AbstractID: 3322 Title: Tumor-delineation uncertainties in FDG-PET and FMISO-PET images and the effect on radiation therapy plans

Purpose: To quantify the uncertainties in tumor boundary delineation in head and neck and lung cancer patients using FDG-PET and FMISO-PET images and evaluate the dosimetric impact on radiotherapy plans.

Method and Materials: We contoured FDG-PET and FMISO-PET based tumor volumes using images from the GE Advance PET scanner. We use the autocontour function of the ADAC/Pinnacle radiation planning system to delineate tumor boundaries at successively higher PET signal levels. CT-based tumor volumes are also contoured by a physician on coregistered PET/CT images. We generated intensity-modulated radiotherapy (IMRT) plans for head and neck patients treating 66 Gy to CT-based gross disease and 54 Gy to nodal regions at risk, followed by a boost to the PET-based tumor.

Results: The volumes of PET-based tumors are a sensitive function of threshold intensity level for all patients. For FDG-based volumes, a 10% decrease in threshold translates into an approximately 200% increase in volume. Lesions smaller than approximately 8 cm^3 display a more pronounced threshold-volume dependence. The threshold-volume dependence in FMISO scans is significantly more sensitive than in FDG scans. Lung cancer patients show a similar trend to head and neck patients with a possible overall shift in sensitivity. IMRT planning results on head and neck patients show that the boost dose limit of FDG-based volumes depends on the threshold level chosen for contouring. In one patient the D95 of the planning target volume decreased from 7770 cGy to 7230 cGy when the contour level changed from 42% to 55%.

Conclusion: PET-based tumor volumes are strongly affected by the choice of threshold level which has a direct dosimetric impact. Further validation and refinement of delineation methods, including a determination of the proper threshold level, should reduce PET-related delineation uncertainties for radiotherapy applications.