AbstractID: 5708 Title: A low-Z target with no flattener and reduced energy for improved contrast in megavoltage cone-beam CT

Purpose: To improve contrast in MV cone-beam CT using a low-Z target (LZT).

Method and Materials: A high-Z tungsten target (HZT) at 6 MV and low-Z carbon targets of different thicknesses were used with no flattener. The maximum energy was used with LZT while eliminating primary electron leakage into the monitor chamber. Output and dose distributions were measured. Images were acquired at 7 frames/sec with a 1024x1024 400-micrometer pixel flat panel detector with 1mm Cu build-up and a Lanex fast scintillator. Phantoms were QC-3V, a contrast/spatial resolution phantom, a sheep head and a cadaver.

Results: Beam energy was 3.5±0.5 MeV and 4.5±0.5 MV for the 1.016 cm and 1.35 cm carbon targets, respectively. The higher energy was more stable with higher output: 0.299 cGy/sec compared to 0.084 cGy/sec. Surface dose was 80%. Field diameter at isocenter was limited to 36 cm by the electron monitor, when present. Computed contrast-to-noise ratio (CNR) for the contrast-spatial resolution phantom for LZT was 3.5 times that of HZT at 10 cGy. Computed CNR for HZT for the 2D QC-3V phantom images is 24 and for LZT is 100 with dose per projection of 0.035cGy. The f50 of LZT is 0.41 lp/mm. Adaptive noise filtering with a kernel of 8x8 increased the CNR by a factor of 2.4 without degrading resolution. Preliminary cone beam images with the low Z target show remarkable bone contrast and indicate improved soft tissue contrast.

Conclusion: A stable 4.5 MV beam was produced on a standard treatment linac equipped with a carbon target, showing improved CNR over images taken with the treatment target and sufficient output for cone-beam CT. A direct comparison to images taken with the carbon and tungsten targets on the same cadaver, expected to show an improvement in soft tissue contrast, will be available at the meeting.