Purpose: To develop and validate algorithms for extraction and insertion of three-dimensional (3D) profiles of tumor masses in cone beam breast CT (CBBCT) images to create simulated abnormality for evaluation with observer performance study.

Methods: A bench-top experimental CBBCT scanner was constructed and used to image mastectomy breast specimens with IRB approval. 5 sets of CBBCT images with confirmed tumor masses and 2 sets of normal CBBCT images were selected and used for this study. All CBBCT images were first corrected for cupping artifacts. The corrected images were then processed to reduce their noise levels and form the denoised images. The corrected and denoised CBBCT images for normal breasts were then segmented into adipose and glandular voxels. The images for abnormal breasts were reviewed by mammographers with the help of clinical images and reports to delineate the tumor masses and form 3D tumor maps. Using these maps, the 3D tumor profiles were rescaled to average glandular signals around the insertion locations in normal images. The boundaries of the 3D rescaled tumor profiles were smoothed to avoid sharp edge. The resultant 3D tumor profiles were inserted onto cupping artifact corrected normal CBBCT images by replacing the signals in adipose voxels near the insertion locations. The cupping artifacts were then added back to generate the simulated abnormal CBBCT images. These images were then visually compared with actual abnormal images for their degree of realism.

Results: Based on visual comparison, the simulated abnormal CBBCT images showed no significant difference in realism from actual abnormal CBBCT images.

Conclusions: We have successfully demonstrated the technique to extract 3D tumor profiles from abnormal CBBCT images and insert them onto normal CBBCT images to form simulated abnormal images for use in observer performance study.

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