AbstractID: 7735 Title: Clinical Impact of Four-Dimensional (4D) Imaging on Radiation Therapy

Purpose: 4D imaging is becoming increasingly available for treatment planning. Generally, the information are used in (1) determining the range of tumor motion so that the tumor margin can be determined on a patient specific basis (3.5D-RT); and (2) helping to choose a gating phase and window for respiration-gated radiotherapy planning (gated-RT). The purpose of this work is to assess the clinical impact of these treatment strategies by retrospectively studying 12 lung cancer patients.

Methods and Materials: 12 lung patients who had underwent 4D-CT and received gated-RT were selected. For each of these patients, two additional treatment plans were generated, including 3.5D-RT plan and conventional 3D-RT plan (in which a population based margin of 2.5cm is used). The V_{20}, V_{40}, TCP and NTCP are evaluated for the three plans. Additionally, the potential of dose escalation to the target is evaluated for 3.5-RT and gated-RT by keeping the lung toxicity at the level of 3D-RT.

Results: 9 out of 12 patients have tumor motion range less than 2.5cm. For these patients, 4D-CT derived patient specific margin leads to a reduction of tumor margin in 3.5D-RT plan and thus significantly reduces the ipsilateral lung toxicity. For the other 4 patients, the motion is comparable or greater than 2.5cm and the use of 4D imaging makes it possible to avoid potential underdosing in the peripheral region of the tumor. In all cases, the gated RT plans lead to significantly reductions of V_{20}, V_{40}, and NTCP. A dose escalation in the range of 3~15% is feasible for all these patients when gated-RT is employed while keeping the lung toxicity at the level of 3D-RT.

Conclusions: The use of 4D-CT individualize the definition of tumor margin in 3.5D- and gated-RTs. With reduced margin size, a clinically significant escalation of dose becomes easily achievable.