Quality Imaging - Comparison of CR Mammography with Screen-Film Mammography

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Abstract. The aim of this work is a quality imaging comparison of CR mammography images printed to film by a laser printer with screen-film mammography. A Giotto and Elscintec dedicated mammography units with fully automatic exposure and a nominal large focal spot size of 0.3 mm were used for the image acquisition of phantoms in screen-film mammography. Four CR mammography units from two different manufacturers and three dedicated x-ray mammography units with fully automatic exposure and a nominal large focal spot size of 0.3 mm were used for the image acquisition of phantoms in CR mammography. The tests quality image included an assessment of system resolution, scoring phantom images, Artifacts, mean optical density and density difference (contrast). In this study, screen-film mammography with a quality control program offers a significantly greater level of quality image relative to CR mammography images printed on film.

Keywords: Quality imaging, comparison, CR mammography, Screen-film mammography.
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INTRODUCTION

Due to the rapid evolution of digital imaging in radiology, CR mammography systems have gradually started replacing screen-film conventional mammography systems. Currently, there are no Mexican federal mandates in digital mammography procedures. Recently, two systems have been developed in digital mammography, Full Field Digital Mammography (FFDM) and CR mammography.

The aim of this work is a quality imaging comparison of screen-film mammography with CR mammography printed on film with. The screen-film mammography is excellent, but this technical approach has several limitations, which if overcome, might lead to improve sensitivity of breasts cancer detection and more accurate radiological diagnostics, although CR mammography printed on film has limitations to.

In CR mammography, the screen-film system is replaced by a CR plate that uses a photostimulable phosphor detector (PSP) system. CR plates are exposed in the same

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manner as screen-film. The latent image is stored on the CR plate in the form of trapped electrons. The CR plate is then read by the use of a stimulating red-wavelength laser that stimulates releases the trapped electrons resulting in a blue-green wavelength light emission. The stored signal contains the corresponding gray scale value along with a spatial position generated by the CR reader [1].

The contrast available in a digital image can be displayed on film or on a monitor. If the images are printed to film by a laser printer, this typically is done with 10 to 12 bits per pixel displayed. If the image at acquisition contained more than 12 bits, then the contrast in the image needs to be remapped to the number of the bits available for film display, then the contrast scale must be compressed.

MATERIAL AND METHODS

Image acquisition in screen-film mammography. A Giotto and Elscintec dedicated mammography units from two facilities with fully automatic exposure and a nominal large focal spot size of 0.3 mm were used for the image acquisition of phantoms. The images were obtained with an Agfa mamoray HDR-C plus film and mamoray screens HDS used clinically at the facilities. The films were developed using an Agfa CP1000 and Agfa Classic EOS film processors. Both facilities have a quality control program [2, 6].

Image acquisition in CR mammography. Four CR mammography units from two different manufacturers and four dedicated x-ray mammography units with fully automatic exposure and a nominal large focal spot size of 0.3 mm were used for the image acquisition of phantoms. The images acquired in CR mammography were printed to film by a laser printer in the same way as the clinical practice in each mammography department at the same size or a size smaller than the detector. An additional disadvantage of film printed is the loss of dynamic range inherent in displaying at 12 to 14 bits image at 8 bits [5].

The phantoms uses for the image acquisition were a mammography artifact evaluation full field phantom, full field digital phantom specifically designed for assessment of digital system resolution and verification of CCD stitching, both from CIRS and ACR Mammography Accreditation Phantom,

RESULTS AND DISCUSSION

The test quality image included system resolution, scoring phantom images, artifacts, mean optical density, density difference (contrast). The visibility of phantom details has been evaluated for screen-films and CR mammography films with a viewbox for mammography with at least 3 000 nits [3]. The phantoms were imaged at 24 kVp and 26 kVp at a dose of ~2.2 mGy per view for the screen-film systems and 28 kVp to 32 kVp (1.5 mGy to 3.5 mGy per view) for the CR system, both systems with fully automatic exposure in clinical conditions.

The scoring phantom images comparison of the CR Mammography with Screen-Film Mammography is summarized in Table 1. The results for screen-film mammography are improve and consistent with predicted performance based on the system scoring approved by FDA and ACR for the screen-film system [3,4].

TABLE 1. Scoring phantom images.						
Detector/system	**Technology**	**Fibers visible**	**Specks visible**	**Mass visible**	**Mean optical density**	**Density difference**
System scoring approved by FDA	FDA	4	3	3	At least 1.40	At least 0.40
Agfa HDR-C plus1	Screen-film	5	4	4	1.66 ± 0.5	0.60 ± 0.05
Agfa HDR-C plus2	Screen-film	5	4	4	1.73 ± 0.5	0.62 ± 0.05
System CR-1	Plate PSP	3	3	3	1.86 ± 0.5	0.51 ± 0.05
System CR-2	Plate PSP	4	2	4	1.20 ± 0.5	0.40 ± 0.05
System CR-3	Plate PSP	4	2	3	1.30 ± 0.5	0.26 ± 0.05
System CR-4	Plate PSP	3	3	4	3.08 ± 0.5	1.58 ± 0.05

The system resolution and artifacts comparison of the CR Mammography with Screen-Film Mammography are summarized in Table 2.

In screen-film systems the artifacts are due to dirty screens and processor, but in CR systems, the artifacts and nonuniformities are due to drifts in the flat-field corrections and plate image problems.

TABLE 2. Comparison of the system minimum resolution and artifacts [4].				
Detector	**Technology**	**perpendicular to anode-cathode axis (11 lp/mm)**	**In the anode-cathode axis (13 lp/mm)**	**Artifacts**
Agfa HDR-C plus1	Screen film	13	13	Yes
Agfa HDR-C plus2	Screen film	13	13	Yes
System CR-1	Plate PSP	4	8	Yes
System CR-2	Plate PSP	4	8	Yes
System CR-3	Plate PSP	4	4	Yes
System CR-4	Plate PSP	4	4	Yes

CONCLUSIONS

The screen-film mammography with a quality control program offers a significantly greater level of quality image relative to CR mammography images printed on film. Other problem in CR mammography is printed on film of a size smaller than the detector.

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