

AbstractID: 6427 Title: Quantitative interstitial multispectral diffuse optical tomography of human prostate using a priori structure information

**Purpose:** To develop an interstitial multispectral diffuse optical tomography (iDOT) system to quantify optical properties, drug concentration and tissue oxygenation of prostate before and after photodynamic therapy (PDT).

**Method and Materials:** iDOT system uses continuous-wave measurements from 12 motorized isotropic detectors inserted in the prostate. Optical properties of prostate were reconstructed using single-wavelength measurements at 732nm. Six point-sources were introduced interstitially. Multispectral iDOT acquired the absorption spectra in 650-850nm region emitted from 6 optic fibers connected to a halogen lamp. The multispectral method directly reconstructs tissue chromophore concentrations and Mie scattering factors through incorporation of a priori anatomic information and spectral properties. The accuracy and convergence of the reconstruction algorithms were tested in mathematical phantoms with known geometry and optical property distribution. Clinical iDOT were performed on 12 patients for single-wavelength optical property measurement and 2 patients for spectral measurements.

**Results:** Phantom study results demonstrated that iDOT can reliably recover the optical properties, chromophore concentrations and scattering factors in clinical-relevant geometries with fast convergence. In clinical studies, the averaged reconstructed pretreatment  $\mu_a$  and  $\mu_s'$  at 730nm varied between  $.003\text{mm}^{-1}$  and  $.162\text{cm}^{-1}$  (mean  $.03\pm.02\text{mm}^{-1}$ ) and  $.11$  and  $4.4\text{mm}^{-1}$  (mean  $1.4\pm 1.1\text{mm}^{-1}$ ) among 12 patients. The absorption coefficients for some patients were significantly reduced post-treatment due to photobleaching of the photosensitizer. For multispectral measurements, the pretreatment total hemoglobin concentration was found between  $51\mu\text{M}$  and  $370\mu\text{M}$ , with oxygen saturation of 67%-90%. There was no significant change post-treatment. The pretreatment photosensitizer concentration varied from 1.4 to 9.2ng/mg for 2 patients. Up to 66% decrease of photosensitizer concentration was observed in one patient in the post-treatment measurements.

**Conclusion:** Preliminary clinical results showed significant inter- and intra-prostatic variation in tissue optical properties, oxygenation and photosensitizer concentration, suggesting that parameters other than anatomical information should be considered for PDT treatment planning.

**Conflict of Interest (only if applicable):**