

AbstractID: 10454 Title: Simultaneous RapidARC treatment and 4D-CBCT verification

**Purpose:** To evaluate the quality of 4D-CBCT images acquired during a RapidARC treatment.

**Methods and Materials:** A RapidARC plan (879 MUs, treatment time: 1.5min) was delivered to a 2 cm moving target in a lung phantom. Simultaneous kilovoltage projection images were acquired during the RapidARC delivery. Each image was identified with the respiratory phase using information from the RPM system, and the kilovoltage projections were sorted by breathing phase (10 bins), filtered with a Shepp-Logan filter and reconstructed into CBCT image sets using an FDK algorithm. The target sphere and a fiducial were located in all 10 4D-CBCT sets using an edge-detection software tool, and the detected target motion was compared with the known motion.

These experiments were repeated using target motion following a breathing trace obtained from a real patient (14 cm amplitude, 5 sec period), and four different simulated traces with target amplitudes ranging from 5 mm to 20 mm, 4.5 second period and  $\sin^6$  motion. For the real patient trace, the motion was in three dimensions. For the other four cases, the motion was constrained to the cranial-caudal direction.

**Results:** The motion of the fiducial and the target sphere detected in the 4D CBCT images were found to have an accuracy of  $0.156 \text{ mm} \pm 1.03 \text{ mm}$  and  $0.4 \text{ mm} \pm 0.22 \text{ mm}$  for the sphere and the fiducial, respectively. The diameter of the sphere was measured in each phase for each experiment with an accuracy of  $0.46 \text{ mm} \pm 0.78 \text{ mm}$ .

**Conclusions:** A 4D-CBCT acquired during a RapidARC treatment can detect target shifts and breathing amplitudes, providing four-dimensional markerless information of a target during treatment.