AbstractID: 10817 Title: Toward a true real-time in vivo dosimetry system using plastic scintillators

Purpose: Plastic scintillation detectors (PSDs) have shown great promise for offline applications such as IMRT QA. Because of their fast response and high sensitivity they could also be used as in vivo detectors. In this work we present and validate a PSD system designed for multi-probe in vivo measurements with an electron-multiplying CCD for real-time photodetection.
Method and Materials: The detectors were built with a dose sensitive volume of 0.4 cubic millimeters. Individual PSDs were assembled in modular detector patches each containing 5 closely packed detector elements. Continuous dose readings were performed every 150 ms (1.5 cGy) with a dead time of less than 0.3 ms between consecutive readings. We first studied the signal-to-noise ratio for different electron multiplication gain factors. We then analyzed the precision and accuracy of the detectors in acrylic and anthropomorphic pelvic phantoms.
Results: The PSDs were found to be compatible with two clinical models of rectal balloons and could easily be inserted into the anthropomorphic phantom. A twofold increase in signal-to-noise ratio was seen by setting the electron-multiplication gain factor to 40 therefore making near real-time dosimetry feasible. Under calibration conditions, the PSDs agreed with ion chamber measurements to 0.08%. Precision was a function of the total dose delivered, ranging from 2% at 2 cGy to 0.4% at 200 cGy.
Conclusion: We have shown PSD read in 150 ms with high accuracy and precision. We have also shown that these detectors can be mounted on different types of rectal balloons therefore transforming these clinical devices in dose detectors without modifying current clinical standard of practice and care. Real-time monitoring of the dose delivered close to the rectum during prostate treatments will be invaluable to protect this sensitive normal structure while keeping small margins around the prostate.

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