Impact of Advancing Technology on Diagnosis and Treatment of Breast Cancer

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KEYWORDS

• Tomosynthesis • Breast MRI • Abbreviated protocol MRI
• Diffusion-weighted imaging • Radioactive seed localization • MAGSEED
• SAVI SCOUT

KEY POINTS

- Three-dimensional imaging of the breast (digital breast tomosynthesis) minimizes the effects of overlapping fibroglandular tissue seen with standard mammography, improving lesion detection, characterization, and localization.
- Digital breast tomosynthesis has demonstrated improved diagnostic accuracy compared with full-field digital mammography alone, with consistently reported decreased recall rates and increased cancer detection rates.
- Fast abbreviated breast MRI reduces time and costs associated with full diagnostic protocol breast MRI while maintaining diagnostic accuracy in the evaluation for breast cancer.
- Diffusion-weighted imaging is a functional MRI technique that has shown promise in breast cancer screening, lesion detection/characterization, and the evaluation of treatment response.
- Recent years have introduced several new localization techniques which increase patient satisfaction and decrease operating room delays compared with traditional needle/wire localization.

TOMOSYNTHESIS

Breast screening with mammography is widely recognized as the most effective method of detecting early breast cancer[1] and has consistently demonstrated a 20% to 40% decrease in mortality among screened women.[2,3] In fact, a 2014 study by

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Webb and colleagues[4] demonstrated that 71% of breast cancer deaths are seen in unscreened women. Despite advances in treatment, stage at diagnosis is the greatest predictor of breast cancer survival and, therefore, early detection leads to improved breast cancer survival.[5]

However, the sensitivity of mammography is far from perfect ranging from 70% to 85%[6] with overlapping dense fibroglandular tissue presenting the greatest impediment to detection. This limitation is due to the inherent nature of mammography, which captures a 2-dimensional (2D) image of a 3-dimensional structure (the breast) with resultant superimposition of fibroglandular tissue, which can obscure underlying malignancy.

Improvement in sensitivity was seen with the switch from screen film mammography to full-field digital mammography (FFDM), in particular in women younger than 50 and those with dense breasts[7,8]; however, it remains suboptimal, in particular with increasing breast densities. In addition to obscuring malignancy, the superimposition of normal fibroglandular tissue can also mimic mammographic appearance of cancer and thus increase the number of false positive recall rates. Digital breast tomosynthesis (DBT) was developed to address both of these deficiencies of FFDM.

Technique

First described by Niklason and colleagues[9] in 1997 and receiving approval from the US Food and Drug Administration (FDA) in 2011, DBT is a technique that enables 3-dimensional visualization of the breast. Unlike standard mammography, which uses a single x-ray beam exposure produced at a fixed angle to the stationary breast and detector, DBT acquires multiple low dose images as the x-ray tube moves in an arc that varies between 15° and 60° (depending on the manufacturer) above the breast and detector (**Fig. 1**). Also depending on the manufacturer, the detector may rotate

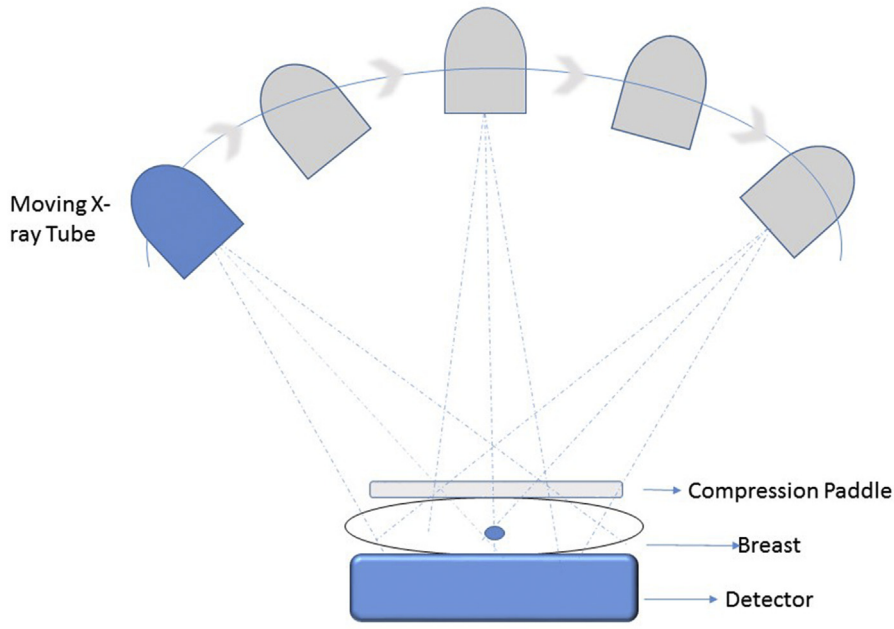

Fig. 1. Schematic of tomosynthesis. The x-ray tube moves in an arch producing low radiation exposures of the breast.