SELF CANALIZATION OF LASER MICROBEAM IN TISSUE AS FUNDAMENTAL MECHANISM OF FRACTIONAL SKIN RESURFACING

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Background: IR Laser-induced (λ = 1715 nm) formation of very deep, narrow, but separated coagulation columns in human skin was reported in Ref. [1]. Cylindrically shaped damage columns extending from skin surface to 1 mm depths with diameters ~0.15 mm were observed. Details of the process of column formation in this approach, now referred to as fractional non-ablative treatment, are still not fully understood.
Objective: Investigate details of column formation and dependence of column shape and dimensions on the beam parameters.
Materials and Methods: Laser sources with different wavelengths (1064 to 1715 nm), pulsewidths (1 to 40 ms), and microbeam energies and geometries were used to treat porcine skin ex vivo. Skin transmission and temperature profiles were measured during the laser pulse. Damage profiles were measured with H&E and NBTC stains. Experimental results were compared with computer simulations.
Results: All beam geometries caused high-aspect coagulation columns. Transmission varied dynamically during the laser pulse. Results can be explained by light-induced changes in absorption and scattering of tissue. Light-induced transparency promotes canalization of photonic energy along the optical axis of the microbeam, which results in significantly deeper penetration into the tissue than predicted by linear theory.
Conclusion: In non-ablative fractional treatments, high-aspect, cylindrically shaped microcolumns can be formed according to a non-linear theory of tissue canalization by using parameters that enhance the phenomenon of light-induced tissue transparency.
Reference: 1. Khatri K et al. Treatment of rhytids with subsurface-focused Er:YLF laser *Lasers in Surgery and Medicine* **Suppl. 15** 21, 2003.