AbstractID: 6879 Title: Implementation of MRI-based Monte Carlo simulation for Gamma Knife SRS

Purpose: To verify the dosimetry accuracy for MRI-based planning of Gamma Knife Stereotactic Radiosurgery.

Method and Materials: In Monte Carlo simulation, Gamma Knife unit geometry was reconstructed exactly as the original unit. Materials were selected as close to the actual one as possible. Patients were scanned on both a CT unit and a 1.5 T MRI scanner. Simulations were performed for these patients using homogeneous geometry based on CT and MRI, and heterogeneous geometry built based on CT numbers or different densities for MR contoured skull structures. The homogenous density was chosen as 1.0g/cc and the density of skull was chosen in the range 1.5 – 2.0 g/cc. Isodose distributions and DVHs were used in comparison.

Results: The dose in the homogeneous geometries based on CT was about 3.2% higher than the dose in heterogeneous geometry based on CT. The difference in the DVH between homogeneous MRI and heterogeneous CT geometry was also around 3.3%. After applying heterogeneity correction to the skull for MRI, the difference was reduced to less than 2%. The 90%, 50% and 10% isodose lines matched each other very well between homogeneous CT and MRI geometries and heterogeneous CT and MRI geometries.

Conclusion: A useful CT and MRI based Monte Carlo simulation has been developed for Gamma Knife dose verification. For many Gamma Knife centers, MRI is the only choice for Gamma Knife planning. Our results show that MRI-based Monte Carlo planning for Gamma Knife is feasible after applying proper skull heterogeneity correction.