Breast Biopsy Phantom Imaging Using the KODAK Digital X-Ray Specimen Imaging System

Scientific Insights

Applications Imaging Concepts Technical Support

KODAK DXS4000 Pro

Application Overview

The American College of Surgeons developed the ACS Stereotactic Breast Biopsy Accreditation Program to evaluate concerns by radiologists, surgeons, other national medical organizations, the government, and the public that qualified personnel perform stereotactic breast biopsies using appropriate equipment to ensure that women receive optimum tissue sampling with the lowest possible risk.

Breast biopsy phantoms, mimicing the characteristics of tissue found in the average breast, have been specifically developed to demonstrate the image quality of the digital biopsy mammography unit.

Imaging Protocol

The radiographic imaging and analysis of a breast biopsy phantom was performed with the KODAK Digital X-Ray Specimen 4000 Pro Imaging System (DXS4000 Pro). The phantom (Nuclear Associates, model 18-250, Fluke Biomedical, Everett, WA USA) is used to establish radiographic accreditation for breast biopsy. The established criteria for accreditation are visualization of 3 of 4 fibers, 3 of 4 groups of specks, and 2.5 of 4 masses.

Discussion of Imaging Results and Associated Image Analysis

All features of the phantom are clearly visible within a broad range of the DXS4000 Pro operating parameters. The influences of radiological parameters as well as the quantitative analysis of the features are reported in Figure 1.

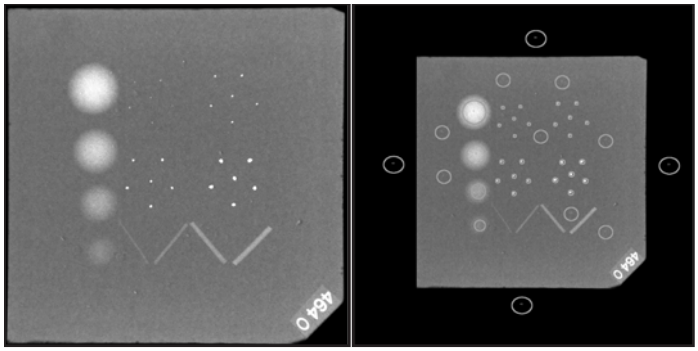

Figure 1. Radiographs and measures of the breast biopsy phantom. Left. Cropped and contrasted, 25 Kvp, no filter. Right. Region of interest (ROI) measures.

Examination of Figure 1 (left) shows all the fiber, speck and mass features. The most challenging features to discern are the group of 6 small specks (0.2 mm), the upper left of the 4 groups of specks. To more clearly characterize the significance of the specks and masses, the features were measured using the ROI features of the analytical software, as shown in Figure 1 (right).

Figures 2 and 3 focus on the most challenging detection aspects of this phantom and the quantitative analysis of the relevant features. The figures show that a broad range of system parameters enable the clear detection of the smallest phantom specks. They suggest that unfiltered x-ray energies corresponding to the system range 25–35 kVp are appropriate to the detection.

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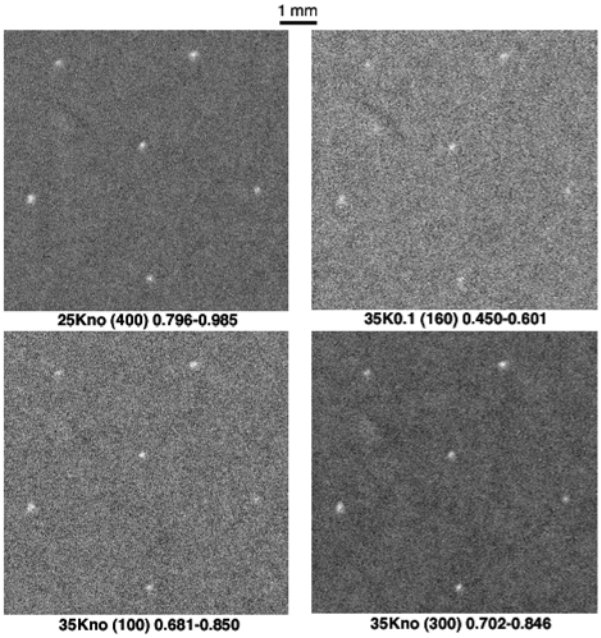

Figure 2. Influence of x-ray energy and exposure on detection of 0.2 mm specks in breast biopsy phantom. Undistorted images cropped and clipped to min/max densities.

According to the energy calibration of the system (calibrated with aluminum standards), this range of mean x-ray energies is 9.8–10.5 Kev, and a contrast diminution of the specks is apparent at 11.2 Kev (35 Kvp, 0.1 mm of aluminum filtration). In addition, the extent of x-ray exposure contributes to the significance of the image and corresponds to limits of x-ray statistics. Further, integrated mass calibration of the system using relevant materials suggests that the smallest specks in the phantom correspond to the contrast expected from about 0.1 mg of hydroxyapatite.

The DXS4000 Pro offers outstanding spatial resolution and contrast of x-ray images. As has been demonstrated above, all levels of fiber, speck and masses presented in the Breast Biopsy Phantoms are clearly contrasted, identified and measured. In addition, the system offers a 20 x 20 cm field of view which is significantly larger than the typical digital system and thus, rivals that of conventional mammography units.

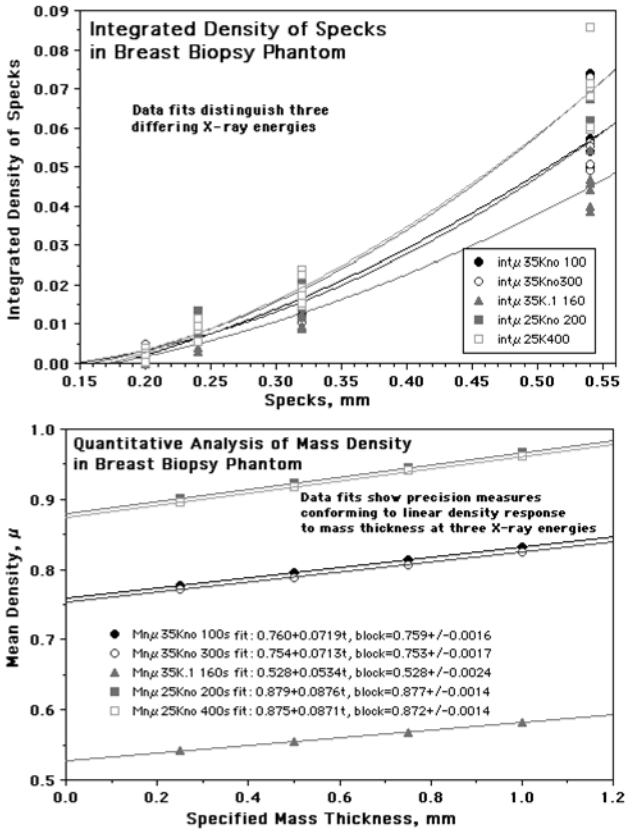

Figure 3. (Above) Integrated density of specks in breast biopsy phantom. Data fits distinguish three differing x-ray energies. (Below) Quantitative analysis of mass density in breast biopsy phantom. Data fits show precision measures conforming to linear density response to mass thickness at three x-ray energies.

Contact Carestream Molecular Imaging

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- ✔ e-mail: ww-molecular-support@carestreamhealth.com
- ✔ Fax: 203-786-5656

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1-877-747-4357
Ouside of the U.S.,
call +1-203-786-5657
mi.carestreamhealth.com