Comparative analysis of narrow-band and broad-band sources for creating hyperthermia in hypodermal tissue

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Background and Objectives: Controlled hyperthermia of subcutaneous tissue is a promising tool for treating a wide range of pathological conditions. Lasers operating at peaks of fat absorption (e.g., 1208 nm) were proposed as unique light sources to attain this capability. In this study, we compared, numerically and experimentally, thermal effects produced in subcutis by such a laser and by an appropriately filtered broad-band source (halogen lamp).

Study Design/Materials and Methods: Two light sources: a broadband halogen-lamp-based infrared light source and a diode-pumped fiber laser operating at wavelength 1208 nm, both with contact surface cooling, were used. Yucatan pig skin was treated in vitro, and resulting thermal damage was evaluated using NTBC stain.

Results: Feasibility of creating well-defined zones of elevated temperature protruding deep into the subcutis with preservation of the upper skin tissue was predicted in computer simulations and confirmed experimentally for both devices. Generally, at equivalent power and pulsewidth settings, the fiber laser resulted in deeper maxima of temperature/damage. However, proper adjustment of parameters of the broadband device allowed to match closely the effects of the fiber laser. This observation suggests that selective surface cooling and pulse duration play prominent roles in precisely targeting subcutaneous treatment areas.

Conclusion: Results suggest that both fat-absorption-selective laser and properly filtered broadband lamp are practical sources for achieving subcutaneous hyperthermia.