

We investigate the potential of cone-beam CT using MV beams and an electronic portal imaging device (EPID) for verifying patient positioning and studying tumor/organ motion during radiation treatment. Using images from a 41x32 cm amorphous-Silicon EPID and 6MV beams, we perform volumetric reconstructions with a filter back projection in the cone-beam geometry described by Feldkamp et al. We identify several pre-reconstruction image corrections critical for high quality reconstructions such as detector sag and dose conversion. Reconstructed images of a contrast phantom indicate that density differences of $>2\%$ can be detected with 50 projections / 2.5 MU per projection. Evaluation of this technique using anthropomorphic thorax and head phantoms indicates that image quality is improved as the number of projections is increased, with acceptable results for 50 projections. For high contrast features the reconstruction quality is similar to conventional CT. A crucial requirement for the clinical implementation of cone-beam CT is low dose to normal tissue. We show that this normal tissue requirement can be achieved while still maintaining good image reconstructions by performing the scans with narrow cone beams, designed to cover only the region of the tumor volume. Our results indicate that, with proper pre-processing of judiciously-acquired projection images, the potential exists for using MV cone-beam CT for 3D imaging of patients during treatment while delivering a clinically reasonable dose distribution. The reconstructed images should provide useful anatomic information for confirmation of target position, setup verification, and modification of plans during treatment.