AbstractID: 3657 Title: Treatment Planning Evaluation and Optimization For SRS and IMRT Using Dose-Surface Histograms

Purpose: To introduce a new method in determination of the periphery dose and dose differences between the tumor and surrounding tissues, including organs at risk (OARs), for stereotactic radiosurgery (SRS) and/or intensity modulation radiotherapy (IMRT) using dose-surface histograms (DSHs).

Method and Materials: Plan-target volume (PTV) and its expansion into surrounding healthy tissue (TISSUE) by 3 mm (or 5 mm) for a small (or large) PTV are created. The contours of the TISSUE on CT or MRI slices are modified at the region where the Tissue intersects with an OAR. The PTV and TISSUE are then expanded or shrunk, denoted as PTV' and TISSUE', by a pixel size (PS) within a fine dose grid, respectively. DSH for the PTV (DSH_{PTV}) can then be determined by (DVH_{PTV}*PTV - $DVH_{PTV'}$*PTV')/(PTV – PTV')/PS. Similarly, DSH for the TISSUE (DSH_{TISSUE}) is given by (DVH_{TISSUE}*Tissue - $DVH_{TISSUE'}$*TISSUE')/(TISSUE – TISSUE')/PS. The mean and variation of DSH_{PTV} characterizes the periphery doses and the difference between the mean doses on DSH_{PTV} and DSH_{VOI} quantifies the dose drop-off from the PTV to the surrounding tissue.

Results: Application of the new method on Gamma Knife plans and LINEAC-based SRS plans clearly shows that gamma knife plan has better dose drop-off but worse periphery doses for relative rounded target. However, the LINEAC-based MLC-shaped arcs plans are generally superior for irregular-shape lesions. In comparison of plans using MLC-shaped arcs, conformal beams, and IMRT, we found no improvement on periphery dose and dose drop-off in IMRT for some cases due to lack of DSH_{PTV} in the inverse planning systems.

Conclusion: The accurate quantification of the periphery dose and dose drop-off is extremely important because they are closely correlated to the treatment prescription and the clinical outcomes.