Abstract ID: 15937 Title: Predicting individual lung tumor volume change during image-guided radiation therapy for adaptive radiation therapy

Purpose: Changes in lung tumor volume can be observed from the daily images acquired during the image-guided radiation therapy (IGRT). The purpose of this study is to predict patient-specific lung tumor volume change in the early part of IGRT so that adaptive radiation therapy can be carried out in the late part of the treatment.

Methods: The two-component model, assuming that lung tumor cells comprise both radiosensitive and radioresistant components, was used. Three mechanisms are included in the model: (1) proliferation of radiosensitive cells, (2) transition of the radioresistant cells into radiosensitive cells, and (3) disintegration of radiation-damaged cells. The model consists of 4 parameters: radiobiological parameter, alpha, potential doubling time for the radiosensitive cells, initial fraction of radiosensitive cells and the disintegration half-life of radiation-damaged cells. The clinical data of lung tumor volume change observed from the beginning up to the mid of the treatment course for a given patient were used to determine the model parameters. The model with the patient-specific parameters was then used to predict tumor volume change for the rest of treatment.

Results: The model predicts individual lung tumor volume change reasonably well. Significant variations of the model parameters were found between patients. For example, for the patient data studied, alpha varies between 0.02 to 0.10 Gy-1, the doubling time changes from a few days to a few months, and the contents of radioresistant cell varies between 20% to 60%. The fact that tumor volume change and model parameters are patient specific indicates that the remaining optimal treatment should adapt to the patient morphological and radiobiological properties.

Conclusions: The lung tumor volume change observed in the early part of IGRT can be used to predict individual tumor volume regression, allowing the adaptive radiotherapy to be carried out in the remaining of the treatment.