AbstractID: 12676 Title: A Study on the Focusing Power of Dynamic Photon Painting

Purpose: Cross-firing technique is widely used in photon-based radiosurgery to create sharp dose falloff near the target. In this technique, a large number of beams are focused to the isocenter in order to minimize contribution from individual beams. In this study, we investigated a technique called dynamic photon painting (DPP), where a radiation beam changed dynamically in direction to irradiate a target, to significantly enhance dose falloff rate. The dynamic motion of the beam source is equivalent to focusing tens of thousands of beams, creating a sharp dose gradient that potentially rival proton Bragg peaks.

Materials and Methods: To study DPP, we took a Cybeknife cone beam and rotate it in a hemispherical trajectory to create DPP dose kernels. The parameters determining a kernel include: (1) range of latitude angles from 0 to 90 degrees, (2) range of longitude angles from 0 to 360 degrees, and (3) source to axis distance (SAD). Using these dose kernels, a complex 3D dose distribution can be created via traversing or "painting" a kernel inside a 3D target volume.

Results: We found: (1) The dose gradient of DPP kernels rivals that of proton Bragg peaks. (2) As the latitude angular range increases, the dose gradient of DPP kernel increases in the plane defined by the circle of latitude and decreases in the plane defined by the circle of longitude. (3) As the starting latitude angle increases, the dose distribution of low dose regions becomes less regular in the plane of the circle of longitude. (4) When DPP kernels are used in treatment planning via dose painting, we get better plans than Gamma Knife radiosurgery.

Conclusions: We have demonstrated that Dynamic Photon Painting has the potential to rival proton therapy and outperform Gamma Knife radiosurgery for our studied cases.