Purpose:Cone-beam CT with circular trajectory is susceptible to cone-angle related artifacts that affect quantitative imaging. These artifacts were quantified under conditions relevant to dedicated breast CT for full and short-scans.
Methods: Three sets of numerical phantoms (0.2-mm voxels) were used: (1) cylindrical Defrise phantom of 14-cm diameter and 10.6-cm length inclusive of 2-mm skin, with alternating 4-mm coronal layers of fixed (0.15) and variable (0 to 1, in steps of 0.1) glandular fraction breast tissue; (2) semi-ellipsoidal Defrise phantom with dimensions matched to the cylindrical phantom for a realistic pendant-breast geometry; (3) 20 surgical mastectomy specimens based numerical phantoms. Source-to-rotational axis and source-to-detector distances of 65-cm and 100-cm, respectively, were used. Noise-free simulations were performed at 30-keV, with the phantoms co-aligned to rotational axis, using an ideal detector (0.4-mm pixels), and without the confounding effects of focal spot blur (point source) and x-ray scatter. Constant angular sampling of 1.2-degrees was used resulting in 300 and 165 projections for full-scan and short-scan (198-degrees). Reconstructions were performed using Hamming-windowed FDK-algorithm with short-scan using Parker weights. For the Defrise phantoms, the cone-angle dependence of the artifacts was analyzed using percent difference at the rotational axis between the reconstructions and phantoms, and by visual inspection. For the mastectomy specimens, power spectral analysis was performed.
Results:For Defrise phantoms, increasing attenuation difference between layers resulted in higher inaccuracies (artifacts). Cylinder resulted in higher inaccuracies compared to semi-ellipsoid particularly near maximum cone-angle. Visual inspection and power spectral analysis indicate that the spatial distribution of these artifacts is different between full and short-scans.
Conclusions: Cone-beam artifacts at breast CT relevant conditions are observed. They depend on object shape, and attenuation difference of the tissues within the object. These artifacts must be remediated as they may impact task-specific assessment and can profoundly affect quantitative imaging.

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