Background and purpose: The recent integration of kilo-voltage cone beam computed tomography (kV-CBCT) imaging systems into linear accelerators makes it possible to image and treat a patient on a single machine. The goal of this study is to investigate the feasibility and usefulness of acquiring kV-CBCT for adaptive radiotherapy for patients with lung and phantom study with significant target position.

Materials and methods: A self made brain phantom and quality assurance phantom were used to compare the dosimetric and geometric accuracy between planning CT and kV-CBCT with bow-tie filter added. The quality of the kV-CBCT volume images acquired using phantom was evaluated by measuring the spatial accuracy, contrast, hounsfield units (HU), and converting HU to electron density. The kV-CBCT was registered to the CT image using normalized mutual information.

Results: In both phantom studies, the DVH based on kV-CBCT images were in excellent agreement with DVH based on planning CT images. CBCT images were dependent on image uniformity, linearity and it needed verify the difference the mean HU value of the center ROI and peripheral ROI using histogram. The difference (<1%) is found in the calculated dose to the target for a complex inhomogeneous phantom between using kV-CBCT images and planning CT images. These results indicate that kV-CBCT images can be used to calculate dosimetric parameter accurately in radiotherapy treatment planning. In a patient study, doses for targets volume plans calculated on kV-CBCT images agreed within 5% with those calculated on planning CT.

Conclusions: We have investigated the feasibility and usefulness of acquiring on-board kV-CBCT images for adaptive radiotherapy treatment planning and tested the accuracy. It is feasible to use kV-CBCT to determine dosimetric consequences resulting from tumor volume changes. The kV-CBCT has potential to become a very useful tool for adaptive radiotherapy treatment planning.