Title

OPTIMAL LASER PARAMETERS FOR CONSISTENT THERAPEUTIC OUTCOMES ACHIEVED WITH THE LONG PULSED 1064nm LASER, MODULATED BY THERMAL CAMERA GUIDANCE AND OPTICAL COHERENCE TOMOGRAPHY

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Background: In optimizing laser thermal damage for new medical applications, non-invasive monitoring and efficacy confirmation could benefit cosmesis via patient-tailored treatment. However, classic endpoints are based on contact treatment and monitoring. Herein we discuss combining non-invasive long-pulsed (LP) 1064 nm Nd:YAG treatment, thermal camera guidance and OCT confirmation while testing literature-based formulas for contact thermal destruction in a non-contact system.

Study Design/Materials and Method: Shaved flexor-surface forearm skin was marked up and anesthetized with lidocaine and epinephrine. The parameters of a scanner-equipped, LP 1064 nm Nd:YAG laser were tailored to achieve an epidermal/superficial dermal heating of between 50 and 60°C over a specified time course. An infrared (IR) camera was used to record skin temperature. Outcome measures included skin temperature, post-treatment appearance and OCT assessment of skin and vascular damage. Clinical response of each treatment was followed daily for 4 weeks.

Results: Relevant parameters included fluence, pulse overlap, pulse stacking, scan pattern size, and number of passes, all of which generated higher skin temperatures. The first high-energy pulses of 100–120 J/cm^2 achieved initial temperatures of 50–58°C, which were maintained with subsequent passes at lower fluences of 25–50 J/cm^2 over the 30–60 seconds time course. Immediately post laser, a clinical response including erythema and edema was noticed. OCT assessment revealed increased vascularity with intact, dilated blood vessels as opposed to reduced blood flow previously reported. Prolonged exposure above 60°C resulted in sub-epidermal blistering and an absence of blood flow in the treatment area with prolonged healing.

Conclusion: The LP 1064 nm laser can be used to achieve heat-related tissue injury, though the narrow parameters necessary for the desired endpoint need the assistance of IR thermal regulation to avoid unacceptable outcomes. Use of the laser scanner ensures precise energy delivery over a defined treatment area. Future studies may explore this as a potential destructive method for non-melanoma skin cancer.