Purpose: Methods of reducing respiratory motion blurring in cone-beam CT (CBCT) have been limited to lung where soft tissue contrast is large. Respiration-correlated cone-beam CT (RC-CBCT) uses slow continuous gantry rotation but image quality is limited by uneven projection spacing. This study investigates efficacy of a novel gated CBCT technique.

Methods: In gated CBCT, the linac (Varian TrueBeam) is programmed such that gantry rotation and kV image acquisition occur within a gate around end expiration (EE) and are triggered by an external respiratory monitor. Standard CBCT and gated CBCT scans are performed in 14 patients (8 thoracic, 6 abdominal) and a respiration correlated CT (RCCT) scan from the same day serves as ground truth. Image quality is compared by calculating contrast-to-noise ratios (CNR) for tumors in lung, gastro-esophageal junction (GEJ) tissue, and liver tissue, relative to surrounding background tissue.

Results: Gated CBCT results in reduced motion artifacts relative to standard CBCT, with better visualization of tumors in lung, and of abdominal organs including GEJ, stomach, liver, kidney, and spleen. CNR of lung tumors is larger in gated CBCT in 5 of 8 cases relative to standard CBCT with mean increase 8.8% (range -8.6% to +30.1%). In cases where CNR is not increased, lung tumor motion observed in RCCT is small (range 3.2 mm to 5.3 mm). For GEJ images, CNR is larger in gated CBCT in all 3 cases (mean increase 45%, range 24.7% to 64.4%). For liver images, CNR is larger in gated CBCT in all 4 cases (mean increase of 73.8%, range 5.4% to 119.9%).

Conclusions: Gated CBCT reduces image blurring caused by respiratory motion. The gated gantry rotation yields uniformly and closely spaced projections resulting in improved reconstructed image quality. The technique is shown to be applicable to abdominal sites, where image contrast of soft tissues is low.

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