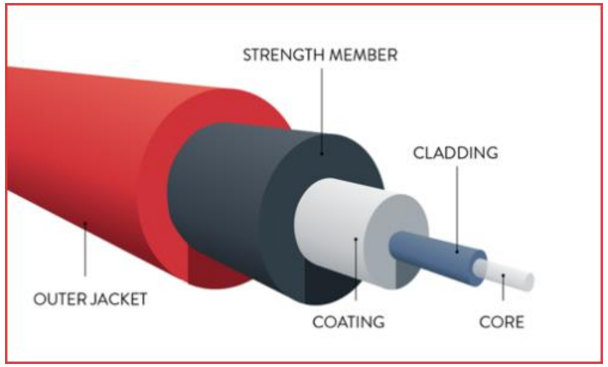


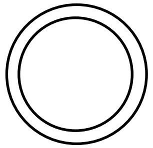
Fig. 1. Boxplot demonstrating the effect of different penetration categories on scar thickness before and after one treatment with the CO_2-AFL.

Our results suggest that a scar penetration of 51–75% achieves the greatest reduction in scar thickness.

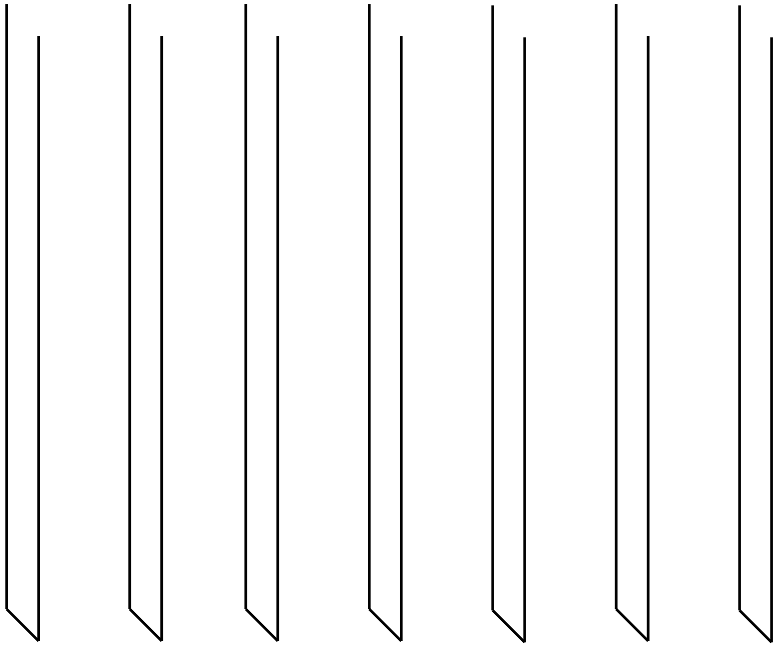


Automatic ultrasuond detection of the thickness of a scar and related energy adjustment

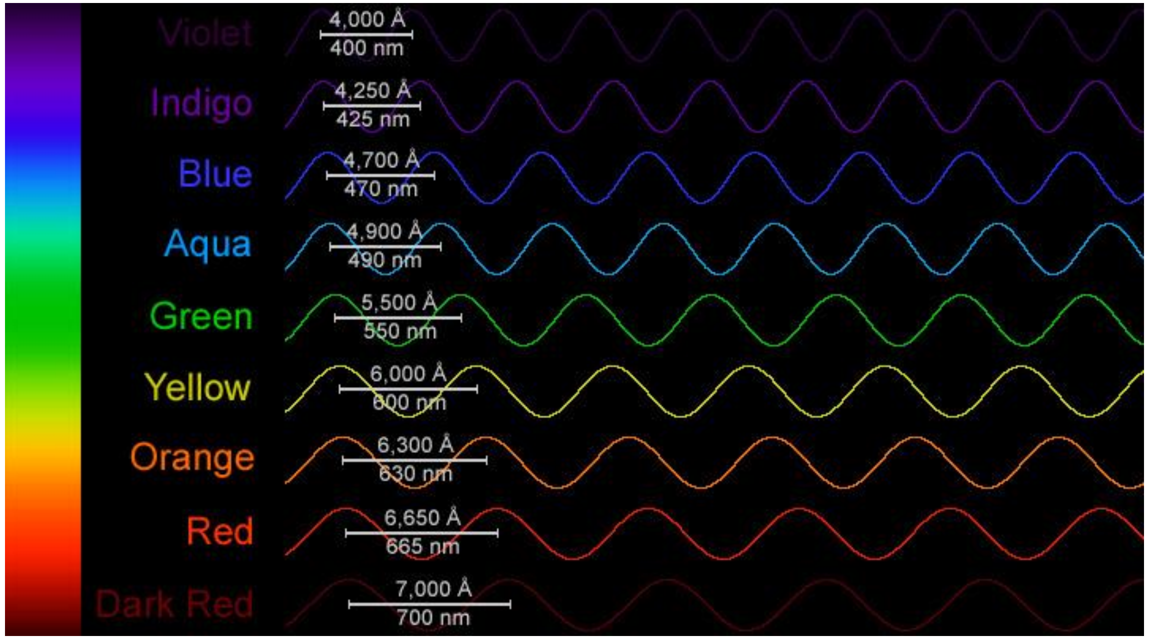




Optic fibers to be inserted inside needles



Neddles can reach different depth



Different wavelength energy source

Working really close to defect to destroy
Need minimal amount of energy
Bypass the surface barrier

Thank you very much for your attention

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