Purpose: To reduce imaging radiation dose to the patient in cone-beam CT (CBCT) for image-guided radiation therapy via intensity-weighted region-of-interest (IWROI) imaging with a half-fan geometry.

Methods: An intensity-weighting (IW) filter made of copper was mounted on the X-ray tube unit of the on-board imager (OBI) for CBCT data acquisition. Since a half-fan full-scan mode is the choice of scanning for most treatment sites including the chest and the abdomen due to its enlarged field-of-view (FOV), the half-fan scan mode has been used in this study. Accordingly, the IW filter was placed asymmetrically to cover outer part of the FOV. As a result, the region corresponding to the outer FOV was illuminated by the filtered beam during the scan. By sacrificing the image quality of the outer ROI-region, one can reduce the overall imaging radiation dose to the patient dramatically. A humanoid abdomen phantom was used for the IWROI imaging experiment. Both the Feldkamp-Davis-Kress (FDK) and the chord-based backprojection-filtration (BPF) algorithms were used for image reconstruction, and the results were compared. Correction of image artifacts caused by the edge of filter and the heterogeneity in beam-quality was also made.

Results: FDK algorithm produced images with artifacts when truncated data were used, whereas the BPF algorithm was capable of reconstructing exact ROI images without truncation artifacts from the truncated cone-beam data. Dosimetric measurements are in progress to assess quantitative evaluation of imaging dose reduction. In addition, a feasibility study of image registration using the ROI images obtained by the proposed method is also going to be presented.

Conclusions: The proposed half-fan-based IWROI imaging technique can be a valuable option for CBCT in IGRT applications, considering the substantial radiation dose imposed by the repeated use of conventional CBCT.