Clinical Implementation of Digital Breast Tomosynthesis

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KEYWORDS

• Digital breast tomosynthesis • Digital mammography • Breast cancer • Screening mammography • Breast imaging

KEY POINTS

- DBT improves specificity and sensitivity in breast cancer screening.
- The conspicuity of masses and areas of distortion is improved with DBT.
- The three-dimensional information from DBT imaging may replace the need for some two-dimensional diagnostic imaging in the evaluation of suspicious lesions.
- Research is ongoing to address the increased x-ray dose of combination DM/DBT and to improve the efficiency of reading the large image sets.

INTRODUCTION

Despite continued controversy over how often and when mammographic screening should occur, the modality remains the mainstay of the early detection of breast cancer. In 2009, the US Preventative Service Task Force on Screening (USPSTFS) published new and controversial guidelines recommending that screening begin at the age of 50 rather than 40 years and that the interval of screening change to every other year rather than yearly. In addition, for the first time, the new guidelines recommended an age at which screening should stop (75 years), when previously no age had been defined.[1]

These controversial guidelines persist in 2013 despite that digital mammography has shown an improved performance over older, analog imaging and that newer, population-based screening trials have shown more than a 30% reduction in breast cancer deaths in patients screened.[2,3] At the heart of the USPSTFS guideline changes are concerns over the risk-benefit ratio of mammography (too many false-positive with few significant cancers detected), the potential for overdiagnosis (finding cancers that probably are not harmful yet are treated aggressively), and that mammography is fraught with false-negatives or misses of clinically significant cancers.

WHY DIGITAL BREAST TOMOSYNTHESIS?

Early data on digital breast tomosynthesis (DBT) has shown that the novel technique may address some of the limitations of conventional mammography by improving the accuracy of screening and diagnostic breast imaging.[4–7] With conventional two-dimensional digital mammographic (DM) imaging, many of the concerning false-positives and -negatives are caused by the same issue: the breast is a three-dimensional structure viewed as a two-dimensional image. In the case of false-positives, normal overlapping tissues of various textures and densities may create a complex appearance that too often mimics suspicious asymmetries or areas of architectural distortion, thus prompting additional imaging and occasionally biopsy (**Fig. 1**). In the case of false-negatives, overlying normal breast tissue may obscure or mask malignant lesions, preventing detection (**Fig. 2**).

The technique of DBT allows the breast to be viewed in a three-dimensional format so that in-focus planes, or slices of the breast, can be visualized thus reducing the impact of confounding or

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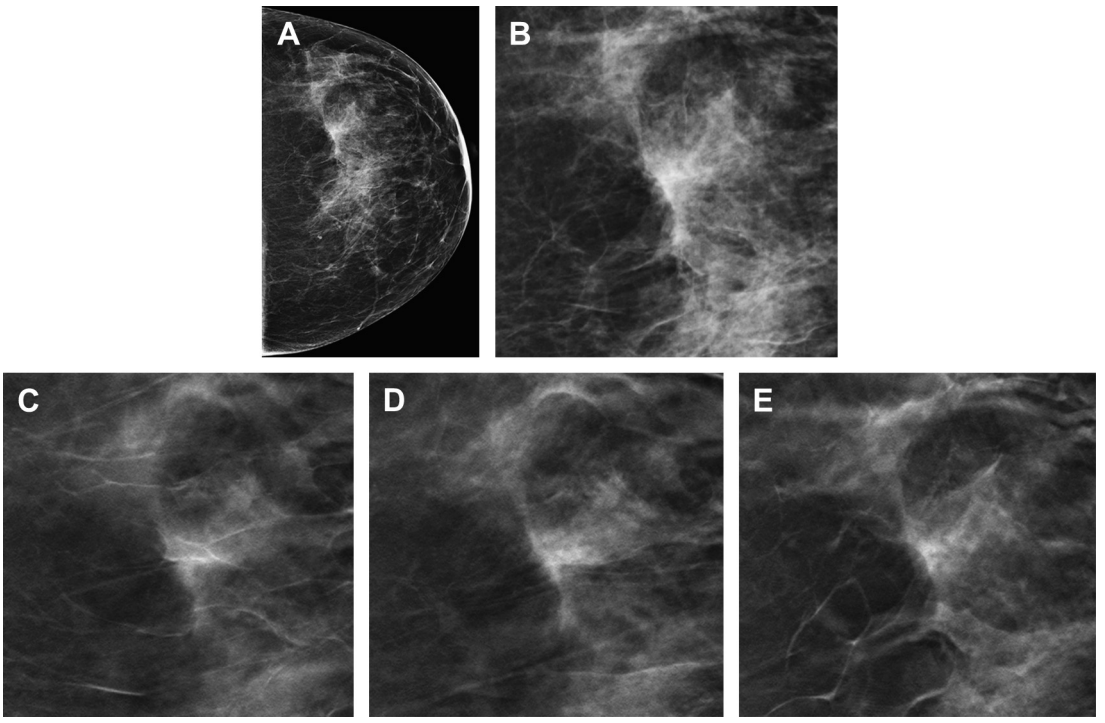

Fig. 1. Reduction in false-positive callbacks with DBT. The DM CC view (*A*) demonstrates focal asymmetry with a suggestion of architectural distortion in the slightly lateral breast. A cropped, enlarged view of the DM focal asymmetry (*B*) better demonstrates the area of possible distortion. Multiple in-plane 1-mm reconstructed slices (*C–E*) from the DBT clearly show that the focal asymmetry seen on the two-dimensional DM study is caused by tissue superimposition rather than a clinically significant finding.

superimposed breast tissue. The multiple, in-plane DBT slices are reconstructed from a series of low-dose exposures acquired as the mammographic x-ray source moves in an arc above the compressed breast.[8–10] The DBT image sets may be acquired from any angle that the x-ray tube moves and may be obtained during the same compression as the two-dimensional mammographic views. This combination of obtaining a two-dimensional image and a tomosynthesis image set together is often called a "combo-mode" acquisition.[11] This combination imaging technique is fast, usually obtained in 3 to 4 seconds (Hologic, Inc. Bedford, MA), and is very well tolerated by patients. In addition, because the two-dimensional and tomosynthesis images are acquired in a single compression, the images are coregistered allowing the reader to toggle back and forth between the image sets to problem solve (see **Fig. 1**). This combination of 2D digital mammography (DM) and DBT imaging was approved by the Food and Drug Administration (FDA) in 2011.[12] **Box 1** summarizes some of the clinical benefits seen with DBT imaging.

Data from reader studies comparing two-dimensional DM with combined DBT and DM show an improvement in sensitivity and specificity[5,13–17] coupled with excellent patient acceptance. Now that DBT has been approved by the FDA and has been implemented in many clinics across the world, prospective clinical data are beginning to emerge. Results from a few of these prospective and observational studies are reviewed here (**Tables 1** and **2**).

SUMMARY OF DBT DATA

DBT in Screening

The early data on the impact of DBT on screening outcomes, although mostly from enriched reader trials, showed up to a 40% reduction in false-positive callbacks[24] with a stable or slightly increased cancer detection rate. Because clinical implementation of DBT began only in the last 2 years, there is little published data from larger, prospective, population-based screening trials to further substantiate these performance outcomes. However, the recently published interval analysis from the prospective Oslo Tomosynthesis Screening Trial provides additional evidence that integration of the combo-mode DBT is associated with improvement in sensitivity and specificity.[6] In