Diagnostic Scan is an efficient, low-dose alternative to geometric magnification for mammography assessment

Philips MicroDose Mammography

Summary

This white paper summarizes a study comparing MicroDose Diagnostic Scan to geometric magnification for imaging fine image details, and explains the efficiency of the Diagnostic Scan functionality of the MicroDose system based on two phantom studies.

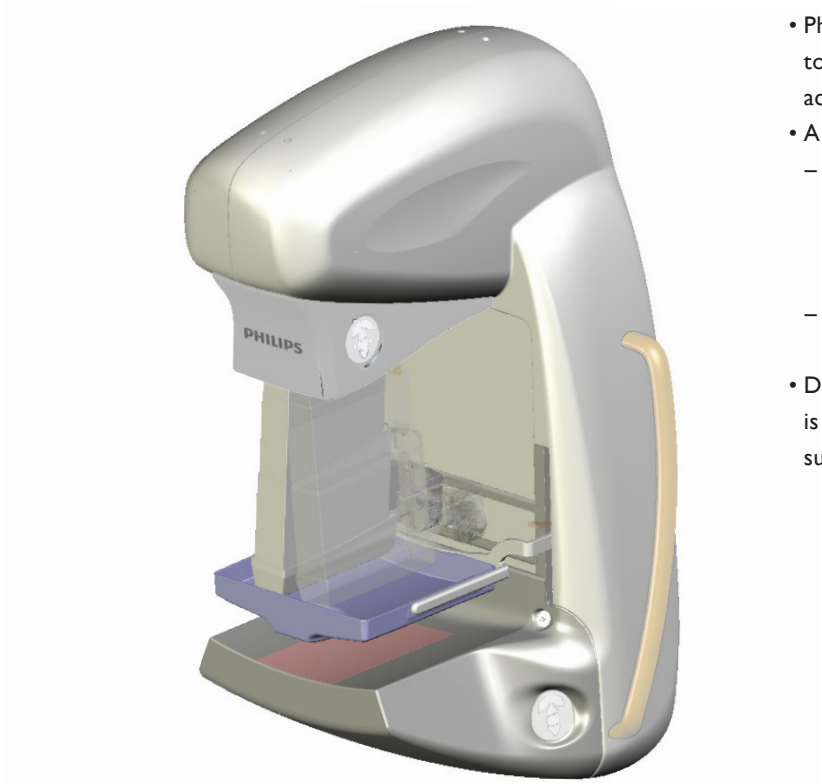


Figure 1: Diagnostic Scan geometry, in which spot compression is combined with a scan focused on a small FOV.

Highlights of these studies reveal:

- Diagnostic Scan, an exclusive feature of Philips MicroDose Mammography, helps discern fine details in spot compression images.
- This is achieved by using higher dose on a spot compression area and electronic magnification on the review workstation.
- Phantom evaluation shows that in comparison to geometric magnification, Diagnostic Scan achieves excellent image quality at a low dose.
- A 2012 Egan study showed that for the detection of:
  - Microcalcifications, regardless of breast size and composition, the Philips MicroDose mammography performed optimally. All systems demonstrated comparable results at larger breast sizes.
  - Mass, all systems performed comparably in an average size breast.[1]
- Diagnostic Scan is efficient and easy to use; there is no need for a magnification table on the patient support to reduce source-to-object distance (SOD).

PHILIPS

Diagnostic Scan increases visibility of fine features

On conventional mammography systems, geometric magnification mode is used to improve visibility of suspected abnormalities. Geometric magnification narrows the field-of-view (FOV), reduces scattered radiation, and increases dose, thus improving the resolution. When a technologist takes images in geometric magnification mode, the breast is placed on a magnification table on the patient support to magnify the image by reducing SOD.

To help discern fine details in spot compression images, the MicroDose system uses a unique functionality called Diagnostic Scan, in combination with electronic magnification on the review workstation. The MicroDose Mammography system uses unique photon counting, multi-slit scanning technology, resulting in the smallest pixel size (50 microns) and the highest resolution (25 megapixels) on the market. Additionally it rejects 97% of the scattered radiation.[2] Due to the high resolution of the MicroDose system, an ordinary image acquired with higher dose targeting a small FOV increases visibility of fine image features. An additional benefit of Diagnostic Scan is that there is no need to add a magnification table to the patient support, which saves a significant amount of time and improves technologists' workflow.

Figure 2: Sport compression paddle.

Phantom evaluation

A phantom study was conducted to evaluate image quality of the MicroDose system with Diagnostic Scan. Three invited physicists compared images of a contrast-detail test object[a] acquired with Diagnostic Scan to those acquired with geometric magnification.[b,c] To simulate detection of microcalcifications, image evaluations focused on the smallest discs. Images were acquired on both systems, with an exposure setting corresponding to a 6 cm breast, and scored by three observers. The mean glandular dose (MGD) for each system is presented in Table 1. The average threshold thickness for each disc diameter and system is indicated in Figure 3. The data shows that the MicroDose system with Diagnostic Scan achieves high image quality at 55% lower MGD, as compared to the tested digital mammography system with geometric magnification.

	Mean Glandular Dose [mGy]
Digital mammography system with geometric magnification	3.1
MicroDose Mammography with Diagnostic Scan	1.8

Table 1: Comparison of MGD.

Contrast-detail curves using the CDMAM 3.4 phantom

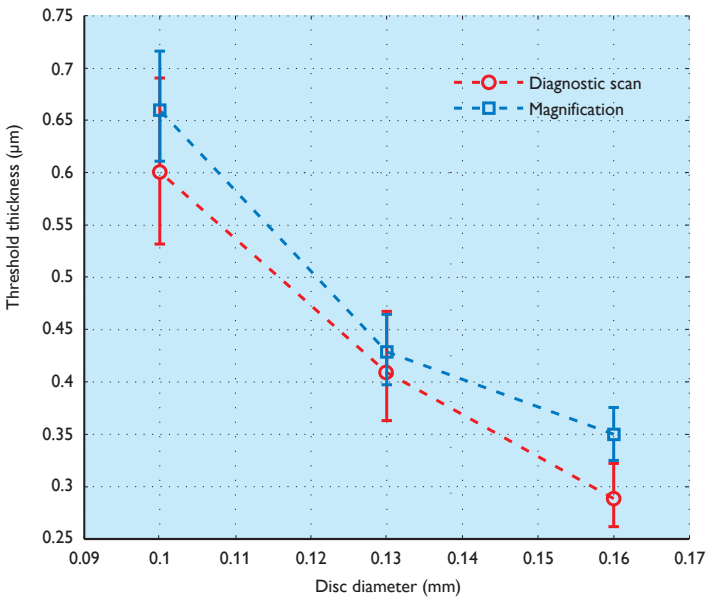


Figure 3: Threshold thickness as a function of disc diameter from visual evaluation of the small discs in the CDMAM 3.4 phantom.

Comparison of contact spot imaging on a MicroDose system compared to conventional geometric magnification imaging

Egan G., et al., conducted detailed phantom testing and analysis using data collected in 2011 and analyzed in 2012.[1] The purpose of this study was to investigate the performance of the MicroDose Mammography system for further assessment of screen-detected lesions, as compared to standard geometric magnification. The performance of contact spot imaging on a MicroDose system was evaluated and compared to conventional, geometric magnification imaging for Hologic Selenia and GE Essential. Each system was studied for dose and contrast for the detection of both simulated masses (using CIRS phantom, containing a detail of 100% glandularity, simulating a tumor mass) and micro calcifications (using Al embedded in PMMA). Contrast-to-Noise Ratio and Average Glandular Dose (AGD)[d] were measured according to the European Reference Organization for Quality Assured Breast Screening and Diagnostic Services guidelines, and a Performance Index (PI) was formulated to facilitate comparison of the three systems.

Performance Index (PI) typically used for optimization studies of digital systems was calculated for all imaging conditions examined.

$$PI = \frac{CNR^n}{AGD}$$

A value of n=2 is typically used for optimization of screening mammography.[3] Since this study concentrates on secondary diagnostic procedures, a value of n=4 was used to allow additional weight to the increased importance of image quality relative to dose for the follow-up assessment imaging of screen-detected lesions. This method was suggested previously by Koutalonis.[4]

Result of Egan study

The study showed that for detection of microcalcifications, regardless of breast size and composition, the MicroDose system performed optimally. All systems demonstrated comparable results with larger breast sizes (Figure 4). For detection of masses, all systems performed comparably in an average-sized breast (Figure 5).

The study also found that the MicroDose system offers inherent workflow advantages, since modality setup does not need to be altered, as needed with other modalities.

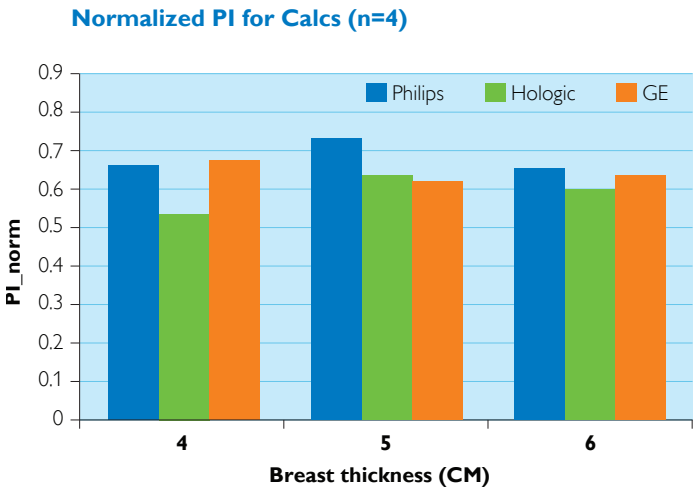


Figure 4: Normalized PI for all systems at each breast thickness for microcalcification detection.

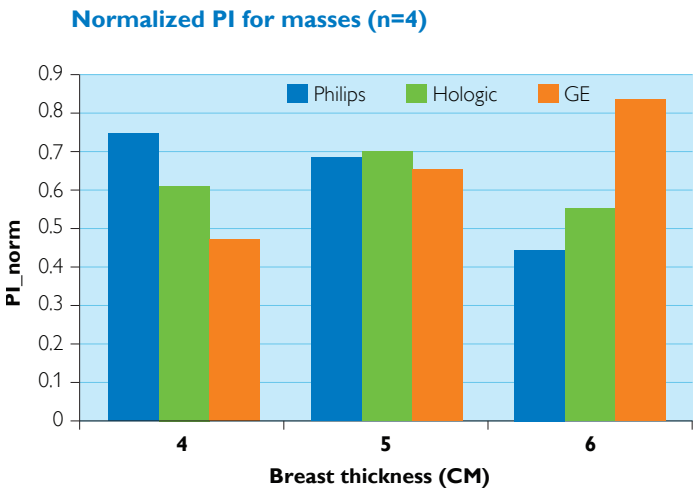


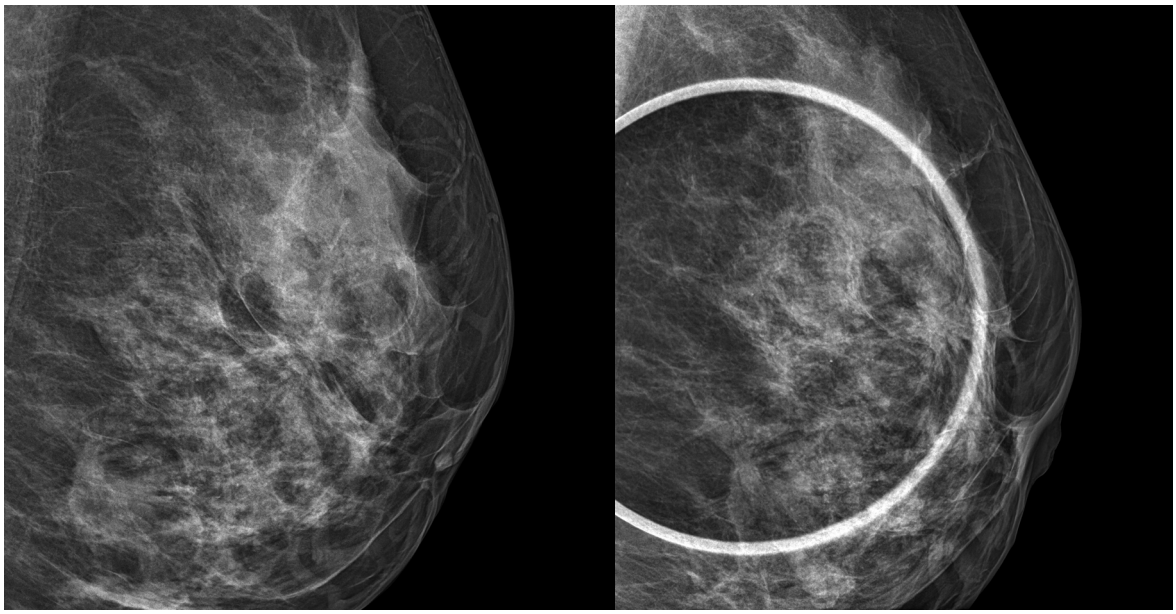
Figure 5: Normalized PI for all systems at each breast thickness for mass detection.

Conclusion

The evaluation, based on phantom testing, demonstrates that the MicroDose system with Diagnostic Scan, combined with electronic magnification on the review workstation, achieves high image quality at a lower dose than the tested digital mammography system with geometric magnification.

In Egan's study, Philips MicroDose Mammography performed comparably to conventional geometric magnification for the detection of masses and microcalcifications.[1]

Diagnostic Scan is efficient and easy to use and there is no need for a magnification table on the patient support to reduce SOD.



MLO view of the left breast

Diagnostic scan image of the left breast in MLO view

Figure 6

References

1. Egan G., et al., 2012. Comparison of contact Spot Imaging on a Scanning Mammography System to Conventional Geometric Magnification Imaging, *Breast Imaging Lecture Notes in Computer Science*, 2012, Volume 7361/2012, pp.165-172, DOI: 10.1007/978-3-642-31271-7_22.
2. Åslund, M., et al., 2006. Scatter rejection in multislit digital mammography. *Medical Physics*, 33, pp. 933-40.
3. Nishino L., et al., 2005. Thickness of molybdenum filter and squared contrast to noise ratio per dose for digital mammography, *AJR*, 185, pp. 960-63.
4. Koutalonis M., 2007. Contrast-to-noise ratio in magnification mammography: a Monte Carlo study. *Phys. Med. Biol.* 52. pp. 3185-99.

Footnotes

a. CDMAM 3.4 phantom.
b. A digital mammography system (100 µm pixel size, 1.8 times magnification, Rh/Rh anode/filter).
c. The evaluation was conducted for Sectra. Philips acquired the Sectra mammography operation in September 2011.
d. Average Glandular Dose (AGD) is the same as Mean Glandular Dose (MGD).

Please visit www.philips.com/microdose

Philips Healthcare is part of Royal Philips Electronics

www.philips.com/healthcare
healthcare@philips.com

Printed in The Netherlands
4522 962 90811 * NOV 2012