Title: **Development of a scintillating fiber dosimeter**

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The purpose of this work is to build a dosimeter made up of a plastic scintillation detector array with high sensitivity, good precision and reproducibility. Plastic scintillation detectors possess qualities to suit the most complex radiation therapy treatment plans, such as those arising in intensity modulated radiation therapy (IMRT), radiosurgery or tomotherapy. The disadvantage of scintillation detectors is the presence of noise arising from radiation effects in the optical fibers guiding the light to the photodetector. To reduce this effect, a complete examination of scintillation dosimeters was carried, beginning with a theoretical analysis of light collection in plastic scintillators. This work was followed by an experimental evaluation of several types of scintillation probes, coupling methods, photodetectors and three noise reduction techniques. Both the theoretical and experimental results justified the choice of a scintillating fiber since it produced a 50 % gain in signal over the plastic scintillator. The CCD camera was found to be the optimal photodetector. It possesses sufficient sensitivity, allows the simultaneous measurement of more than 3,000 dose signals, has built-in color separation and is sufficiently stable. Once the best components were selected, there followed the development of a dosimeter comprised of three scintillating fibers and a CCD camera to test filtering techniques and verify their reproducibility and precision. It was shown that, after denoising, a precision better than 1 % was possible without compromising spatial resolution. The response of three probes with volume of 0.0014, 0.0034 and 0.0083 cm^3 is constant for dose rates varying from 10 to 600 cGy/min and linear for integration times between 0.05 and 50 s. Reproducibility better than 1 % was found for minimal doses of 45, 35 and 20 cGy deposited respectively in the small, medium and large probe. An array of detectors was built using ten plastic scintillating fibers aligned with 5 mm spacing in a water equivalent phantom. It was used for accurate evaluation of dose distributions. Even if the dosimeter was built using a relatively inexpensive color CCD camera, its small detecting volume and the excellent properties of plastic scintillators make it an ideal detector for IMRT and applications producing complex radiation fields.

Key words: scintillator, scintillating fiber, dosimetry, dosimeter array, CCD camera, small volume dosimeter, spatial resolution