Purpose: A binary moving blocker-based technique for scatter-corrected CBCT reconstruction enabling a single scanning configuration is proposed, in which width-truncated projections are acquired from a shifted detector.

Methods: A beam blocker consisting of lead strips is mounted in front of the kV x-ray tube and alternately moves in and out during the gantry rotation. The projections are acquired in two phases. Projections belonging to the first phase are attenuated by the blocker resulting in a stripe pattern from blocked and unblocked regions. The second phase includes unblocked region only allowing for a complete volumetric reconstruction. To derive scatter map from the blocked projections, an 1D B-Spline interpolation/extrapolation is applied by using the detected information in shaded regions. The scatter map of even indexed projections is calculated by averaging two scatter maps that correspond to their adjacent odd indexed projections. Scatter-corrected projections are obtained by subtracting the corresponding scatter maps from projection data and are utilized to generate a CBCT imaging by a compressed sensing (CS) based iterative reconstruction algorithm. The Catphan504 and pelvis phantoms were used to evaluate the performance of the proposed method.

Results: The proposed binary moving blocker-based technique markedly suppressed the scatter- and bone-induced artifacts in CBCT. Compared with CBCT generated by non-blocker based FDK algorithm, the non-uniformity value was reduced from 39.3% to 2.1%. CT number errors in the regions of interest were reduced from 50 to less than 10. The CS based reconstruction algorithm provided the contrast-to-noise ratio with spatial resolution comparable to the benchmark image.

Conclusions: The proposed technique enables complete volumetric scatter-corrected CBCT imaging with width-truncated projections and allows reducing the patient dose at partially-shaded regions.