AbstractID: 11233 Title: A comparison between 4D and 3D PET-based tumor volume definition for lung cancer patients

Purpose: Utilizing an automatic segmentation technique, the definition of tumor volume on clinical 4D (gated) and 3D (non-gated) PET scans was compared and the potential benefits of gated PET/CT acquisition for lung cancer patients were explored.
Method and Materials: Data from patients that underwent 3D and 4D PET/CT scans prior to radiation therapy were analyzed. A belt (Anzai Medical Systems Inc) was used to monitor patient breathing and gate the 4D acquisition. The raw data were then binned into five breathing phases. On the reconstructed PET images, an automatic segmentation technique based on a Gaussian Mixture Model (GMM) was applied to each phase individually and five gross tumor volumes (4D-GTVs) were defined. The individual 4D-GTVs were grouped together to create an internal target volume (ITV). The GMM method was also applied to the 3D data and a 3D-GTV was defined. The resulting ITV and GTVs were compared and the contours were superimposed on the CT portion of the PET/CT scan to visually assess tumor coverage.
Results: The ITV was 8% to 148% greater than the 3D-GTV with an average of 45%. Visual inspection of the ITV and 3D-GTV contours superimposed on the CT revealed better coverage of the CT-defined tumor with the ITV. This was especially apparent in the superior and inferior portions of tumors exhibiting respiratory motion close to 1cm and small lung nodules with moderate FDG uptake. Deformations in the FDG uptake between different breathing phases were observed, demonstrating the possibility of deformations in the tumor shape.
Conclusion: This is one of the first studies comparing tumor volume definition on 4D and 3D PET/CT clinical data. The results suggest that ITV obtained from 4D PET/CT covers the full extent of moving tumors better than a 3D-GTV obtained from 3D PET/CT.