

AbstractID: 9579 Title: Predictability of Patient-Specific Prostate Margins from Real-Time Intrafraction Motion Measurements

Purpose: To investigate the ability to predict individualized PTV margins for prostate treatment based on limited real-time intrafraction motion data.

Method and Materials: Under IRB approved protocols, 35 patients with 3 transponders implanted in the prostate were studied. Transponders were placed at the apex, right- and left-base and urethra using ultrasound guidance. Isocenter was chosen relative to the centroid of the transponders and the patients were initially positioned using the electromagnetic system. The relative position of the transponders was monitored continuously during each fraction, at 10 Hz. The probability distribution of absolute displacements from isocenter was found in each direction for the first fraction. Cumulative margins, M_n , were found using van Herk's formula ($2.5 \Sigma + 0.7 \sigma'$) after each fraction, including all fractions ($n=N$), to determine the best retrospective PTV margin for each individual patient. Metrics from the first fraction's probability distribution were tested for correlation (Pearson's r , P_r) with the final cumulative margin. These metrics included the position in each direction which was $\geq 50\%$ and 95% (R_{50} , R_{95}) of absolute deviations from isocenter. The percentage of patients for which $(|M_N - M_n| \leq 1 \text{ mm})$ was found after n fractions.

Results: The correlation coefficients in the Left-Right, Anterior-Posterior, and Superior-Inferior directions were $P_r50 = (0.275, 0.422, 0.177)$, $P_r95 = (0.435, 0.489, 0.168)$. The percentage of patients within 1 mm of their final margin after $n = 2, 3, 5, 10, 20$ days was $LR = (94.3, 97.1, 97.1, 100.0, 100.0)\%$, $AP = (40.0, 57.1, 74.3, 91.4, 97.1)\%$, and $SI = (34.3, 37.1, 65.7, 91.4)\%$.

Conclusion: R_{50} and R_{95} from a single fraction of measured intrafraction displacements are poorly correlated with a given patient's final individualized margins. In addition, 15 to 20 fractions are required to estimate margins within 1 mm for 90% of patients.

Conflict of Interest: Supported by NCI R01CA59827 and Calypso Medical