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Effect of epidermal absorption on laser treatment dose calculations

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Abstract content
   (Max 300 words)

Introduction: Skin cancer treatments such as Photodynamic Therapy (PDT) rely on light, generally obtained from a laser source, to activate a drug. Penetration of laser light through human skin is highly dependant on the optical properties of skin. The absorption coefficient of the epidermis varies with the amount of melanin in the epidermis (or the skin phototype). The absorption and scattering of the light in the outer skin layers determine the fluence of the light reaching the intended treatment site. For effective treatment the losses due to the scattering and absorption must be taken into account.
Material & Methods: A two layer skin model (epidermis and dermis) with an embedded tumour was developed in the ASAP software environment. This software is based on Monte Carlo ray tracing and 3.1 million rays were traced through the model. In the program the layer geometry, refractive index, anisotropy and the absorption and scattering coefficients of each layer is specified. The epidermal thickness was varied from 40-90 μm. The spread in absorption coefficients (0.002-3.0 mm-1) for the typical South African skin phototypes were used as input to the computer model to determine the fluence reaching the tumour at a depth of 200 μm. The absorption in the epidermis was also evaluated.
Results: For a 90 μm thick epidermis with an absorption coefficient of 3 mm-1, 50 % of the light was absorbed in the epidermis. This influences the laser treatment parameters for effective treatment at a depth of 200 μm. Keeping the laser power density constant, the treatment time must increase from 235 s to as much as 374 s to deliver the same dose to the tumour.

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