An Overview of Digital Breast Tomosynthesis

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ABSTRACT: **The Centers of Disease Control and Prevention has reported that breast cancer is currently the second leading cause of cancer death among women. Mammography is considered the gold standard for detecting breast cancer and the only proven screening tool to reduce mortality. When the breast tissue is dense, it may lower breast cancer detection with mammography. Digital breast tomosynthesis (DBT) was developed to aid in the detection of lesions in dense breast tissue. DBT has the ability to partially remove tissues that are above and below the plane of the lesion. Thus, offering improved visualization and characterization of abnormalities that are seen within the breast and evaluation of dense breast tissue. Imaging and diagnosis of breast cancer is very complex. This article will help radiology nurses understand the role of DBT in increasing diagnostic accuracy. Full-field digital mammography and DBT will be compared. The radiology nurse who is knowledgeable in breast disease evaluation and the technology available will be well prepared to assist patients with understanding the diagnosis of their disease. (J Radiol Nurs 2015;34:131-136.)**

KEYWORDS: **Women's imaging; Mammography; Digital breast tomosynthesis; FFDM; Radiology nursing; Radiation dose.**

Breast cancer is increasingly becoming the primary cause of death for women older than 40 years (Hakim et al., 2010). According to the Centers for Disease Control and Prevention (CDC), breast cancer is the most common cancer among women and the second leading cause of cancer death among women (CDC, 2013). Early detection of breast cancer has been shown to save lives. Currently, mammography is considered the gold standard for detecting breast cancer and is the only proven screening tool to decrease mortality at a rate of 15% to 35% (Destounis, Arieno, & Morgan, 2014; Hakim et al., 2010; Niklason et al., 1997; Park, Franken, Garg, Fajardo, & Niklason, 2007). Mammography has a sensitivity and specificity of 84.9% and 90.3%, respectively (BCSC, 2014). However, the sensitivity and specificity of mammography can decrease as the density of the breast tissue increases (Pisano et al., 2005). It is believed that 10% to 30% of cancers are missed because of dense breast tissue (Destounis et al., 2014; Niklason et al., 1997; Pisano et al., 2005).

Digital breast tomosynthesis (DBT) is a new technology developed to improve detection of breast lesions, with particular benefit for imaging dense breast tissue. It can better characterize breast lesions detected on mammography (Helvie, 2010). DBT is a technology that has been in the development stage since the 1980s but because of poor quality image detectors, it was not until recent years that it made its entrance into the world of mammography. It is imperative for health care professionals to understand the health needs and concerns of women. These specialists should be able to answer questions about breast health and understand the latest technologies in the field of breast cancer imaging and diagnosis. There are several breast imaging manufacturers, including Hologic, Inc., GE Healthcare, and Fujifilm Medical Systems, which have produced a prototype device with DBT capabilities. Each of these different prototypes possess unique characteristics that produce similar results (Helvie, 2010; Park et al., 2007). After years of research that included reader studies and clinical trials, Hologic, Inc. was able to obtain Food and Drug Administration (FDA) approval for the Selenia Dimensions 3D System (Selenia Dimensions, Hologic Inc., Bedford, MA) in February 2011 (FDA, 2014).

The Selenia Dimensions 3D System was designed to perform two different examinations; a standard two-dimensional (2D) mammogram (using the step and shoot method) and in addition a three-dimensional

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No grant support or other financial assistance was received.

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1546-0843/$36.00

http://dx.doi.org/10.1016/j.jradnu.2014.10.004

(3D) technique (pulsed short exposures during continuous motion of the x-ray tube). DBT imaging is performed by the x-ray tube moving in an arc during the exposure period while the patient is in compression, producing 3D images. Another versatile function of this technology is that it can perform combination 2D/3D imaging under the same compression, making it more convenient for the patient (Park et al., 2007).

The Selenia Dimensions 3D System images are obtained while the x-ray tube moves in a 15° arc (−7.5° to +7.5°) obtaining 15 projection images (one image per degree) at multiple different angles while the breast is in compression in the standard craniocaudal and mediolateral (ML) oblique planes. The images are then reconstructed using a mathematical algorithm that combines tomographic images and volumetric 3D images (Alakhras et al., 2013; Park et al., 2007; Poplack, Tosteson, Kogel, & Nagy, 2007).

After the images are reconstructed, they can be viewed on a Picture Archiving and Communication System and connectivity workstation in as small as 1 mm slices. The thickness of the slices can be adjusted by the radiologist to view thicker slices, which can be helpful when looking at calcifications that may be so fine that unless the images are viewed as thicker slices the calcifications may not be perceived. By increasing the slice thickness, it will increase the ability to perceive a 3D configuration of clustered calcium; however, the spatial resolution of each individual calcification is affected (Spangler et al., 2011). With the ability to adjust the slice thickness, it also allows for a cross-sectional visualization of the breast that permits the radiologist to partially remove tissue above and below the plane of the lesion (Gur et al., 2009). This offers better evaluation and characterization of abnormalities that are seen within the breast. Slice thickness manipulation by the radiologist at the workstation is also a benefit for the evaluation of dense breast tissue (Figure 1A, B).

With the development of DBT, it was hoped that the advances in technology could potentially eliminate the need to perform additional mammographic imaging, such as ML view, lateromedial views, spot compression, and magnification views, because of the detection of an abnormality on screening mammography. It was also hoped to minimize screening mammography recall rates as most of the recalls are for overlap of normal breast tissue that causes false densities that may mimic a suspicious lesion. Early studies on DBT mainly concentrated on these two aspects. In 2007, Poplack et al. (2007) prospectively studied 99 digital screening recalls in 98 women. The authors found that DBT was equivalent ($n = 51$) or superior ($n = 37$) to diagnostic mammography in 89% (88 of 99) of the cases. A limitation in this study was that all diagnostic views were performed on film-screen units as per clinical practice at that time. The authors concluded that DBT has comparable or superior image quality to that of film-screen mammography in a diagnostic setting and could potentially decrease the recall rate when used with digital screening mammography. The recall rate in their study was decreased by 40% depending on the type of abnormality (Poplack et al., 2007).

Gur et al. (2009) evaluated the performance of full-field digital mammography (FFDM) compared with DBT by comparing the recall rates of the two modalities. The study consisted of 125 examinations (90 examinations with no cancer finding and 35 examinations

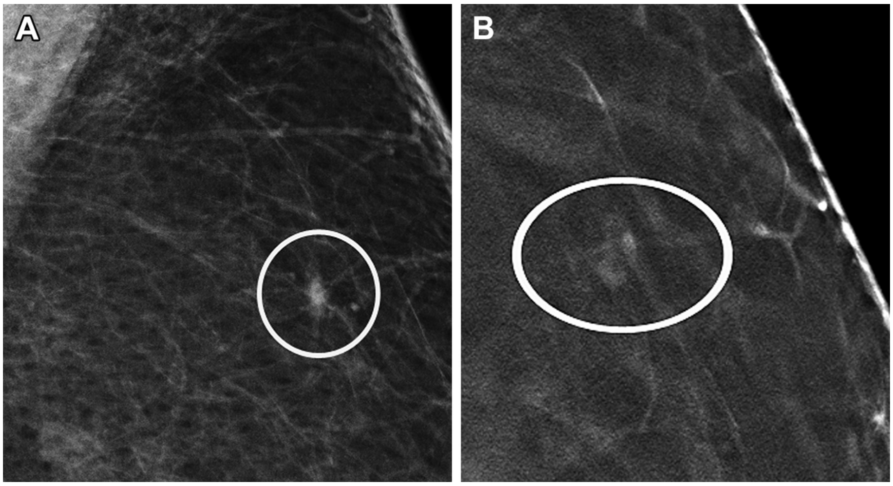

Figure 1. Patient presents for a screening mammogram and has a two-dimensional/three-dimensional combo digital breast tomosynthesis (DBT) examination. (A) Full-field digital mammography shows an abnormality in the upper left breast. (B) DBT shows a normal lymph node in the area of the abnormality, thus eliminating the need for additional imaging.