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NUCLEAR MEDICINE AND MOLECULAR IMAGING

ORIGINAL ARTICLE

Feasibility and accuracy of digital breast tomosynthesis–guided vacuum-assisted breast biopsy for noncalcified mammographic targets

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PURPOSE
We aimed to determine the feasibility and accuracy of digital breast tomosynthesis–guided vacuum-assisted breast biopsy (DBT-VAB) for noncalcified lesions without a sonographic correlate and to assess the concordance of imaging and pathology findings.

METHODS
A retrospective review of our institutional biopsy database between December 11, 2015, and August 31, 2016, identified 72 consecutive women with 73 noncalcified lesions on digital breast tomosynthesis who underwent attempted DBT-VAB. Relevant imaging was reviewed in consensus by 3 fellowship-trained breast radiologists for imaging features and biopsy parameters. Medical records were reviewed for histopathology and imaging follow-up.

RESULTS
The target lesion was successfully sampled by DBT-VAB in 99% (72 of 73) of cases. The median time to complete DBT-VAB was 16 minutes. No major complications were reported. Findings included 3 focal asymmetries (4%), 7 asymmetries (10%), 21 masses (29%), and 41 architectural distortions (ADs) (57%). Final histopathology was malignant in 24% (17 of 72), actionable high-risk in 4% (3 of 72), and benign in 72% (52 of 72). VAB pathology was concordant in 86% (62 of 72): 21% malignant, 6% high risk, and 60% benign. VAB pathology was discordant in 14% (10 of 72). One malignancy and 4 complex sclerosing lesions were missed after DBT-VAB of AD, which was confirmed on surgical excision. Therefore, the misdiagnosis rate for DBT-VAB was 7% (5 of 72).

CONCLUSION
DBT-VAB is a quick and feasible biopsy method for targeting noncalcified mammographic lesions without a sonographic correlate. The 24% malignancy rate reaffirms that biopsy is necessary for suspicious mammographic lesions occult on ultrasound. Although DBT-VAB shows high accuracy for noncalcified lesions, meticulous radiology-pathology correlation is required in the interpretation of DBT-VAB results, with surgical excision of discordant cases.

The clinical use of digital breast tomosynthesis (DBT) continues to increase as many studies have shown that DBT increases cancer detection rates and decreases recall rates compared to conventional full-field digital mammography (FFDM).[1-10] Additionally, other studies have shown that certain suspicious findings visible only by DBT without a definitive sonographic correlate have a high enough positive predictive value (PPV3) for malignancy (30%-47%) that tissue sampling is imperative for an accurate diagnosis.[11,12] In the past, management of suspicious lesions visible only by DBT was challenging because dedicated tomosynthesis-guided needle biopsy equipment was not available. The only options for tissue sampling previously were needle localization followed by surgical excisional biopsy, problem-solving MRI to guide needle biopsy, or the use of mammographic landmarks for conventional stereotactic-guided biopsy.[11,13-15]

With the introduction of DBT-guided vacuum-assisted breast biopsy (DBT-VAB) by Hologic in 2013, needle biopsy of lesions visible only by DBT became possible. Since its introduction, a few institutions have evaluated the feasibility of DBT-VAB compared to conventional stereotactic-guided biopsy. Preliminary results from these studies show excellent feasibility, few complications, and decreased procedure time when compared

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with conventional stereotactic-guided core biopsy.[16-20] However, the majority of these prior studies had predominantly calcified targets within their cohort with small numbers of noncalcified lesions within their sample set. More importantly, there is currently limited literature available regarding the accuracy of DBT-VAB for noncalcified lesions. To our knowledge, only one prior study[20] has reported on final surgical pathology and/or 2-year follow-up data for noncalcified lesions initially sampled by DBT-VAB.

Therefore, our objective was to evaluate the feasibility and accuracy of DBT-VAB for suspicious noncalcified lesions detected during our initial experience with this biopsy technique.

Methods

Inclusion criteria

This Institutional Review Board (IRB)–approved (DFCI IRB 17-109) retrospective single-institution study was compliant with the Health Insurance Portability and Accountability Act. As this was a retrospective review, written informed consent from our study participants was not required by our IRB. We reviewed 446 consecutive patients at our institution who underwent mammographic-guided biopsy from December 11, 2015, to August 31, 2016. The start date for our study indicates the day that our institution fully converted from a 2-dimensional (2D) FFDM-prone stereotactic biopsy system to an upright unit capable of both 2D stereotactic biopsy and DBT-VAB.

Seventy-seven women (mean age, 57 years; range 38-87 years) with 78 consecutive noncalcified lesions without definitive sonographic correlates were referred for DBT-VAB. Five lesions were excluded from the study population due to the following reasons: 4 lesions underwent conventional stereotactic-guided biopsy with 2D targeting and 1 lesion had prior diagnostic imaging at an outside institution that was unavailable for consensus review. Our final study population was 72 patients with 73 findings.

Main points

- A tomosynthesis-guided breast biopsy is quick and feasible for noncalcified lesions.
- The accuracy of tomosynthesis-guided breast biopsy is high for noncalcified lesions.
- Radiology-pathology discordance is more likely if the target lesion is architectural distortion.
- Misdiagnosis is more likely if the target lesion measures under 2 cm.

Data collection

One author reviewed the electronic medical record for patient demographic information including age, breast cancer risk factors, prior breast surgical history, and breast density. DBT-VAB reports were examined for technical details and any reported complications; pathology reports were reviewed for VAB results and any final surgical pathology results. Procedure report addendums were analyzed for radiology-pathology concordance, which was prospectively assessed by the biopsy radiologist. Any follow-up clinical data and imaging reports were reviewed in March 2019 to gather follow-up information greater than 2 years from the initial biopsy date. Three radiologists, all fellowship-trained breast radiologists with 2-26 years of breast imaging experience, reviewed the diagnostic and procedural imaging in consensus. Factors that were recorded during consensus review included target lesion type (mass, asymmetry, or architectural distortion [AD]), target lesion size—with AD and spiculated masses measured from spicule to spicule, needle placement accuracy relative to the target, and procedure time. Time for procedure was calculated from the time indicated on the first acquired biopsy image (scout) to the last acquired biopsy image (post-biopsy clip placement image).

All diagnostic workup of noncalcified lesions at our institution is performed as combination imaging with both FFDM and DBT. Our standard diagnostic protocol includes spot compression DBT imaging in both views for 2-view findings and in 1 view for a single-view finding. Full lateral combination FFDM and DBT imaging is also acquired for further localization. Lesion classification is based on the American College of Radiology BI-RADS Atlas, 5th edition,[21] which defines asymmetries as an area of fibroglandular tissue visible on only 1 view, a focal asymmetry as fibroglandular tissue visible on 2 views, a mass as a space-occupying lesion with convex outward borders visible in 2 views and AD as thin straight lines or spicules radiating from a point. The consensus reviewers distinguished spiculated masses from pure AD by the presence of a dense central nidus. If a measurable radiodense central nidus was present, the consensus reviewers characterized the lesion as a spiculated mass and not as AD.

A senior pathologist re-reviewed select cases where the VAB pathology was considered discordant with the imaging findings, and the final surgical pathology identified the accurate diagnosis, which explained the imaging appearance. These cases were classified as misdiagnosis at VAB and included both benign and malignant pathologies.

DBT-VAB: Equipment and technique

All DBT-guided biopsies were performed on an FFDM unit with a DBT platform (Selenia Dimensions, Hologic). The upright Hologic Affirm Breast Biopsy System and Eviva Biopsy Handpiece (Eviva; Hologic) were utilized for targeting and sampling, respectively. Biopsies were performed by 1 of 15 breast fellowship-trained radiologists with 2-26 years of experience. The patient was positioned in an upright sitting or lateral decubitus position with the breast in compression. The biopsy approach was chosen by the performing radiologist and was based on the lesion location; typically, the shortest distance to the lesion was chosen. All included lesions were targeted using tomosynthesis. Lesions only visible in 1 view (i.e., asymmetries) were targeted using tomosynthesis in the view they were best visible. The DBT slice where the lesion was most conspicuous was selected using a cursor, then the biopsy system software determined the lesion coordinates. Using sterile technique and lidocaine for local anesthesia, a 9-gauge standard (10 cm length, 20 mm aperture) or petite (10 cm length, 12 mm aperture) Eviva biopsy needle was advanced to the target. Images (pre- ± post-fire images using either DBT or 2D stereotactic pair images) were acquired at the radiologist's discretion to confirm adequate positioning of the needle relative to the target. On average, 6-8 biopsy specimens were obtained in a clockwise manner for each lesion sampled. The biopsy marker clip was placed at the biopsy site after sampling was completed. A single post-clip image was obtained to ensure marker clip deployment prior to removal of the biopsy handpiece. After adequate hemostasis was obtained and a sterile dressing was applied to the needle entry site, an FFDM with or

without tomosynthesis, per the discretion of the performing radiologist, was obtained in full craniocaudal (CC) and mediolateral (ML) projections to evaluate the position of the marker clip relative to the DBT-targeted noncalcified lesion.

Data analysis

Feasibility was determined by the percentage of lesions that were referred for DBT-VAB that could be successfully sampled. Accuracy was evaluated by the percentage of lesions that had concordant versus discordant VAB pathology. Final histopathology was reviewed for all lesions sampled, and a lesion-level analysis was also performed. The percentages of lesions falling into malignant, high-risk, and benign categories were calculated based on available final histopathology. At our institution, actionable high-risk lesions are those that are referred for surgical excision and include atypical ductal hyperplasia (ADH) and any finding of atypia recommended for excision by pathology. VAB pathology of atypical lobular hyperplasia, lobular carcinoma in situ, flat epithelial atypia, papillomas without atypia, and complex sclerosing lesions (CSLs) (radial scar) are variably managed by radiology and surgery, usually in consensus, without routine surgical excision. Upgrade and/or misdiagnosis rates were determined based on the review of any available final surgical pathology and correlative imaging. Discordant cases where the VAB pathology did not explain the imaging findings but the final histopathology did explain the DBT finding were considered misdiagnosis by DBT-VAB, for both benign and malignant etiologies. Imaging reports for any follow-up imaging were also reviewed (to date March 15, 2019) to evaluate the false-negative rate of DBT-VAB, ensuring at least 2 years of follow-up imaging.

Results

During the study period, attempted DBT-VAB of noncalcified lesions accounted for 16.36% of all mammography-guided biopsies (73 of 446). DBT-VAB was technically feasible in 98.63% (72 of 73) of lesions referred for DBT-VAB including 7 asymmetries (3 developing asymmetries) (10%), 3 focal asymmetries (none were developing) (4%), 21 masses (29%), and 41 cases of AD (57%) (Figure 1). The size of the target lesions was determined by group consensus and was measured from spicule to spicule for cases of spiculated masses and AD. The median size of the target lesion was 16 mm (range, 4-63 mm). The median procedure time was 16 minutes (range, 9-39 minutes). A review of procedure reports identified no major complications from DBT-VAB. The one case of unsuccessful biopsy was that of AD; the target could not be reliably visualized at the time of attempted DBT-VAB, and the procedure was canceled. The patient was referred for a diagnostic MRI, which she could not tolerate. Upon re-review of the initial diagnostic imaging, the original finding was felt to be equivocal; therefore, the decision was made to proceed with follow-up imaging and not surgical excision per patient and referring physician choice. The patient was placed into surveillance imaging and is without evidence of disease on mammography at 2 years following attempted biopsy.

The VAB pathology of the 72 lesions was as follows: 15 malignant, 53 benign, and 4 high-risk actionable. Three of the 4 patients with high-risk actionable lesions proceeded with the recommended surgical excision, and 1 case (25%) was upgraded to malignancy. The one upgraded case presented as a 5 mm spiculated mass on DBT and showed ADH within a sclerosing lesion, which resembled a tubular carcinoma on VAB pathology; final surgical pathology showed upgrade to 0.6 cm ductal carcinoma in situ (DCIS) (estrogen receptor positive [ER+], progesterone receptor positive [PR+], and human epidermal growth factor receptor negative [HER–]). The patient who declined surgical excision had a history of prior contralateral mastectomy 10 years prior and underwent DBT-VAB of a 14 mm area of AD. VAB pathology showed ADH with micropapillary architecture arising within a CSL. The patient proceeded with follow-up DBT every 6 months, and her most recent mammogram, 29 months after her biopsy, shows stability of the biopsied lesion with the biopsy marker clip in good position; this patient also underwent breast MRI 31 months after biopsy, and no suspicious enhancement was seen at the biopsy site. The other 2 cases (1 AD and 1 oval mass) with high-risk pathology on VAB underwent surgical excision with no upgrade on final surgical pathology.

Of the 53 benign lesions, 10 were considered discordant and proceeded to surgical excision, including 1 spiculated mass and 9 cases of AD; the spiculated mass

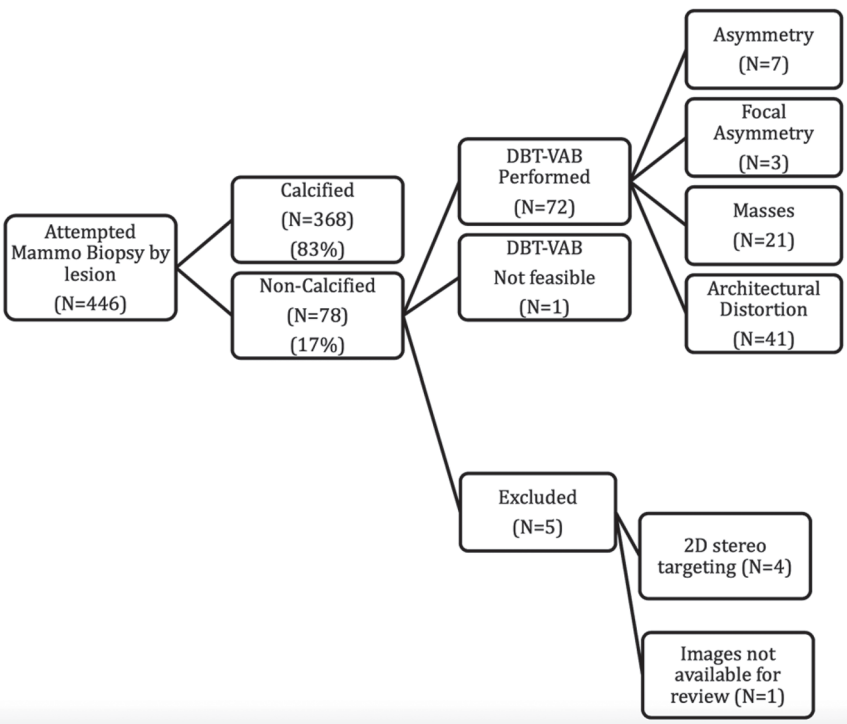

Figure 1. Flow diagram showing biopsy lesion selection and type.

upgraded to malignancy on surgical excision. The finding presented as a 5 mm spiculated mass on DBT; VAB pathology after DBT-VAB showed benign breast tissue, epithelial hyperplasia, and apocrine metaplasia, which was considered discordant by the performing radiologist. On the post-biopsy mammogram with tomosynthesis, the marker clip was located just posterior to the target. Subsequent surgical excision revealed a 6 mm node–negative grade 2 invasive ductal carcinoma with DCIS (ER weak+, PR–, and HER2–) (Figure 2). Of the nine discordant cases of AD, none upgraded to malignancy on final surgical pathology.

Therefore, the final pathology of the 72 lesions included 17 malignant (24%), 52 benign (72%), and 3 high risk (4%). The overall PPV3 for our study population of noncalcified lesions was 23.61% (17 of 72). Of the 17 malignancies, 16 were invasive carcinomas and 1 was a case of DCIS within a sclerosing lesion. Malignancy was found in 1 of 3 (33%) focal asymmetries, 9 of 21 (43%) masses (4 of 9 spiculated masses), and 7 of 41 (17%) cases of AD (Table 1). No malignancy was found in any of the targeted asymmetries, even though 3 of 7 (43%) were felt to be developing asymmetries by consensus review (Figure 3).

Vacuum-assisted biopsy pathology was considered prospectively concordant with imaging in 86.11% of cases (62 of 72) by the performing radiologist: 15 cases were malignant and concordant (21%), 4 cases were concordant actionable high-risk lesions (6%), and 43 cases were benign and concordant (60%). All malignant (n = 15) and high-risk actionable cases (n = 4) were referred for surgical excision, with 3 of 4 high-risk cases eventually excised as described previously. All the benign and concordant cases were referred for follow-up mammography 6-12 months after biopsy. Although some patients were lost to follow-up, greater than 2-year follow-up imaging data is available for 80% of these patients, and no malignancy has been identified on follow-up imaging to date (range, 0-36 months; median, 26 months).

DBT-VAB pathology was felt to be discordant with the imaging appearance in 13.88% of cases (10 of 72) by the performing radiologist. As described above, these included the spiculated mass that upgraded to IDC on surgical pathology and the 9 ADs with no upgrades on pathology. Although final pathology was benign, 4 of 9 (44%) cases of discordant AD were considered missed by DBT-VAB because the VAB pathology was benign etiology without an explanation for AD, resulting in CSLs on final surgical excisional pathology (Figure 4). The majority of discordant cases (9 of 10 [90%]) had post-biopsy mammograms performed with tomosynthesis. Biopsy marker clips were displaced by 1 cm or more in 4 of 10 (40%) of the discordant cases. However, a consensus review of the post-biopsy DBT mammograms in the missed cancer and 4 CSLs showed the biopsy marker clips to be at or within 1 cm of the target lesion. So even though the sampling appeared accurate, the pathologic explanation for the spiculated mass or AD was missed. Therefore, the overall misdiagnosis rate for DBT-VAB, both benign (n=4) and malignant (n=1), was 6.94% (5 of 72). Additionally, the target lesions measured less than 2 cm for all cases that were considered misdiagnosed by DBT-VAB.

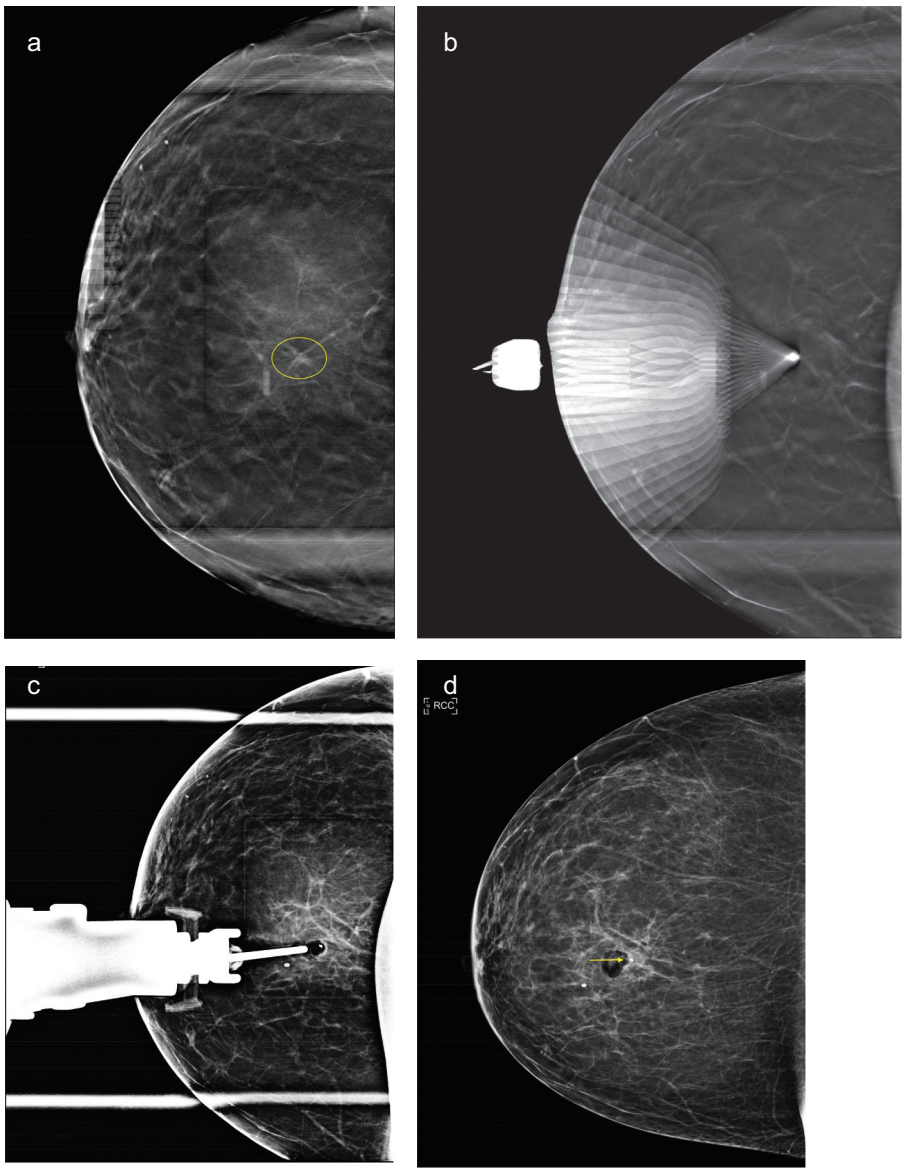

Figure 2. a-d. A 58-year-old woman on screening detected 0.5 cm spiculated mass in the right upper breast at mid-depth; vacuum-assisted breast biopsy (VAB) showed benign discordant finding, and final surgical pathology identified grade 2 invasive ductal carcinoma. Localization craniocaudal image **(a)** for biopsy targeting shows the spiculated mass in the slightly lateral breast at mid-depth. Prefire tomosynthesis image **(b)** confirms accurate needle position relative to the target lesion. Postsampling tomosynthesis image **(c)** demonstrates the marker clip overlying the target lesion. Full-field post-procedural mammogram with tomosynthesis **(d)** shows the marker clip in appropriate position.

Table 1. Final histopathology of noncalcified targets by lesion type

	Lesion type			
Pathology	Asymmetry	Focal asymmetry	Masses	Architectural distortion
Malignant (n = 17)	0	1	9	7
DCIS	–	–	1	–
Invasive ductal	–	1	6	5
Invasive lobular	–	–	1	2
Invasive ductal/lobular	–	–	1	–
High risk (n = 3)	–	–	1	2
Benign (n = 52)	7	2	11	32
Total lesions (n = 72)	7	3	21	41

DCIS, ductal carcinoma in situ.

Discussion

Our results confirm that DBT-VAB is a quick and feasible biopsy method for targeting noncalcified lesions visible by DBT alone. Our 99% feasibility rate, no major complications, and median procedure time of 16 minutes are comparable to other studies that have evaluated DBT-VAB.[17-20,22] The 24% malignancy rate (PPV3) in our cohort reaffirms the need for tissue sampling of noncalcified lesions suspicious by mammography without correlative findings on ultrasound. Our concordance rate of 86% (62 of 72) with no false-negative cases to date indicates that DBT-VAB for low-contrast lesions is highly accurate. Additionally, 90% of discordant cases (9 of 10) had target lesions of AD, a more subtle lesion type to identify; this is comparable to the results of Rochat et al.,[20] who reported that 88% of their discordant cases were ADs. Our misdiagnosis rate of 7% (5 of 72) suggests that radiologists need to be very cautious in assessing radiology-pathology correlation and should not hesitate to recommend surgical excision for any discordant case.

Our overall malignancy rate falls within the published range, when compared to the PPV3 reported in other studies for noncalcified targets sampled by DBT-VAB, ranging from 21% to 58%.[16,18,22,23] In one of the prior studies with a PPV3 of over 50%,[16] many of those findings had a sonographic correlate but were sampled using DBT. This higher PPV3 is expected, given a prior study showing that suspicious DBT lesions, particularly ADs, with a sonographic correlate have a higher PPV3 for malignancy than those without an ultrasound correlate.[12] Our PPV3 of 24% is similar to Patel et al.[23] and Rochat et al.,[20] who found PPV3s of 26% and 17%, respectively, for VAB of DBT-detected AD; the similar PPV is likely due to similar target lesion types between the studies, predominantly sonographically occult AD.

Our malignancy rate for asymmetries and focal asymmetries was 10% (1 of 10), which is slightly lower than the 18% PPV3 for developing asymmetries without sonographic correlates previously published by our institution.[24] The rate in this current study is lower than that in our prior study likely because we are only identifying cases sampled by DBT-VAB, and this would exclude any asymmetries sampled via conventional prone stereotactic-guided biopsy or biopsy of an MRI correlate. Another study evaluating DBT-VAB of noncalcified lesions had no malignancies for the 6 asymmetries sampled by DBT-VAB.[22] Our malignancy rate for masses was 43% (9 of 21), slightly higher than the 31% (5 of 16) malignancy rate for noncalcified masses without sonographic correlates identified by Ariaratnam et al.[22] This slightly higher rate may be due to the fact that 44% (4 of 9) of our masses biopsied by DBT-VAB were spiculated masses. Our malignancy rate for ADs was 17% (7 of 41), which is similar to the 19%-26% rate reported in other US studies for DBT-VAB of ADs without a sonographic correlate.[20,22,23] However, this rate is well below the PPV3 for DBT-VAB for AD published by Waldherr et al.[18] in Switzerland with a malignancy rate of 54% (13 of 24)[18]; their rate is more similar to the malignancy rate of 47% identified by Freer et al.[11] for tomosynthesis-guided needle localization of AD cases without correlative findings on other modalities. The differing PPV3 between the United States and Europe may be due to variations in practice. Studies have shown an overall higher recall rate and higher negative surgical biopsy rate in the United States compared to the United Kingdom, which may be related to cultural differences in practice.[11] Additionally, the cases in our study were referred for DBT-VAB by an individual interpreting radiologist and not by double-read or consensus opinion. The referring radiologist may have been more prone to recommend a biopsy of even equivocal AD given the availability of the new DBT-VAB core biopsy technology. The higher malignancy rate reported by Freer et al.[11] for surgical biopsy of DBT-detected AD may be because all cases referred for surgery were reviewed in consensus by a panel of breast radiologists; therefore, equivocal cases of AD (i.e., complex parenchymal pattern with numerous crossing lines) would not have been sent for excisional biopsy.[11]

Our secondary purpose, to evaluate the accuracy of DBT-VAB for noncalcified target lesions, is somewhat unique when compared to other studies of DBT-VAB because many other published studies[16-19] predominantly reported calcified targets (52%-84% of cases), in which specimen radiography provided immediate confirmation of targeting accuracy. In contrast, our study is one of the few studies that evaluate the accuracy of noncalcified lesions undergoing DBT-VAB where either surgical pathology results or greater than 2-year imaging follow-up data is available and reported for the majority (82%) of cases. Our high radiology-pathology concordance rate of 86% with no known false-negative benign cases to date suggests

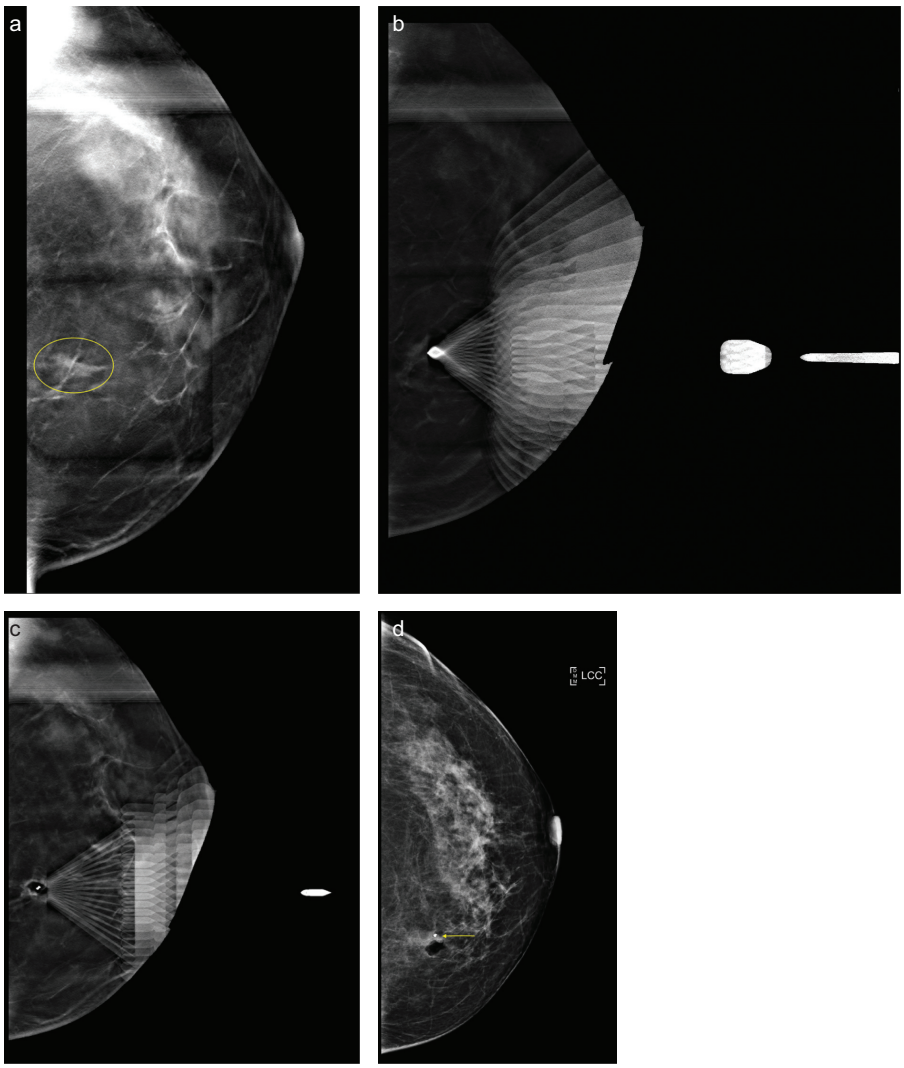

Figure 3. a-d. A 48-year-old woman on screening detected architectural distortion in the left upper outer quadrant at posterior depth; VAB showed benign discordant findings and final surgical pathology showed a complex sclerosing lesion (0.5 cm). Localization craniocaudal image **(a)** for biopsy targeting shows focal architectural distortion in the lateral breast posterior depth. Prefire tomosynthesis image **(b)** confirms the needle position within the central nidus of the region of distortion. Postsampling tomosynthesis image **(c)** demonstrates the marker overlying the region of architectural distortion. Full-field post-procedural mammogram **(d)** shows the cork-shaped clip in appropriate position. A ribbon-shaped clip is also present from an additional benign biopsy of an incidental subcentimeter oval mass done the same day under ultrasound guidance.

that DBT-VAB is a highly accurate method for sampling suspicious noncalcified lesions seen best with DBT without a definitive sonographic correlate. However, our 7% (5 of 72) misdiagnosis rate reinforces the need for careful targeting and sampling during the procedure and meticulous radiology-pathology correlation when interpreting pathology results after DBT-VAB.

Although the DBT-VAB rate for a missed cancer in our cohort was only 1% (1 of 72), 4 CSLs were missed by DBT-VAB. Although CSLs are benign lesions and management is variable in the United States,[26] it is still important to be aware that the target lesion can be missed even with a 9-gauge VAB. While upgrade rates to malignancy for CSLs found on core biopsy are reportedly low (less than 5%) if VAB is performed and no atypia is seen associated with the CSL on VAB pathology,[27-29] there is still a possibility that malignancy could be missed if the CSL and any associated atypia are not detected at VAB. In all 4 missed CSLs, post-biopsy mammograms were obtained with tomosynthesis. Consensus review of the post-biopsy mammograms showed that the biopsy marker clip was within the central nidus of the AD in 3 of 4 cases and within 1 cm for the fourth case, yet the true diagnosis was still missed by DBT-VAB. On pathology re-review of the final surgical pathology slides for these 4 missed CSLs, the core biopsy site was seen at a distance from the CSL. This suggests that despite apparent accurate targeting and clip placement, the targeted AD was missed by DBT-VAB and was not a misdiagnosis by the pathologist at VAB. Therefore, the performing radiologist should carefully select the tomosynthesis slice where the target lesion is best seen during procedure targeting and obtain an adequate number of biopsy samples to ensure satisfactory radiology-pathology concordance. Additionally, prudent radiology-pathology correlation is also important in these cases. Careful radiology-pathology correlation is especially important for smaller target lesions even when the clip position seems accurate on the post-biopsy mammogram, given that all of the cases of misdiagnosis had target lesions measuring under 2 cm.

Our median procedure time of 16 minutes is similar to other studies but slightly longer than the average reported procedure time of 12-15 minutes for DBT-VAB.[17-19,22] Our slightly longer time may reflect our target lesion type of only non-calcified low-contrast lesions, which may increase the targeting time. Additionally, we only have one mammography technologist assisting the radiologist for DBT-VAB, whereas other institutions employ a 2-technologist model.[19]

One of the limitations of our study is that it is a single academic institution retrospective study; therefore, the results may not be generalizable to other breast imaging practices. Our false-negative rate for DBT-VAB may be slightly underestimated, as our cases were not cross-referenced to a tumor registry. While surgical excision was not performed on all cases of high risk or CSL, imaging and clinical data are available for greater than 2 years after initial biopsy for the majority of cases.

In conclusion, our data supports DBT-VAB as a quick and feasible biopsy technique for

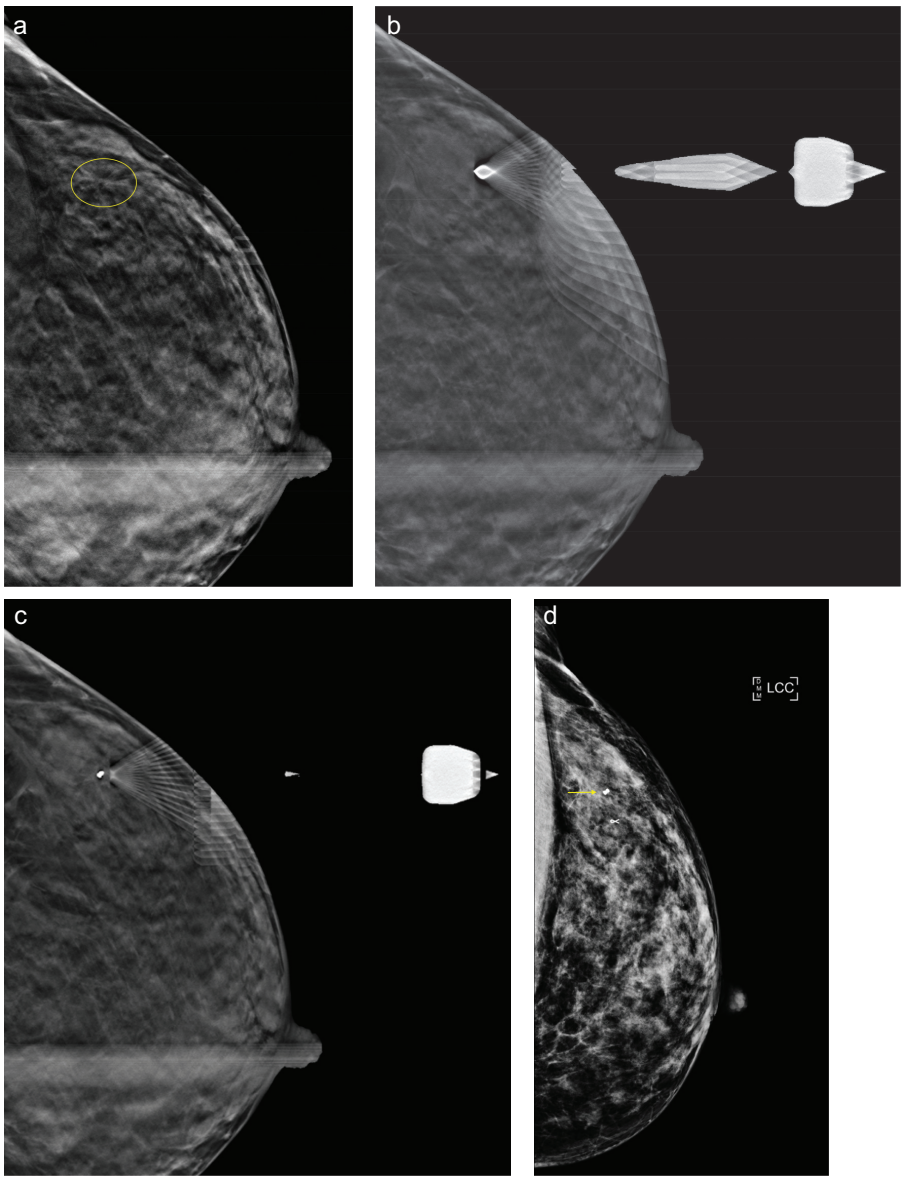

Figure 4. a-d. A 52-year-old woman with a screening detected 1.5 cm developing one-view asymmetry in the inner left breast at posterior depth; VAB showed benign concordant finding of pseudoangiomatous stromal hyperplasia (PASH). Localization craniocaudal image **(a)** for biopsy targeting shows an asymmetry in the inner breast at posterior depth. Prefire tomosynthesis image **(b)** confirms the needle is at the target lesion. Postsampling tomosynthesis image **(c)** demonstrates the marker clip overlying the targeted asymmetry. Full-field post-procedural mammogram **(d)** shows the marker clip in an appropriate position.

sampling of suspicious noncalcified mammographic lesions not visible by ultrasound. The 24% malignancy rate reaffirms the need to sample suspicious lesions best seen with DBT even if no correlative findings are identified on ultrasound. Our 7% misdiagnosis rate highlights the importance of meticulous radiology-pathology correlation in the interpretation of DBT-VAB results. Radiologists should have a low threshold for recommending surgical excisional biopsy if there is any question of discordant core needle biopsy results after DBT-VAB for a noncalcified lesion.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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