AbstractID: 3770 Title: A kernel-based model for light fluence rate calculation in prostate photodynamic therapy

Purpose: To develop a model to accurately calculate light fluence rates in prostate photodynamic therapy (PDT).

Method and Materials: A kernel-based model was developed to calculate light fluence rates in prostate PDT. A kernel was generated for each light source, which was based on the solution of the diffusion equation describing light transport in scattering media and was developed for the linear light sources used in the PDT. Light fluence rates in the prostate were obtained by summing the contributions from each light source. Optical homogeneity was assumed for each kernel. The model was applied in PDT treatment planning to predict light fluence distribution within a whole prostate in three dimensions. Light fluence rates were calculated in patients who had undergone PDT treatment and were compared with the in-vivo measurements. Calculations under different conditions, e.g., using estimated parameters or measured parameters, were compared.

Results: In the treatment planning, isodose lines were predicted and were superimposed on the ultrasound images of the patient's prostate, and the light fluence rates at the detector positions as well as in the urethra were predicted. Comparisons were made between the calculations and measurements among 12 patients with: (1) measured or estimated mean optical property (uniform source strength, 150 mW/cm), and (2) measured or estimated mean optical property (actual source strengths). The errors of the calculations using actual source strengths were smaller than those using the uniform source strengths, which had maximums of 500% and 400%, respectively, among the 12 patients. Using actual source strengths, the average errors of the calculations over 12 patients, were ~89% and ~104% using measured and the mean optical property, respectively.

Conclusion: The study indicates that accurate source strengths are important in the calculations and accurate optical properties are necessary for accurate calculations of light fluence rate distribution.