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Reducing Radiation Dose in Digital Mammography by Increasing Display Luminance

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Introduction

Although Full Field Digital Mammography (FFDM) has done much to reduce radiation dose in screening mammography, many women are still concerned with possible risks associated with annual exams and dose. Reducing dose increases noise impacting image quality. Noise can be dealt with at numerous points in the imaging chain, including the display on which the final presentation of images to the breast imager occurs.

Hypothesis

Increasing the luminance of the display on which FFDM images are presented can maintain acceptable levels of target detection performance when radiation dose is reduced.

Methods

Two CDMAM Phantom images were obtained with an FFDM device at the same voltage (26 kV) and same distance between detectors (2 cm), but at 45 and 50 mAs resulting in entrance surface doses of 7.093 and 7.880 mGy. They were processed to make the average gray level of the background independent of dose level, while maintaining SNR. Individual CDMAM tiles were displayed on a Barco Coronis Uniti 12 MP MDMC-12132. Calibrated to the DICOM GSDF. Eight radiologists participated. Images were shown in 3 display settings: 420 cd/m^2, 1000 cd/m^2 and SpotView^{TM} which resulted in an average display luminance of (3138.8 ± 30.1) cd/m^2. Percent correct (Pc) was calculated for each dose under the different settings by comparing the CDMAM gold disc position noted by observers with the actual position. Total Pc and Pc per dose were compared using a Friedman test. Average time spent per image was calculated under the different settings per observer and per radiation dose. The settings were statistically compared on the 5% significance level using paired t-tests.

Results

Pc for all 3 luminance levels was higher in the high dose compared to low dose condition (Figure 1). In the low dose condition, Pc was highest with SpotView and SpotView and 1000 cd/m^2 were significantly higher than 420 cd/m^2. In the high dose condition, SpotView Pc was significantly higher than both of the lower luminances. Average time spent per image (Figure 2) was lower in the high dose compared to low dose condition, and at both dose levels time decreased as luminance increased, with SpotView overall have significantly shorter times than 420 cd/m^2 and 1000 cd/m^2.

Figure 1

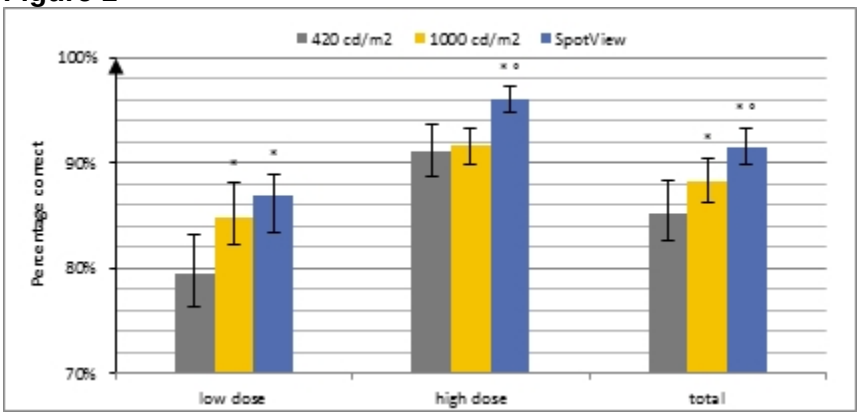
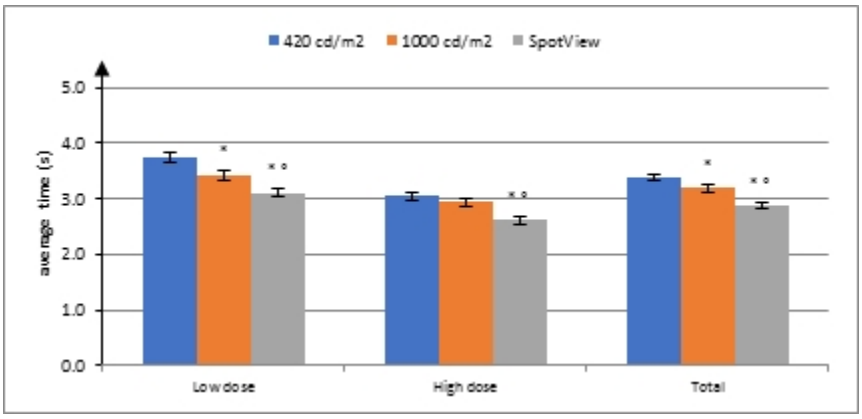


Figure 2



Conclusion

Increasing display luminance from 400 cd/m² to 1000 cd/m² significantly increases reading accuracy (Pc) by approximately 3.0%. Use of SpotView significantly increases reading accuracy by approximately 6.2%. Increasing display luminance from 400 cd/m² to 1000 cd/m² significantly decreases reading time by approximately 6.0%. Use of SpotView significantly decreases reading time with approximately 16.0%. Further research is required to verify these results using clinical images.

Statement of Impact

It may be possible to reduce mammographic dose significantly without impacting diagnostic accuracy using a novel display tool that selectively boosts luminance in suspicious regions. The added luminance may also increase interpretation efficiency.

Keywords

dose reduction, mammography, display luminance