Purpose: Age-related macular degeneration (AMD) is the leading cause of irreversible vision loss for people over the age of 60 in the United States. In this study the dosimetric feasibility of using gold nanoparticles (AuNP) as radiosensitizers to enhance stereotactic radiosurgery for neovascular AMD is investigated.

Methods: Analytic calculations were carried out to estimate the nucleus dose enhancement factor (nDEF) due to photon-induced photo-/Auger electrons from AuNP targeting neovascular AMD endothelial cells (EC). The nDEF represents the ratio of the dose to the nucleus with and without the presence of AuNP. As in previous studies, the EC is modeled as a slab of 2 µm (thickness) x 10 µm (length) x 10 µm (width) containing a nucleus of 5 µm diameter and thickness of 0.5 - 1 µm. The targeted AuNP are attached to the exterior of the EC. The nDEF was calculated for a range of feasible AuNP local concentrations (1 - 7 mg/g) using the clinically applicable 100 kVp x-rays employed by the IRayTM system (Oraya Therapeutics Inc. Newark, CA), with total filtration of 0.75 mm Al and 0.8 mm Be. For comparison the nDEF for other energies: 80 kVp, 90 kVp, 110 kVp, and 120 kVp was also investigated.

Results: For 100 kVp x-rays, the results revealed nDEF values of 1.30 - 3.26 for the investigated concentration range of 1 - 7 mg/g, respectively. In comparison, for the same concentration range, nDEF values of 1.32 - 3.40, 1.31-3.33, 1.29 - 3.19, 1.28 - 3.12 were calculated for 80 kVp, 90 kVp, 110 kVp, and 120 kVp x-rays, respectively.

Conclusions: The results predict substantial dose enhancement to the sensitive nucleus of neovascular endothelial cells, targeted by AuNP during kilovoltage stereotactic radiosurgery. This suggests that AuNP may be employed as radiosensitizers to enhance therapeutic efficacy during radiosurgery for neovascular AMD.