Digital breast tomosynthesis: implications for mammographic practice

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Introduction

Digital breast tomosynthesis (DBT) or 3D mammography is an advanced form of mammography that uses multiple low dose x-ray systems and computer reconstructions to create 3D images of the breast. This is achieved by moving the x-ray tube in an arc while making a series of exposures with the overall dose comparable to a conventional 2D mammogram. This technique has rapidly emerged as an important imaging tool. It reduces the masking effect of overlapping fibroglandular tissue mimicking or obscuring lesions and facilitates differentiation between malignant and non-malignant features, especially in mammographically dense breasts (figure 1).

Research suggests that 2D mammography, with the addition of DBT, has the potential to improve the accuracy of screening mammography by reducing screening recall rates and increasing cancer detection rates. Such studies include the OSLO and STORM trials. These reported a 27-34% increase in the cancer detection rates across all breast densities and a 15-17% decrease in false-positive recall rate using DBT adjunct to 2D mammography. To address the concern of almost double the radiation dose as a consequence of 2D and additional DBT a synthetic 2D image can now be created from the tomosynthesis data and research has moved on to evaluate the accuracy of this.

Current position of use of DBT in UK NHSBSP

The current position on the use of tomosynthesis in the UK NHS breast screening programme has been outlined in guidance issued, which supports the use of DBT for further assessment of possible screen-detected soft tissue abnormalities in place of spot compression views. When used, tomosynthesis should be performed in two projections.

Mammographic technique

The NHSBSP stipulates training for mammographers who use DBT in assessment, which includes:

• vendor-specific training;
• advice on ‘how to use’;
• practical and theoretical grounding in the technology from an NHSBSP training centre;
• routine QC and tolerances, use of phantoms;
• artefacts;
• the provision of information about the technology to women;
• PACS retrieval.

Positioning is key to ensure that all the breast tissue is included on the mammogram, enabling the detection and diagnosis of breast cancer and other breast pathologies as early as possible. Compared to other radiographic positioning techniques, it is acknowledged that it is difficult, requiring skill to obtain high quality mammograms. Features uniquely inherent to the breast, such as shape, size, density and low contrast, combined with patient factors such as anxiety, tenderness and fear of radiation, challenge the most skilled mammography practitioner. Researchers have concluded that this was found to be the case with DBT with improved visualisation of pectoralis muscle on cranial caudal views and inframammary fold on medio-lateral oblique views at the expense of including more skin folds.

Positioning errors can be caused by not including all the breast tissue on the lateral aspect of the image. DBT requires more room on both sides of the breast to accommodate the wide angle of the tomo sweep needed to produce the image.

Image artefacts tend to arise from patient motion or shoulders being in the radiation field of view. A simple recommendation to prevent this is to discourage the patient from talking during the image acquisition process.

Breast compression

Breast cancer screening using DBT without the vigorous compression used in standard 2D mammography would be welcomed by women, especially because time under compression is greater with DBT due to the longer exposure time required for the procedure. This reduction in compression, if it results in a reduction in pain and discomfort, could increase screening compliance, with current reported breast screening uptake at only 71.1%. Studies of DBT thus far have shown promising results in this regard with some reporting up to a 50% reduction in compression force for DBT without compromise in image quality, motion blurring or lesion conspicuity, despite the increased exposure time during image acquisition.
DBT: radiology assessment

DBT is widely used during the assessment process in both screening and symptomatic assessment clinics, replacing the conventional spot or collimated compression views of non-calcified findings. This has led to improvement in visualisation of subtle signs that are difficult to appreciate on standard 2D mammograms. It is acknowledged that there is a prolonged image acquisition time and screen reading time, relative to 2D alone. However, this is associated with improved screening accuracy. This was found to have minimal impact on workflow at initial implementation.

Guidance stipulates that the responsible assessor who interprets these images is required to attend an NHSBSP recognised training course on the use of tomosynthesis before embarking on its clinical use.

DBT-guided biopsy of the breast

With the growing adoption of DBT, an increasing number of imaging abnormalities are being identified only on tomosynthesis, which provide management challenges and dilemmas that can now be addressed with tomosynthesis-guided core biopsy. From a mammographer's perspective, the basic steps of the procedure itself are similar to traditional 2D-guided biopsy; a significant difference being lesion targeting with the abnormality targeted on the image slice that best shows the abnormality. Studies show that this procedure has comparable efficiencies, with no significant differences between procedure time, average dose or accuracy of test, indicating tomo-guided biopsy as an alternative to the 2D biopsy method. In addition, some studies even suggest a decrease in procedure time when used in conjunction with vacuum-assisted biopsy (figure 2).

DBT-guided wire localisation

Tomothesis-guided wire localisation has been shown to be an accurate and feasible method to perform wire localisation procedures on breast abnormalities that are only visible on DBT. As with the biopsy procedure, the lesion can be targeted on the image slice that best shows the abnormality, and then wire inserted for greater confidence in the accuracy of its placement. Post-wire placement DBT mammography can also confirm the accuracy of the wire placement that had previously been occult on 2D mammograms (figure 3).

DBT: specimen imaging

Sample radiography is often considered to be the method of choice for the radiological proof of the complete removal of a lesion. Breast specimens are flattened after surgical removal and application of compression during imaging, losing up to 50% of their original height. This is known as the “pancake” phenomenon and has implications for accuracy of margin analysis. Research is currently investigating the use of DBT of specimen to determine whether a reduction in the rate of re-excisions for histologically verified breast cancer followed by breast-conserving therapy with wire marking is possible compared to standard 2D imaging.

Research has found that DBT is significantly superior to 2D regarding identification of the closest margin and sensitivity in assessment of margin status.

Conclusion

Current recommendations support the use of DBT as an adjunct to conventional 2D mammography in NHSBSP assessment. Extensive research into the use of DBT throughout a breast cancer diagnosis has shown that it is at least as good as its 2D counterpart with further evidential review required before consideration if it is to replace standard 2D mammography in the UK NHSBSP.

References


