Purpose: To investigate the feasibility of using a patient passive breath gating (PBG) equipment in kilo-voltage cone-beam CT (kVCBCT) image acquisition to reduce the respiratory induced motion artifacts for image-guided radiotherapy.

Methods: A PBG equipment developed in our department was used to passively block patient’s breathing. Assisted by this device, patients were able to hold their breath for 15-25 seconds. An infrared block was placed on the patient’s body and the breath-hold was triggered by the signal from the Varian RPM system. Three sets of kVCBCT images were acquired using the same imaging parameters with the OBI system on Varian Trilogy for a gastric cancer patient: free breathing (FB), with two-breath-hold (BH1) and three-breath-hold (BH2). Patient was allowed to breathe normally for 5-10s between breath-hold. A planning CT was obtained with one breath-hold on a conventional 4D CT scanner. The diaphragm position on FB, BH1 and BH2 CBCT images was compared with its position on the planning CT to assess the motion artifacts.

Results: The acquisition time for each of the three kVCBCTs was 60 seconds. The patient tolerated the breath-hold CBCT scanning well. Severe image blurriness and streak artifacts caused by respiratory motion were observed near the diaphragm on FB CBCT. However, for the breath-hold CBCT images, the motion artifacts were reduced and the diaphragm edge was restored. Two-breath-hold scan (BH1) produced better image quality than three-breath-hold (BH2). The details of the diaphragm edge on BH1 images were comparable to the planning CT.

Conclusions: Diaphragm motion causes image distortion in FB CBCT. The PBG can be used in kVCBCT acquisition to reduce motion artifacts. The breath-hold kVCBCT can produce higher image quality for image-guided radiotherapy and adaptive radiotherapy in the thorax and abdominal regions.

Conflict of Interest (only if applicable): Research supported by Varian Medical System.

Funding Support, Disclosures, and Conflict of Interest:

This work is partly supported by Varian Medical System.