Purpose: To evaluate the feasibility of CsI detector for low dose 2.5 MV cone-beam computed tomography (MVCB).

Methods: The new Varian TrueBeamTM at our center is equipped with a prototype non-clinical 2.5 MV imaging system with a 9 mm thick cesium iodide (CsI) scintillator EPID. Both static portal radiographs and MVCB images can be obtained. The minimum dose per beam pulse or frame is ~0.0025 cGy. Approximately 450 projections were collected at up to 9 frames/second in a full 360 degrees rotation that may take 60-90 seconds. MVCB scans of a RANDO phantom were acquired using 2.5 MV and 6 MV x-rays, the latter taken with conventional EPID (aS1000, Varian Medical Systems). KVCB scans were also taken for comparative purposes. An acrylic phantom containing high-Z inserts was imaged with all beams to assess image artifacts.

Results: The new 2.5X prototype system required only ~2.4-3.4 cGy to achieve clinically acceptable image quality in the head, thorax, and pelvis, while standard 6X MVCB required ~26 cGy. Image quality approaching kVCB can be obtained with 2.5X MVCB using doses of ~ 9cGy, although images acquired using 2.4 cGy were sufficient for bony alignment purposes. As expected, MVCB images in the head and thorax are superior to pelvis. In addition, the 2.5 MV imaging beam greatly reduces high-Z image artifacts that can significantly perturb kV image quality.

Conclusions: 2.5X MVCB with high quantum efficiency CsI detector can replace kVCB in most clinical situations at greatly reduced cost and fewer high-Z artifacts. Unlike kV, treatment planning systems can easily incorporate MV dose into plan optimization. Further, patients having metallic implants (e.g. dental fillings, hip prosthesis, etc.) can benefit from MVCB due to its insensitivity to high-Z materials and its ability to yield true electron densities for treatment planning.

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