AbstractID: 5395 Title: A Quality Assurance Procedure to Monitor Mechanical Stability and Image Quality of an On-Board kV Cone-Beam CT Imager

**Purpose:** To develop Quality Assurance (QA) procedures that monitor mechanical stability and image quality performance of a new kV on-board-imager (OBI) and cone beam CT (CBCT) system.

**Material and Methods:** QA of mechanical stability includes measurements of the OBI kV and Linac MV isocenters, shifts resulting from gantry rotation, translational of imager, flexing of support arms, and reproducibility of couch shifts. Image quality QA includes measurement of noise, CT number uniformity, linearity, spatial and contrast resolutions.

**Results:** Our system has a systematic shift between kV and MV isocenters of ~1.4 mm. Translational motion of the OBI is accurate to ~0.9 mm and rotational motion to ~0.2 mm. Couch positioning accuracy has an error of ~0.9 mm longitudinally. CT numbers are less uniform than for conventional CT with full fan (without filter) CBCT scans producing better results than other modes (CT number uniformity ~2.5%). $\sigma$ for CBCT is about 1% worse than for conventional CT and thus low-contrast level objects such as supra-and sub-slice targets with < 0.5% nominal contrast in the contrast resolution module are not resolved in CBCT. CBCT numbers agree with simulator CT within 3% in the range -1000 to +1000 for scans in air. High-contrast resolution of the OBI cone-beam CT is comparable to the conventional CT simulator.

**Conclusions:** Systematic shifts of the OBI isocenter from radiation isocenter must be considered for patient setup and IGRT procedures using CBCT. Systematic isocenter shifts caused by rotational and translational motions of couch and gantry must also be corrected for to achieve sub-millimeter target localization accuracy. Image quality of kV cone-beam CT is inferior to conventional simulator CT in terms of uniformity, and low-contrast resolution, but has comparable CT number linearity and high-contrast resolution.

**Conflict of Interest:** This work is supported by NCI Grant P01-CA59017