Purpose:To study the feasibility of implementing a low cost, high speed in vivo real time dosimeter based on scintillating fiber arrays to verify intensity modulated radiation therapy (IMRT) to enhance treatment safety and delivered dose verification.
Methods:Detector construction is performed by mounting linear scintillating fiber sensors in a water equivalent plastic support to form a homogenous water equivalent array. The fibers are aligned to match each MLC leaf pair and the detector is placed in the accessory tray of a clinical LINAC for beam output determination. Each fiber is coupled to a high speed photodetector and front end amplifier to process the detector output which is digitized and analyzed using in house developed software to compute the beam fluence, dose rate, and MLC opening.
Results:The detector response correlates linearly with the LINAC beam intensity and MLC positions. The sensor and front end amplifier has a time response of 0.2 usec, thus every 2 usec LINAC pulse is recorded to determine the beam fluence with a precision better than 1%. The array offers a minimum beam attenuation of 2.4%, allowing the use of this technology as an in vivo transmission detector. We determined that the detector is capable of measuring the MLC opening with a precision of 2 mm per leaf.
Conclusions:We have proven the feasibility of constructing a scintillating fiber sensor array for in vivo real time dosimetry to enhance patient safety during IMRT treatment and measure actual dose delivered to the patient. The technical highlight of this detector is based on the high speed of the linear sensors and front end amplifier which allows real time verification of the IMRT fluence output, dose rate, and leaf opening with a minimum of perturbation or absorption of the delivered beam.