Purpose: Cone-beam computed tomography (CBCT) is the main imaging tool for image-guided radiotherapy but its functionalities is limited by small imaging volume and restricted image position (imaged at the central instead of treatment position for lateral targets to avoid collisions). In this paper we present the concept of "panoramic CBCT" which can image patients at the treatment position with a volume as large as practically needed.

Methods: This novel "panoramic CBCT" technique scans the target panoramically for different imager positions, stitch together the panoramic projection images of the same gantry angle to form a larger projection image, and perform CBCT reconstruction using the stitched projection images. To study the potential reconstruction artifacts of this imaging technique, we calculated cone-beam projections of the MCAT thorax phantom for one imager in three adjacent positions. Different gaps and exposure levels were introduced between adjacent imager positions to simulate imperfect stitching. Simultaneous algebraic reconstruction technique (SART) was used to reconstruct CBCT images using the stitched projection images for half-scan (180-degree+cone-anlge/2 gantry rotation). As a gold standard, CBCT reconstruction using projection images big enough to encompass the target were also performed for full scan (360-degree gantry rotation).

Results: Incomplete reconstruction with artifacts was observed for reconstruction using projections from the central imager position only. When stitching is perfect, complete reconstruction was obtained from the stitched projection images with quality similar to the gold standard. Streak and ring artifacts were observed when stitching is imperfect and the severity of artifacts increases with the gap size and exposure level difference.

Conclusions: Since half-scan can be achieved for most treatment positions without collisions, the proposed "panoramic CBCT" can image tumors of any location for patients of any size at the treatment position. Good image stitching algorithms are needed to eliminate the reconstruction artifacts from imperfect stitching.