AbstractID: 13216 Title: A novel inverse planning strategy for dose escalation with PET image guidance in RT of NSCLC

Purpose: Dose escalation in treatment target while sparing critical organs can be a challenge even with contemporary IMRT and IMPT technologies, especially for large and complex targets. F^{18}-fluorodeoxyglucose (F^{18}-FDG) is the most-used tracer in PET to image the glucose uptake in tissues, and is correlated with an increased rate of glycolysis in many tumor cells. In this study, we explored IMRT and IMPT treatment planning on NSCLC to selectively escalate dose inside CTV with the guidance of functional PET information.

Method and Materials: Our PET/CT protocol with attenuation correction using average CT has been shown to improve the registration between CT and PET data, and PET data quantification. After fusion of the PET and Planning CT, a voxelized dose prescription inside CTV was created in proportion to the standardized uptake values (SUV) such that voxels with a specified high SUV were assigned 74Gy and the minimum dose was constrained to 63Gy. IMRT and IMPT plans were then optimized by using the voxelized prescription combined with other clinical constraints (e.g. lung V20 < 40%). Reference plans were also created to uniformly escalate CTV dose. Assessment of correlation between dose distribution in CTV and FDG PET was made with normalized mutual information (NMI).

Results: We achieved higher NMI of 0.47 and 0.48 for IMRT and IMPT with FDG-PET, and lower NMI of 0.42 and 0.41 for IMRT and IMPT with uniform escalations, respectively. Uniform escalation plans yielded a V20 of near 40% or higher. FDG-PET dose escalation lowered the V20 to 37.1% for IMRT and 30.1% for IMPT.

Conclusion: Both IMRT and IMPT plans demonstrated good correlations with the PET information while respecting dose tolerance of critical organs. In addition, with PET, IMPT showed a greater ability in shaping the dose distribution and minimizing dose to critical organs, than IMRT.