AbstractID: 5875 Title: Characterizing and modeling patient respiratory patterns for radiation therapy

Purpose: Lung tumor breathing motion is a function of both the breathing depth (tidal volume) and breathing rate (airflow). Treatment planning for lung tumors will require a patient-specific tumor motion model. An understanding of the patient's typical breathing cycle will be critical to accurate treatment planning predictions for linear-accelerator gating or tracking. This work examines patient-breathing characteristics to determine the patterns and stability of the breathing cycle.

Method and Materials: A total of 34 patients (with and without lung cancer) were scanned with a previously described 4DCT protocol under synchronized tidal breathing monitoring. We examined the scatter plot of air flow against tidal volume for the entire scan session. A 2D histogram was then generated by calculating the frequency of data points falling into each tidal volume-airflow window. The 2D histogram depicted the probability that the patient breathed at certain tidal volume and air flow window. We evaluated the breathing consistency of the three patients with multiple scans.

Results: There was no significant differences in the breathing period (P=0.11) or in the peak-to-peak amplitude (P=0.22) between patients with lung cancers and patients with upper-abdomen cancers. The 2D histogram revealed two different breathing patterns: patients who spent more time breathing at the end of exhalation (20 patients), exhibiting a characteristic volume-flow curve, and patients who spent the majority of time inhaling and exhaling (14 patients). The latter patients did not spend any appreciable amount of time between successive breaths. For the three patients with two sessions, the mean frequency difference between corresponding tidal volume-airflow windows was <0.3%.

Conclusion: We characterized patient breathing by examining the tidal volume-airflow plot and histogram. The results showed two different breathing patterns suggesting that not all patients are appropriate for gated radiotherapy. All three patients showed high consistency in two scan sessions.

Supported by NIH R01CA96679