AbstractID: 4731 Title: Is it necessary to adjust the prescription dose to compensate for Cobalt source decay of Gamma Knife radiosurgery?

Purpose: To investigate whether it is necessary to adjust the prescription dose to compensate for Cobalt source decay of Gamma Knife radiosurgery (GKRS) for trigeminal neuralgia.

Methods and Materials: A radiobiological model for GKRS was utilized to estimate the radiation response of the brain tissue to the radiosurgery dose distributions expressed in the form of dose volume histogram (DVH). For each bin of the DVH, a linear-quadratic equation was constructed to calculate the Extrapolated Response Dose (ERD) given the specific dose rate and dose. The relationship between ERD and clinical outcome, i.e., pain relief of trigeminal neuralgia, was evaluated using the data from 343 patients who received trigeminal neuralgia GKRS during a period of 6 years. This model is validated by published clinical data. Necessary dose adjustment to compensate for source decay was obtained during a period of 10 years (two half-lives).

Results: Between the first (5/98-5/99) and last (11/01-11/03) quartile of the patients, complete or nearly complete (≥90%) pain relief rate was 54.2% verse 50.6%, respectively, at the 12 month follow-up. Dose rate was not a factor influencing pain relief (p=0.755). Meanwhile, our model predicts that pain relief rate drops 3%, and the necessary dose adjustment for the trigeminal neuralgia GKRS should increase 3-5% for the typical prescription dose of 70-90Gy at the end of two half-lives. The model also suggests that when the radiosurgery prescription dose is low (e.g. cases such as acoustic neuroma or brain metastases) dose adjustment is not necessary because the change of ERD is negligible.

Conclusions: Prolonged treatment due to radiation source decay has little effect on clinical outcome for trigeminal neuralgia GKRS with up to 10 years of service.