AbstractID: 6577 Title: A Dynamic Dose Delivery Model for Gamma Knife Radiosurgery

Purpose:

To develop a *dynamic dose delivery* model for Gamma Knife radiosurgery by taking advantage of the robotic patient positioning system in the latest Gamma Knife model.

Methods and Material

Gamma Knife has been the treatment of choice for many brain tumors and functional disorders. Current Gamma Knife radiosurgery is a ball-packing approach, whose goal is to “pack” the different sized spherical high-dose volumes into a target tumor volume. We have developed a dynamic Gamma Knife treatment scheme based on the concept of “dose-painting” to take advantage of the new robotic patient positioning system on the latest Gamma Knife unit. In our scheme, the spherical high dose volume created by the Gamma Knife unit will be viewed as a 3D spherical “paintbrush”, and treatment planning reduces to finding the best route of the “paintbrush” to “paint” a 3D tumor volume. Under our dose-painting concept, Gamma Knife radiosurgery becomes dynamic, where the patient is moving continuously under the robotic positioning system. Planning is modeled as a variation of the traveling salesman problem.

Results:

A theoretical study of dynamic Gamma Knife radiosurgery scheme has been carried out for a C-shaped tumor volume. Dose distributions are calculated using an established analytical dose calculation engine. The dose distribution of the dynamic plan is calculated by fine interpolation from equally placed and equally weighted shots. The study showed that the new dynamic scheme can provide equal or superior dose distributions with significantly (> 40%) shortened treatment time.

Conclusion:

We have proposed and tested a dynamic delivery scheme for Gamma Knife radiosurgery using robotic patient positioning on the latest Gamma Knife model. A prototype study has been carried out. The results showed that our dynamic scheme provides equal or better dose distributions than current Gamma Knife method but with a significantly shortened treatment time.