AbstractID: 7549 Title: Microscopic Estimation of Tumor Dose Enhancement during Gold Nanoparticle-Aided Radiation Therapy (GNRT) using Diagnostic Energy Range x-rays

Purpose: To estimate microscopic tumor dose enhancement due to gold nanoparticles 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 provided some quantitative estimation of macroscopic dose enhancement (i.e., the average dose enhancement over the entire tumor volume) for a number of GNRT scenarios, which is useful to understand potential therapeutic outcome, in terms of a conventional dose response scheme. On the other hand, the magnitude of physical dose enhancement at the cellular level is expected to be drastically different from that averaged over the tumor volume. Therefore, the current study attempted to estimate microscopic tumor dose enhancement for a clinically feasible GNRT scenario using diagnostic energy range x-rays. Specifically, after obtaining secondary electron spectra due to interactions between 140 kV x-rays and gold nanoparticles, detailed history Monte Carlo calculations were performed at a nanometer scale to estimate the energy deposition by secondary electrons originated from gold nanoparticles.

Results: The current results suggest that the microscopic dose enhancement up to a factor of 8 could be possible within 20 microns from a single gold nanoparticle. The results also show that the magnitude of microscopic dose enhancement is a function of the distance from the site of a gold nanoparticle.

Conclusion: A drastic tumor dose enhancement (i.e., > 100%) at the cellular level could be achievable during GNRT using diagnostic energy range x-rays. However, an actual radiobiological outcome would depend on a number of factors such as the size, amount, and distribution of gold nanoparticles within the tumor.