

AbstractID: 9028 Title: Comparison of dosimetric consequences of intrafraction prostate motion between IMRT and IMPT

Purpose: To compare the dosimetric impact of intrafraction prostate motion in IMRT and intensity modulated proton therapy (IMPT), with an emphasis on determining the necessary CTV-to-PTV margins to compensate for the motion in these two modalities.

Method and Materials: Intrafraction prostate motion of 35 patients was tracked in real-time using the Calypso System. Data were categorized into three groups according to the treatment intervention performed in response to the motion: (1) if motion larger than 3 mm was observed for 30 seconds during a fraction, dose delivery was interrupted and the patient was re-aligned; (2) as above, but with motion threshold of 5 mm for 30 seconds; (3) no treatment intervention performed regardless of the motion amplitude. Dose delivered in presence of motion was evaluated by convolving the static dose distribution matrix with the motion probability density matrix. IMRT and IMPT plans for the same patient data were constructed with Pinnacle and UFORT planning systems respectively, using CTV-PTV margins from zero to 11 mm.

Results: For single fractions with the largest average motion in groups (1) to (3), CTV-PTV margins of 2, 5, and 11 mm for IMRT, and 3, 7, 11 mm for IMPT, are necessary to maintain minimum CTV doses above 95% of nominal dose respectively. In the individual patient with the largest average motion over an entire treatment course (37 fractions), the necessary CTV-PTV margin was 2 and 3 mm for IMRT and IMPT respectively. Using these margins, any compromise in CTV DVH and the generalized equivalent uniform dose (gEUD) under the corresponding motion was insignificant.

Conclusion: The required CTV-PTV margin for IMPT is slightly larger than that for IMRT, due largely to the sharper penumbra of proton beam relative to photons. However, IMPT resulted in superior sparing of the urinary bladder and rectum compared with IMRT.