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Towards definitive hair removal with high power diode lasers: *In silico* study of the influence of the laser parameters on the efficacy and safety of the treatment

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Abstract

The efficacy and safety of conventional laser hair removal technology is fundamentally based on clinical case studies. However, the internal temperature of hair during treatment and thus the efficacy of the laser pulse cannot be measured or evaluated. Also, the level of heat that reaches the surrounding skin tissue is just estimated in order to prevent burning. In this sense, any method that enables the measurement of the temperature that reaches the hair and skin during a laser pulse is a potential tool to improve laser hair removal technique and to increase the safety of laser technology. Here we develop new numerical multiphysics simulation software to simulate the hair removal process using COMSOL Multiphysics® software. We create 3D models of dermal tissue that include the epidermis, dermis and hair follicle structure. Subsequently, laser pulses of 755 nm, 810 nm and 1064 nm with different power and pulse characteristics have been simulated. Through a process of numerical calculation, we simulated the heating of skin and hair follicles with various characteristics and determined the temperature and thermal damage in order to anticipate the efficacy and safety of laser hair removal. We show that the best results are obtained with shorter pulse durations and, therefore, with the highest laser power. Moreover, we demonstrate that longer wavelengths (1064 nm) provide better efficacy and safety for dark skin. The model developed in this study can be used to gain a better understanding of the laser hair removal process, to conduct clinical studies, develop better and safer devices, and to assist clinicians in the selection of parameters for achieving optimal and safe results during hair removal.

Biography

Professional with 20 years of experience in laser and optics for different medical, scientific, industrial and defense applications. Doctorate in applied physics and optics in 2000 specialized in advanced materials and techniques of synthesis and characterization of materials. Director of research and general manager of leading company in the manufacture of laser components. CTO of cocoon medical since 2014. Founder of the scientific department in cocoon medical in 2016 and creation of mathematical methods to simulate the heating and cooling processes of living tissues using laser, RF, ultrasound and cold based techniques. More than 40 publications in scientific journals and more than a dozen papers in international congresses, in addition to several patents published on new materials.

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