AbstractID: 5532 Title: Modifications of Megavoltage Photon Beams for Gold Nanoparticle-Aided Radiation Therapy (GNRT): A Monte Carlo study

Purpose: To produce megavoltage photon beams capable of achieving clinically significant (> 10%) macroscopic tumor dose enhancement during *gold nanoparticle-aided radiation therapy (GNRT)*.

Method and Materials: *GNRT* is an emerging treatment modality currently under development, based on the following observations: a) high tumor specificity of gold nanoparticles due to passive extravasation; b) significant tumor dose enhancement during x-ray irradiation as a result of increased photoelectric absorption due to high atomic number (Z) of gold. A previous Monte Carlo study found that no meaningful tumor dose enhancement would occur during *GNRT* with typical megavoltage photon beams, even after the removal of the flattening filter from linear accelerators. Therefore, the current Monte Carlo study investigated a number of ways to further increase the amount of low energy photons in the beam and consequently to achieve clinically significant tumor dose enhancement with photon beams in megavoltage range. Specifically, the macroscopic tumor dose enhancement under the identical geometry was calculated using the BEAMnrc/DOSXYZnrc code as the following conditions changed: the energy of electron pencil beam incident on the target, the target thickness, and the target material.

Results: The current results showed that the macroscopic dose enhancement up to 40 and 18% across the tumor volume could be achievable with unflattened 2 and 4 MV photon beams, respectively, at a reasonable gold concentration of 3% within the tumor, after the proposed changes in target thickness and material. These beams were found capable of producing clinically acceptable treatment plans for *GNRT*, in spite of their softer photon energy spectra and larger buildup doses, compared to conventional megavoltage beams at the same nominal photon energies.

Conclusion: Clinically significant tumor dose enhancement could be achievable during GNRT with megavoltage photon beams, provided that the proposed modifications to linear accelerators are made.