AbstractID: 8209 Title: Effect of inhomogeneity on dose distribution for Gamma Knife Perfexion treatment

Purpose: To investigate the dose perturbation in Gamma Knife® Perfexion™ Stereotactic Radiosurgery due to inhomogeneity.

Method and Materials: We applied Monte Carlo (MC) simulation for Gamma Knife® Perfexion™. Approximation parameters for geometries and materials were used to reconstruct 4mm, 8mm and 16mm collimators in Gamma Knife® Perfexion™ unit. A total of 192 Cobalt-60 sources with the same activity were simulated. Phase space files stored all particles passing through collimator and reaching a sphere surface of surrounding the isocenter. Patient's geometries were rebuilt from CT data. The doses were calculated using MC simulation with and without inhomogeneity correction. Dose perturbation effect was derived from the comparison of DVH between homogeneous and inhomogeneous geometries.

Results: Three patients were investigated. For each patient, at least 2 sites were selected: one in brain and another one close to air cavity. A total of 14 Monte Carlo simulations were performed for 16mm collimator with and without inhomogeneity correction. The statistical error for isocenter dose is around 0.2%. Monte Carlo results show that inhomogeneity effects lowered the dose, on average, by 4.6% in brain site. For sites close to the air cavity, the inhomogeneity effects are mixed. The inhomogeneity effect ranged from 2.7% to -1.3%. Less attenuation from air cavity increases the dose to the site. However, the high density area such as spine results more attenuation and it eventually reduces the dose.

Conclusion: Monte Carlo shows that the inhomogeneity effect could cause lower delivered doses from Gamma Knife® Perfexion™ in brain sites and higher or lower doses in those sites close to air cavity. More investigations are necessary to determine accurate dose for treatment sites close to air cavity for Gamma Knife® Perfexion™.