AbstractID: 5529 Title: Evaluation of 4DRT: CT Acquisition and Gated Delivery System

Introduction
Our objective was to characterize retrospectively acquired 4DCT data for prospective gated delivery, and the effects of gate length on beam energy stability, output constancy, and positional accuracy / inter-device constancy.

Materials and Methods
A barometric sensor gated the Siemens Oncor linac and Siemens Sensation CT scanner. Respiratory motion of 20 mm at 15 bpm over a stationary jig was used to assess radio-opaque marker positions. Retrospective 4DCT reconstructions were obtained at 6 phases of inspiration and expiration, ranging from 0% to 100% by 20% intervals. The center of the pin was identified using 50% threshold values on the CT dataset. On the linac, gate windows of 1500, 850, 500, 350, 300, and 250 ms for the 12 phases were studied. Ion chambers were used to measure the beam energy and output stability at 10 cm and 20 cm in solid water simultaneously. Marker position during gated delivery was determined via film. Nine profiles, centered around the marker, were extracted for both the static and moving axes. The averages were smoothed, and the peak position and full-width-at-half-maximum (FWHM) were determined. The difference in FWHM along the static and moving axis is the intra-gate motion.

Results
Dosimetry for gates >= 500 ms was excellent. Although the average energy was constant, gate length reduction from 500ms to 250 ms resulted in an energy standard deviation increase of 1-14%, an output constancy increase from 1.6% to 4.6%, and a 50% dose rate decrease. Mean discrepancies between marker position measured on CT and linac were 3 mm, with 8 mm maximum.

Conclusions
Dosimetric characteristics of the linac are reasonable for gating windows ≥ 500 ms. Target position measured on retrospective 4DCT can introduce significant uncertainty for several phases of the respiratory cycle.