AbstractID: 11207 Title: Dose Gradient Analysis with Beam Concentricity in Conformal Planning

Purpose: The CyberKnife can perform both isocentric and non-isocentric plans for stereotactic radiosurgery. Isocentric plans typically have higher dose gradients while non-isocentric plans offer higher conformality. The objective of this work was to combine the best of both planning techniques as appropriate for the clinical situation.

Method: A parameter, Target Boundary Distance (TBD), was introduced for the non-isocentric planning in cyberknife planning system. TBD defines as the distance between the target boundary and the pencil beam boundary. If TBD is 0 (the default value), the pencil beam is pre-defined to be tangent to the inner target boundary. The beams will shoot further inside the target, and geometrically closer to the centroid of the target, as TBD decreases. Dose gradient analysis was performed for a total of 10 clinical cases using a variety of treatment plan parameters.

Results: Analyzed plans included different collimator size and TBD values along with isocentric plans. Compared with the TBD=0 plan, the plans with an appropriate negative TBD had higher dose gradients, lower total MU, a smaller number of beams, and similar tumor coverage - at the cost of a slight decrease in the conformality and homogeneity indexes. The tissue toxicity can be reduced up to 20% with this technique in all these 10 cases. When TBD is smaller than [– (PTV Diameter – Collimator) / 2], the conformality and homogeneity indexes may deteriorate significantly. The small collimator plan had higher homogeneity, a larger number of beams and higher total MU, but not necessarily result in higher dose gradients.

Conclusion: Our analysis shows that the TBD can be adopted to adjust the dose gradient. We found that the inclusion of an appropriate negative TBD into non-isocentric treatment planning can be an effective tool to increase the dose gradient and reduce surrounding normal tissue toxicity.