AbstractID: 13711 Title: Interfraction variability of tumor motion trajectory from serial 4D cone-beam CT imaging during audio-visual biofeedback

Purpose:
To quantify interfraction variations in position, volume, and intrafraction breathing motion trajectory of lung tumors and critical structures with 4DCT and 4D cone beam CT (4D CBCT) images, for patients undergoing audiovisual biofeedback.
Method and Materials:
A pretreatment 4D fan beam CT (4DCT) and 35-40 daily 4D CBCTs were acquired daily throughout the treatment for 7 non-small cell lung cancer patients. The tumor, esophagus, and trachea were contoured for all 10 phases of each CT. Each phase-specific image was registered manually on bony anatomy to the end-inhalation phase image from the 4DCT. The centroid and volume of each structure were calculated for each phase, and used to quantify the variability of the tumor and critical structure locations during each fraction. The tumor volume, relative to its end-inhalation volume on 4DCT, was calculated for end-inhalation and end-exhalation phases for each fraction. The mean position of each organ, relative to the 4DCT, was calculated for each 4D CBCT scan.
Results:
Analysis has been completed for one patient to date consisting of 27 fractions, consisting of 7 4D CBCTs. Over the course of treatment, the tumor volume at end-inhalation decreased by 31%. The systematic (random) error in mean tumor position was found to be 0.12cm (0.14 cm), 0.29cm (0.12 cm), and 0.31cm (0.62 cm) in the mediolateral, anterior-posterior, and superior inferior directions respectively. These were large in comparison to the average range of tumor motion, which was 0.09cm, 0.21cm, 0.25cm in the corresponding axes. The corresponding ranges of motion over the treatment course, were 0.06-0.13cm,, 0.14-0.26cm, and 0.12-0.42cm.
Conclusion:
For this patient, the interfractional variation in mean tumor position was the dominant variation with fraction-to-fraction changes as large as 2 cm. Audiovisual biofeedback did not adequately control these baseline variations.
Supported by Grant P01 CA 116602