AbstractID: 3542 Title: Cumulative Dose Calculation Using Deformable Image Registration

Purpose: To use deformable image registration to calculate cumulative dose distributions received by a radiotherapy patient in order to evaluate the dosimetric impact of anatomical variations during the course of treatment.

Method and Materials: An intensity-based deformable registration algorithm was developed to register the anatomy between the planning CT image and the daily CT images acquired from an in-room CT-on-rails system. After the transformation from daily CT to planning CT was found, daily treatment doses delivered to an organ can be meaningfully accumulated. For one head-and-neck patient, the treatment plan was transferred to 15 daily CT scans using bony registration, and the dose distributions were calculated for the daily anatomy without daily setup errors. Using deformable image registration, these daily dose distributions were mapped back to the planning CT image. The cumulative dose was calculated and compared to the original plan using dose-volume histograms (DVHs).

Results: The dose delivered to the patient had minimal changes from the plan. Dose coverage for clinical target volumes at 70Gy, 63Gy, and 56Gy, left and right parotids at 25Gy, and mandible at 70Gy were evaluated. At these dose levels, the DVHs showed less than 1% difference, except for the left parotid, which had a 6% volume difference. The maximum dose in brainstem was 1.4% less than planned, the maximum dose in spinal cord was 2.2% higher than planned. The mean doses in left and right parotid were 4.4% higher and 2.5% lower than planned.

Conclusion: In this case, we found little dosimetric differences due to changing anatomy during the course of treatment. Future studies will include daily setup errors. Deformable image registration is proven to be an effective approach for calculating cumulative dose distributions delivered to the patient, which can be used to evaluate the quality of treatment execution.