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Digital Mammography: An Update

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Digital Mammography: An Update

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Mammography remains important for early detection and diagnosis of malignant breast diseases. In recent years, digital imaging technology has been able to address the challenges inherent in film-screen mammography and improve many aspects of care. Promising techniques include needle biopsies guided by digital mammography, computer-assisted diagnosis, tomosynthesis, contrast-enhanced mammography and scinti-mammography. Although it is unlikely that digital mammography will revolutionize how breast cancer is treated, it continues to enhance and help provide timely and accurate detection and diagnosis.

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After completing this article, readers should be able to:

- *Discuss recent and important innovations in digital mammography.*
- *Differentiate 4 digital mammography systems.*
- *Describe 4 important diagnostic techniques.*
- *Identify when digital mammography is superior to film-screen mammography.*

Mammography became associated with breast cancer detection in the 1970s; by the late 1980s, the use of film-screen mammography was routine in most breast imaging facilities in the United States.[1] Mammography's use as an annual screening tool for women older than 40 is advocated by most medical societies. Screening mammography's primary purpose is to detect small, node-negative breast cancers at an early stage.[2]

A number of large, randomized studies have indicated that screening mammography reduces the rate of death from breast cancer. A Swedish study compared 2 to 6 rounds of annual mammography with usual breast care and revealed a 9% to 32% reduction in the risk of death from breast cancer when mammography was used.[3,4]

Film-screen mammography continues to be the gold standard for early breast cancer detection because of its availability and relatively low cost; however, digital imaging technology use is increasing in hospitals and outpatient facilities nationwide. According to American College of Radiology, full-field digital mammography systems represent 27% of mammography units in the United States, and their use is growing at a rate of 6% per month.[5]

With proper exposure, film-screen mammography produces acceptable, quality images with high spatial resolution that are viewable on widely available illuminators [6]; however, film-screen technology is limited by a relatively narrow dynamic range, low contrast resolution and the possibility of film noise and film processing artifacts. Digital mammography offers a broader dynamic range and higher contrast resolution. It also separates the tasks of image acquisition, display and storage, allowing for the independent optimization of each function.

Rather than using standard film to capture x-rays, digital mammography uses computers and specially designed image detectors to convert the x-ray signal into an electronic form, producing an image of the breast that can be displayed on high-resolution monitors. These images, made up of pixels, can be processed in real time and stored digitally for future access. Digital mammography also offers significant advantages in detection, screening and diagnosis.

Factors Affecting Digital Mammography

Any successful screening mammography practice fulfills 3 directives. The first is quality image interpretation that results in detection of a high percentage of early-

stage breast cancers, an acceptable recall rate and an acceptable biopsy rate and yield. The second is providing cost-efficient service. The third is to offer access for as many eligible women as possible.[2]

Improving Interpretation

Digital mammography provides high-luminance viewing conditions, high-quality clinical images, the opportunity to compare new images with previous mammograms, double reading (ie, interpretation by more than 1 radiologist) and computer-aided detection of abnormalities.[2]

Viewing Conditions

Optimum viewing conditions are just as important for accurate digital mammography interpretation as for film-screen mammography. Viewing conditions are influenced by the monitor's luminance capability, the ambient room illumination and the masking of extraneous light from the monitor.[2] Extraneous light can degrade image contrast and limit the visualization of densities. Monitor luminance is important because the subtle findings in digital mammograms, such as microcalcifications, require monitors that are brighter than those used for other radiological viewing. To deal with the large number of pixels in a digital mammogram (typically 4.4 million to 27 million, or 4 to 11 times as many pixels as found in a typical digital chest radiograph), digital mammography workstations must have higher-resolution monitors than those used for standard digital radiology viewing.[7]

High Contrast Resolution

Digital mammography's improved contrast resolution is especially important when viewing mammograms of dense breast tissue, which can contain overlapping densities and has proven to be more difficult to image using traditional film mammography. The fibrocystic changes found in dense breasts and in women with a history of prolonged hormone replacement therapy can complicate image interpretation. Digital mammography can address these challenges with improved contrast resolution and the ability to manipulate images on digital monitors. Postprocessing techniques such as image manipulation including magnification, contrast enhancement and pixel adjustments can ease interpretation of difficult-to-read images, potentially reducing the need for additional diagnostic images and, thus, decreasing patient anxiety.

Effective use of the radiologist's time is essential.[2] Improved contrast resolution and image manipulation can alleviate some of the viewing strain for radiologists and reduce false-positive and false-negative interpretations.

Additionally, digital mammography images taken at remote locations or in mobile units can be electronically transmitted to radiologists for interpretation (telemammography). Electronic transmission of images increases access to mammography and reduces the time patients must wait for results.

Detection and Diagnosis

Computer-aided detection (CAD) was an early motive for the development of digital mammography. The radiologist must first interpret the entire image before activating CAD, which then marks areas of concern on the image.[7] Computer-aided detection can offer a valuable "second opinion" in screening and diagnosis.

Double reading, the practice of having more than 1 radiologist view and interpret images, can improve patient outcomes; however, this practice is not widespread because of staffing limitations and a lack of reimbursement. CAD technology does not use a second radiologist interpreter, can be billed in conjunction with the primary mammography service and is a covered service by the Centers for Medicare and Medicaid Services. According to 1 study,[8] computer-aided detection has a similar result to double reading. In this study, the sensitivity was 97% for CAD vs 96% for double reading. The recall rate was 10.7% for computer-aided detection vs 10.6% for double reading. In another study that evaluated undiagnosed cancers visible in retrospect, computer-aided detection identified 86% of missed calcifications and 73% of missed masses.[9] It is important to note that in its present form, CAD should be used only for detetion and never for diagnosis or reassurance. Regrettably, the erroneous term "computer-aided diagnosis" has been used in the some of the radiologic and lay literature.[10]

Reader Performance

A 2005 Norwegian study[6] of 6 radiologists compared film-screen and digital mammography reader performance in the detection and classification of breast lesions. The study revealed that 235 of 276 interpretations were true-positive for both modalities, 6 interpretations were false-negative for both, 27 interpretations were true-positive with digital mammography but false-negative with film-screen mammography and 8 interpretations were false-negative with digital but true-positive with film-screen. The researchers noted that, while not statistically significant, their findings support the conclusion that digital mammography with soft-copy reading is slightly