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# Pathology results of architectural distortion on detected with digital breast tomosynthesis without definite sonographic correlate

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ABSTRACT

*Background:* Digital breast tomosynthesis (DBT) is a mammographic technique which improves the detection of breast cancer. Architectural distortion of malignancy may be occult on 2D mammography and ultrasound but detected by DBT.
*Methods:* 110 patients who underwent 116 DBT-guided needle biopsies for architectural distortion were identified between June 2014 and August 2017 and underwent review of medical records.
*Results:* 59 of 116 biopsies (51%) revealed lesions warranting further consideration or excision. These included 21 specimens with invasive carcinoma, 2 ductal carcinoma in situ (DCIS), 5 atypical ductal hyperplasia, 4 atypical lobular hyperplasia, and 2 other lesions. 46 lesions were excised. Surgical pathology demonstrated 22 malignant lesions (20 invasive carcinomas and 2 DCIS). 11 patients continued surveillance and two patients were lost to follow up. 94 lesions (87%) were not visible on ultrasonography.
*Conclusions:* DBT-guided biopsy for architectural distortion detected a malignancy in 19% of lesions, demonstrating the importance of pathologic diagnosis for lesions without correlating ultrasound findings.



## Introduction

Digital breast tomosynthesis (DBT) is an advanced mammographic technique incorporating multiple angular projections of the breast to enable three-dimensional (3D) reconstruction while requiring only a single breast compression event.[1] This technology has been approved by the United States Food and Drug Administration for screening and diagnosis of breast cancer since February of 2011.[2] In a screening context, the use of DBT in combination with two dimensional (2D) digital mammography has been shown to increase detection of invasive breast cancer with most, but not all, studies demonstrating a decrease in recall rate.[3–7] In diagnostic settings, research suggests that DBT is better than full field digital mammography in the detection of subtle signs of malignancy, enabling classification of indeterminate lesions as suspicious for malignancy or more likely benign.[1,8] Additionally, DBT has been shown to evaluate lesion size better than digital mammography, therefore increasing the accuracy of preoperative breast cancer staging.[9,10]

Like other breast imaging modalities, DBT can be used to guide biopsies of suspicious breast lesions. Viala et al.[11] comprehensively reported the technical details of stereotactic vacuum-assisted biopsy of lesions using a DBT system. In particular, patients with architectural distortion may have an increased benefit from the use of DBT-guided biopsy. Architectural distortion comprises 6% of detected abnormalities on screening mammography and is significantly less common than masses or calcifications.[12–14] The Breast Imaging Reporting and Data System (BI-RADS) defines architectural distortion as "The normal architecture (of the breast) is distorted with no definite mass visible. This includes spiculations radiating from a point and focal retraction or distortion at the edge of the parenchyma. Architectural distortion can also be an associated finding."[15] Benign causes include radial scars, complex sclerosing lesions, sclerosing adenosis, fat necrosis, posttraumatic changes, and spiculated benign lesions; however invasive breast cancer and

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ductal carcinoma in situ (DCIS) may also present as architectural distortion. Both benign and malignant lesions causing architectural distortion often do not have correlate lesions visible on ultrasound, emphasizing the role of DBT-guided biopsy in the evaluation of these lesions.[14] Ariaratnam et al.[16] recently assessed the use of a vacuum assisted biopsy system exclusively for lesions occult on 2D mammography and ultrasound and demonstrated a 21% positive predictive value for malignancy in 38 lesions.

Our community health network cancer center offers DBT to all patients indicated for screening mammography, and uses DBT extensively for diagnostic mammography as well. The aim of this study was to determine the pathologic outcomes of patients who were found to have architectural distortion on DBT and underwent DBT-guided biopsy for lesions not amenable to ultrasound-guided biopsy.

## Materials and methods

### *Study population*

Records were retrospectively reviewed to identify all patients who underwent DBT-guided needle biopsies for architectural distortion between June 1, 2014 and August 31, 2017. A total of 110 women underwent 116 DBT-guided biopsies during the study period. Architectural distortion can be associated with calcifications, asymmetries, or masses; however this population included only patients with asymmetry associated with architectural distortion. The study was approved by the Legacy Health Institutional Review Board and a waiver of the need for informed consent was obtained.

### *Imaging technique and interpretation*

All studies were interpreted by one of three breast specialist radiologists and assessed using the standards of the BI-RADS atlas.[15] Screening DBT examinations included standard craniocaudal and mediolateral oblique views. When architectural distortion was identified on screening mammography, a BI-RADS category of 0 was assigned and the patient was recalled for additional diagnostic imaging including DBT and usually ultrasound. Patients with previously noted findings that were seen in follow up and patients who underwent screening mammography outside of our health care system were indicated for diagnostic DBT. All DBT examinations included tomosynthesis views and reconstruction of standard digital 2D mammographic views to keep radiation exposure at the same level as traditional 2D mammography.

All biopsies were performed with the Affirm® Breast Biopsy Guidance System and reviewed by breast specialist pathologists. Patients with biopsy pathology of papilloma, radial scar, atypical lobular hyperplasia, atypical ductal hyperplasia, DCIS, and invasive carcinoma were indicated for surgical biopsy. The surgical biopsy specimens were examined by institutional pathologists.

### *Data collection and analysis*

Medical records were reviewed for dates of all imaging studies and procedures, mammographic and sonographic findings, BI-RADS final assessment categories, patient age at the time of DBT-guided biopsy, laterality of biopsy, complications following DBT-guided biopsy, DBT-guided biopsy and surgical pathology results. After the completion of data collection, concordance between imaging findings, biopsy pathology, and surgical excision pathology was reviewed. All data were analyzed using a spreadsheet software program (Excel, version 2016, Microsoft).

## Results

### *Patient characteristics*

All 110 patients were female, and the mean age at the time of biopsy was 60 years old (range: 35–85 years).

### *Lesion imaging characteristics*

Of the 116 lesions biopsied, 100 were initially noted on screening DBT, and 16 had been previously noted on DBT mammography. All lesions were imaged with diagnostic DBT. The diagnostic DBT included concurrent ultrasonography in 108 lesions, however eight patients did not have ultrasounds within the six months preceding their DBT-guided biopsy. Of the lesions imaged with ultrasonography, 87% (94/108) of lesions were not visible with this modality. Three DBT-guided biopsies were performed after ultrasound-guided biopsy pathology results were discordant with imaging. In the remaining 11 lesions with findings on both ultrasound and DBT, the interpreting radiologist decided that DBT-guided biopsy was more likely to be diagnostic than ultrasound-guided biopsy.

### *Pathology findings*

49% (57/116) of biopsies demonstrated benign breast tissue while 51% (59/116) of biopsies in 55 patients detected radial scars, atypical lesions, or malignancies (Table 1). These included 21 invasive carcinomas, two DCIS, five atypical ductal hyperplasias, four atypical lobular hyperplasias, a pseudoangiomatous stromal hyperplasia, and an intraductal papilloma.

Thirteen patients with non-benign biopsy results did not undergo surgical excision of their lesions at our institution (Table 2A). Five patients with seven radial scar lesions (one patient had three lesions) declined the recommendation for surgical excision. Four patients with atypical lesions were recommended for ongoing surveillance without excision following a multidisciplinary review of the case by surgery, pathology, and radiology. One patient with a radial scar moved out of state prior to excision, and one patient with DCIS opted for surgery at another institution.

In the 46 biopsied lesions treated with surgical excision, the biopsy and surgical pathology was concordant in 80% (37/46, Table 2B) including two patients with invasive cancer on biopsy who were found to have no residual disease at the time of surgical excision, and one patient with invasive cancer on biopsy who was found to have DCIS without invasive caner on surgical pathology. The biopsy and surgical pathology was discordant in 20% (9/46, Table 2C).

Evaluation of sentinel lymph nodes was performed at the time of surgical excision in 20 of the 22 patients with DBT-guided biopsy results consistent with invasive cancer or DCIS. One patient with DCIS was not indicated for sentinel lymph node biopsy, and another patient with invasive carcinoma did not undergo sentinel lymph

**Table 1**
Biopsy pathology results.

| Biopsy result (n = 116) | N |
|---|---|
| Benign breast tissue | 57 |
| Radial scar | 25 |
| PASH | 1 |
| Papilloma | 1 |
| ALH | 4 |
| ADH | 5 |
| DCIS | 2 |
| Invasive carcinoma | 21 |

**Table 2A**
Biopsy/Surgical Pathology Concordance. A. Biopsy pathology without subsequent surgical excision (total n = 13).

| Biopsy pathology | N | Notes |
|---|---|---|
| Radial scar | 8 | 5 patients with 7 lesions declined surgical excision<br>One patient moved out of state prior to planned surgical excision |
| PASH | 1 | After multidisciplinary discussion, surgical excision was not recommended |
| ALH | 1 | After multidisciplinary discussion, surgical excision was not recommended |
| ADH | 2 | After multidisciplinary discussion, surgical excision was not recommended |
| DCIS | 1 | Patient underwent surgical excision at another institution and records were not available for review |

**Table 2B**
B. Concordant biopsy and surgical pathology (total n = 37).

| Biopsy result | Surgical pathology result | N |
|---|---|---|
| Radial scar | Radial scar | 14 |
| Papilloma | Papilloma | 1 |
| DCIS | DCIS | 1 |
| Invasive cancer | Invasive cancer | 18 |
| Invasive cancer | Benign breast tissue | 2 |
| Invasive cancer | DCIS | 1 |

**Table 2C**
C. Discordant biopsy and surgical pathology (total n = 9).

| Biopsy result | Surgical pathology result | N |
|---|---|---|
| Radial scar | Benign breast tissue | 2 |
| Radial scar | ADH | 1 |
| ALH | Benign breast tissue | 1 |
| ALH | Invasive cancer | 2 |
| ADH | Benign breast tissue | 1 |
| ADH | Radial scar | 2 |

node biopsy due to her age (87 years old), small area of concern on imaging, and receptor status on biopsy pathology. Of the 20 patients who did undergo sentinel lymph node biopsy, 18 (90%) did not have evidence of nodal malignant spread. One patient had a previously biopsied known positive node, and the other patient was found to have a positive sentinel lymph node on frozen section and underwent completion axillary dissection with only the sentinel lymph node containing malignancy on final pathology.

All seven lesions in seven patients which were visible on ultrasound and DBT were malignant, while 13 lesions in 13 patients not been seen on ultrasound were malignant, and two malignant lesions had not been imaged with ultrasound. Overall, 14% of lesions visible on DBT but not ultrasound were malignant (Table 3).

### *Concordance*

Imaging findings were concordant with DBT-guided biopsy pathology in all lesions, and surgical pathology in 95% of lesions (45/47). Two patients with invasive carcinoma on DBT-guided biopsy did not have any residual carcinoma on surgical excision.

### *Complications*

One patient developed a large hematoma following DBT-guided biopsy. Another patient experienced lightheadedness after the biopsy which precluded the routine post-procedure mammography. No other complications were noted for a rate of 2% (2/110 of patients).

## Discussion

In this group of patients with DBT-detected architectural distortion without a mass or calcifications, DBT-guided biopsy was well tolerated with a low rate of complications. DBT-guided biopsy results revealed the need for consideration of surgical excisional biopsy in 51% of lesions, and a malignancy was ultimately detected in 19% of lesions biopsied. Only 13% of the biopsied lesions were able to be seen on ultrasound, emphasizing the utility of DBT-guided biopsy techniques in cases where ultrasound-guided biopsy is not possible.

Architectural distortion is the third most common imaging finding in nonpalpable breast cancers, and the most challenging because of its subtlety and variable appearance.[12,14] In retrospective assessments of false-negative mammography, architectural distortion is a common finding, and is thought to represent the earliest evidence of certain invasive breast cancers.[14] DBT has been shown to increase sensitivity, increase reader confidence, and decrease interobserver variability in the detection of architectural distortion.[17] Bahl et al.[18] found that DBT detected architectural distortion twice as often as conventional 2D digital mammography. Initially there was additional radiation exposure to patients when DBT was combined with traditional 2D mammography, but newer techniques have enabled the reconstruction of 2D images from DBT images. These advances allow for DBT-only screening without increased radiation.[1]

**Table 3**
Characteristics of sonographically occult malignant lesions (chronologic order).

| Patient | Age | DBT BI-RADS | Biopsy Result | Surgical Pathology Result | Size of Lesion (cm) | Positive Sentinel Lymph Nodes |
|---|---|---|---|---|---|---|
| 1 | 63 | 6 | Invasive ductal carcinoma | DCIS | 0.5 | 0/2 |
| 2 | 62 | 6 | DCIS | DCIS | 1 | n/a |
| 3 | 67 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 0.6 | 0/1 |
| 4 | 66 | 4 | Atypical lobular hyperplasia | Invasive ductal carcinoma | 0.5 | 0/2 |
| 5 | 67 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 1.2 | 0/2 |
| 6 | 48 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 1.1 | 0/3 |
| 7 | 65 | 6 | Invasive lobular carcinoma | Invasive lobular carcinoma | 1.9 | 0/3 |
| 8 | 70 | 6 | Invasive ductal and lobular carcinoma | Invasive ductal carcinoma | 0.4 | 0/3 |
| 9 | 53 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 0.7 | 0/2 |
| 10 | 85 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 0.4 | n/a |
| 11 | 66 | 4 | Atypical lobular hyperplasia | Invasive lobular carcinoma | 0.9 | 0/1 |
| 12 | 56 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 0.6 | 0/2 |
| 13 | 67 | 6 | Invasive ductal carcinoma | Invasive ductal carcinoma | 0.7 | 0/3 |

Because of the increased sensitivity of DBT compared to 2D mammography, there was initially concern about the potential for overdiagnosis and unnecessary biopsies performed for benign lesions[1] however research has demonstrated that DBT can actually decrease the recall rate compared to 2D mammography when used for screening.[5,7] Interestingly, there is emerging evidence that DBT is capable in detecting less-aggressive subtypes of breast cancer, particularly in dense breast tissue. Kim et al.[19] found 9.2% of invasive breast cancers were seen on DBT but not full-field digital mammography, and these lesions were significantly associated with $</=2$ cm tumor size, luminal A-like subtype, and dense breast parenchyma. Our results are consistent, with 90% of patients who underwent sentinel lymph node biopsy at the time of surgical excision having negative results.

Because areas of architectural distortion are often undetectable on 2D mammography, the possibility of traditional stereotactic biopsy is negated. In previous studies comparing DBT-detected architectural distortion without 2D mammography correlates, the positive predictive value for malignancy varied from 35.7 to 50.7%.[18,20–22] In many of these cases where DBT-guided biopsy is not available, these lesions are biopsied under magnetic resonance (MR) guidance, which may cause delayed care, increased costs, and increased patient discomfort during the procedure compared to other biopsy techniques.[1]

Lesions causing architectural distortion on DBT may be difficult to identify with ultrasound due to subtle or absent echogenic signals, resulting in false-negative ultrasound-guided needle biopsy results.[1] Radial scars may appear as parenchymal distortion or hypoechoic masses, mimicking malignancy. Fat necrosis has variable internal echotextures and may be cystic or solid. DCIS is usually seen on ultrasound as a hypoechoic mass with or without echogenic foci or area of microcalcifications, but up to 4% of DCIS cases may have architectural distortion only. Although the majority of invasive cancers are detectable on ultrasound, there are other carcinomas without ultrasonographic correlate to the architectural distortion seen on mammography.[12,14] In addition to the ability to biopsy sonographically occult lesions, one study reports decreased average time required to perform DBT-guided biopsy compared to ultrasound-guided (15 min vs. 20–25 min). This group plans to continue exploring the use of DBT-guided biopsy even in lesions visible on ultrasound.[11]

Bahl et al.[18] demonstrated that architectural distortion detected on DBT without a sonographically apparent lesion was found to be malignant after biopsy in 29% of cases. This was significantly lower than the rate of malignancy in architectural distortion lesions with a sonographic correlate (66.5%, $p < 0.001$) but is still carries clinical relevance. These findings included a mix of image-guided biopsy and surgical pathology results, which may partially explain the increased percentage in malignancy compared to our dataset correlating biopsy and final surgical pathology results.

In another recent study, DBT-guided biopsy of 38 lesions not seen on ultrasound or 2D digital mammography demonstrated eight malignancies (five invasive ductal carcinomas, one invasive lobular carcinoma, two DCIS), and 14 high risk lesions indicated for surgical biopsy. After excision of 10 of these high risk lesions, two were upgraded to malignancy leading to an overall positive predictive value of 26%.[16] It is possible that the relatively small sample sizes in these populations thus far contribute to the differences in rate of malignancy of sonographically occult lesions between this study and our finding of 14%. Additionally, because all of the screening mammograms were performed with DBT technology and not traditional 2D digital mammography, it is unknown how many of the lesions would have been detected with alternative mammographic techniques.

## Conclusions

DBT-guided biopsy has been demonstrated to be feasible, safe, and effective for the pathologic diagnosis of lesions presenting with architectural distortion and may be particularly valuable for the detection of early stage malignancies. Future research is needed to compare DBT-guided biopsy to the traditional standard of MR-guided biopsy in terms of cost, efficacy, and patient satisfaction for lesions not visualized on ultrasound or 2D mammography. With the expansion of DBT use in screening, it is likely that more centers will perform DBT-guided biopsy, and further comparisons of DBT-guided and ultrasound-guided biopsy should be made in lesions which are potentially amenable to both techniques.

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