AbstractID: 10904 Title: 4D Treatment Planning Strategy for Lung Tumor Irradiation with Protons

Purpose: To present a new strategy of 4D treatment planning for lung irradiation with protons.
Method and Materials: Organ motion is a serious issue in radiation therapy planning, especially for proton irradiation, because the finite range of a proton beam makes the treatment delivery sensitive to density changes along the beam path. In our method the patient is immobilized supine in a whole body-pod, and undergoes a 4D-CT scan of the lung. Images are taken at 10 phases per breathing cycle. GTV is contoured on the maximum intensity projection (MIP) scan. The GTV is corrected for density averaging errors across lung-bone or lung-normal tissue boundaries using the EE (end exhale) and EI (end inhale) images. The GTV is then transferred to the EE scan which is used as the primary scan for treatment planning. Beam apertures were designed by incorporating beam specific lateral margins around GTV, and compensator bolus design incorporated set-up and scatter uncertainties through a smear radius. Same method is used to design the aperture and compensator bolus for each CTV beam.
Results: Four cases with different locations of the tumor in the lung were studied. Each case was planned four different ways: (i) EE scan as the primary planning scan (ii) MIP scan as the primary planning scan and (iii) and (iv) were 4D-CT planning strategies published in literature. For small tumors all methods gave similar results irrespective of the tumor location in the lung. For large tumors (~100 cc) EE method gave the best results both for tumor coverage and for sparing of normal lung tissue.
Conclusion: Out of four methods compared, our method of using EE scan as a primary scan for planning and using MIP scan for contouring the GTV gave best results irrespective of the tumor location in the lung or the size.