AbstractID: 4831 Title: How to account for patient-specific tumor motion in target definition for lung cancer treatment planning: Dosimetric comparison of a multi-phase CT simulation approach and MRI cine study

Purpose: In order to account for tumor motion, a multi-phase CT scanning and MRI cine imaging were used to assist planning target volume (PTV) definition in treatment planning. In this work, we compared tumor coverage in the subsequent treatment delivery using these two approaches.

Materials & Methods: Consented patients underwent CT simulation consisting 2 short scans taken at maximum inspiration and expiration breath holding conditions, in addition to a normal free-breathing scan. These same patients went through MRI cine scanning. For treatment planning and delivery, we constructed a PTV from a combination of the targets delineated on all 3 CT scans after image registration by applying 3 mm margin (termed PTV_3CT). For this study, another PTV expansion was generated from the gross tumor volume (GTV) on the free breathing scan by margins that were determined by MRI cine (termed as PTV_MRI). Treatment planning using the same beam configurations and weights was performed on the PTV_MRI. Since a localization CT scan was obtained for each patient using a CT-on-rails system prior to each treatment, we are able to obtain the actual GTV in treatment position (GTV_tx) and compare their coverage for the plans designed for either the PTV_3CT or PTV_MRI.

Results: For 5 patients and 20 GTV_tx studied, they were all within the PTV_MRI geometrically and have full dose coverage in terms of D_{95}. However, for plans designed for PTV_3CT, 9 out of 20 of the GTV_tx were found, at a varying degree, to be partially out of the PTV_3CT and the coverage varies from 95.9% to 100% of the planned values. Although the difference in coverage is small, it is statistically significant, as the p-value for the t-test is 0.006.

Conclusions: The MRI-cine appears to be a better study of motion than the multiphase CT approach in this study.