Purpose: Recently we demonstrated the use of a 1-D grid placed between the source and patient to directly reduce scatter, and correct the remaining scatter in cone-beam computed tomography (CBCT). However, that technique required two 360° gantry rotations to acquire an entire image dataset. The purpose of this study was to investigate the feasibility and potential improvements of a multi-exposure approach, which takes two or more partial projections at each gantry position with a rapidly oscillating grid to acquire the full dataset in one rotation.

Methods: A Trilogy CBCT system was used for the experiment. Grids with various septa-to-interspace-ratios (SIR) were tested. A grid with higher SIR may reduce scatter more effectively, but requires a larger number of exposures at each gantry position for full projection data. The multi-exposure technique was simulated using multiple rotations, with the grid manually shifted after each rotation with a distance equal to the grid interspace, instead of multiple exposures at each gantry position, with the grid shifted after each exposure. Scatter-to-primary-ratio (SPR) was measured and compared for various object thicknesses and grids with various SIRs. CBCT images were reconstructed after scatter correction for two grids with SIR of 1 and 3, corresponding to 2 and 4 exposures at each gantry position, and compared with conventional CBCT.

Results: SPR was reduced linearly with increasing SIR. The scatter artifacts were removed after scatter correction for both grids. The contrast-to-noise-ratios (CNRs) of three phantom inserts with different densities were 20.5, 13.2, and 6.9 for conventional CBCT. The corresponding CNRs were improved to 23.5, 15.8, and 7.9 with the grid of SIR=1, and to 27.2, 18.3, and 8.7 with the grid of SIR=3.

Conclusion: Initial results suggest that the multi-exposure approach may improve CBCT image quality by removing scatter artifacts, increasing CNR without increasing scanning time.