

AbstractID: 10679 Title: Dosimetric impact of gold fiducial markers in patients undergoing external beam radiation therapy

Purpose: Gold fiducial markers are widely used in image guided radiation therapy to correct for setup error and organ movement. These gold fiducial markers could cause dose perturbations in the target volume for patients undergoing external beam radiation therapy. The objective of this study was to determine the dosimetric impact of gold fiducial markers in patients receiving photon radiation therapy.

Method and Materials: Monte Carlo simulations were performed using a newly developed user code for EGSnrcMP. The gold fiducial marker was 3 mm long and 1.2 mm in diameter. Single field and parallel opposed, 6 MV and 18 MV photon beams, were tested with the marker in different orientations. Radiochromic film measurements confirmed the accuracy of the Monte Carlo model.

Results: Monte Carlo simulations indicated that dose perturbation depended on marker size, orientation, and beam energy of the incident beam. Maximum dose perturbation were found for single 6 MV beam. In that case, dose increase reached a factor of 1.52 near the upstream surface of the marker due to electron backscatter. At the downstream surface the dose dropped to 0.72 of the dose at the same point without the marker. For 18 MV the respective values were 1.46 and 0.91. In parallel-opposed beams, the dose reduction was within only 5% and 2% at 6 MV and 18, respectively. Dose enhancement, however, remained significant reaching factors of 1.15 and 1.30 for the two energies.

Conclusion: Dose perturbations from the gold fiducial marker exceeded 50%. The dose reduction effect can be alleviated with multiple beams incident from various directions, whereas the dose enhancement can be optimized to achieve elevated dose around the markers placed inside a lesion. Markers of different sizes and/or materials (carbon, for example) will be further investigated for their potential for improving dose distributions.