RESEARCH

Value of digital breast tomosynthesis in characterization of breast lesions in dense breast

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Abstract

Background Patients with dense breasts have a higher risk factor for developing breast cancer. Digital mammography (DM) exhibits a reduced sensitivity in dense breast tissue as a result of overlapping fibro-glandular tissue. Digital breast tomosynthesis (DBT) solves this problem, so allows better characterization of masses, asymmetries, and parenchymal distortion. It is useful in screening studies for early detection of breast lesions by accurate detection and description of their margins, shape, and extent as well as surrounding structures.

Objective We aimed to evaluate the added value of DBT in characterizing of different breast lesions in dense breasts compared to DM.

Methods A Prospective Cohort study involved ninety female cases having dense breast parenchyma (ACR C & ACR D) having breast complaint lesions detected by DM or ultrasound or recalled from screening units, during the period from June 2021 to Jan 2023.

All patient underwent DM and DBT with correlation with the pathological finding or follow up.

Results As regards the characterization of breast mass DBT had higher sensitivity, higher specificity (98%, 87% respectively). However, DM showed less sensitivity, less specificity (58%, 80%,) with ($p < 0.0001$, $p = 0.0005$ respectively).

Conclusions DBT effectively visualizes overlapping tissue in dense breasts. DBT is important due to its ability to detect breast cancer earlier, characterize lesions accurately, and inspect the margins of masses precisely, along with decreasing recall rates for false-positive results.

Keywords Breast lesions, DBT, Dense breast

Background

Breast cancer represents the predominant type of cancer among females globally, comprising 27% of all women's cancer cases [1]. Early detection decreases mortality related to breast cancer. The survival probability within 5 years would rise to nearly 95% if the malignancies could be discovered at an earlier stage [2].

Digital mammography (DM) represents the basic imaging technique utilized for diagnosing breast cancer; however, it is linked to a few limitations as regards dense breasts [3].

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Breast density is the fibrog-landular tissues' proportion to fat so used to define how many different types of breast tissue. Women having greater breast density exhibit a four to five fold increased chance of breast cancer than those having low breast density [4, 5].

Due to decreased differentiation between the dense lesions and surrounding dense breast tissue, DM offers reduced specificity as well as sensitivity for females having dense breasts [6]. Digital breast tomosynthesis (DBT) is aimed at minimizing dense breast tissue overlap [1].

Many published studies suggest that DBT is preferable to the standard DM as DBT improves lesion description, and assessment of areas of architectural distortion and asymmetries [7, 8].

DBT is important for diagnostic settings, which lowers associated expenses, additional mammographic views [9], and biopsies [10].

DBT excludes suspicious lesions discovered during screening [11]. As it is effective in differentiating benign from malignant tumors [12].

The prognosis and treatment plans for breast cancer are determined by the initial tumor stage at the time of diagnosis. As neoadjuvant chemotherapy and breast-conservative surgeries become more common, a clear characterization of the tumor size and numbers is essential step, DBT in the preoperative local staging of breast cancer with focus on the detection of multifocal/multicentric disease in a patient population with dense breasts is a promising imaging technique [13, 14].

This work was aimed to assessing the DBT added value in characterizing different breast lesions in dense breasts compared to DM.

Methods
Study design and ethical approval
In this prospective cohort study, approved by our institutional review board of Medicine Ethical Committee, all participants were asked to fill out an informed consent after fully explaining our research to them. Privacy of all patient data is guaranteed.

Study population (eligibility criteria)
This research involved female cases with dense breasts having breast complaints during the period from 1st June 2021 to 30th Jan 2023 at our institute.

Inclusion criteria: symptomatic females with a breast lump, pain, or nipple discharge, females with lesions detected by DM or ultrasound, females recalled from screening units, females with dense breast parenchyma (ACR C & ACR D), and females below the age of 40 with positive family history.

Exclusion criteria: patients who had previous breast surgery or mastectomy, already diagnosed with breast cancer, already had breast implants and those with non-dense breast parenchyma (ACR A & ACR B) were not involved in our research.

All participants underwent DM and DBT. We carried out a complementary ultrasound to either verify or rule out mammographic findings utilizing a high-frequency probe.

The mammographic examination was performed utilizing an upgraded Hologic Healthcare Full Field Digital Mammography machine to produce 3D Digital Tomosynthesis. It possesses a dual anode (Rhodium Molybdenum) with a CsI digital detector. Standard DM views of mediolateral oblique (MLO) as well as cranio-caudal (CC) views were captured for all participants. For DBT (MLO for all patients and CC was done in 25 patients) views were also accomplished. DBT entailed obtaining twelve to fifteen 2D projection exposures utilizing a digital detector from a mammographic X-ray source, moving within a restricted arc angle. The compressed breast 3D volume was accomplished utilizing the 2D projections, resulting in a sequence of images (slices) encompassing the entire breast. Assessing these images was done on the workstation.

Image analysis and interpretation of DM and DBT
The DM along with DBT images were independently and blindly evaluated by two radiologists, one possessing eleven years of expertise while the other possessing sixteen years of expertise, If the two readers were unable to reach an agreement, a third highly skilled radiologist possessing 2 years expertise would be responsible for making the ultimate decision. The agreement level amongst observers was high.

Each participant underwent a breast density evaluation and chose a patient with dense breasts (ACR C & ACR D). Based on the ACR BIRADS lexicon 2013 [14].

All findings were assessed as regards location; type (mass, asymmetry, distortion ± calcifications) as well extension.

- *Mass lesions were assessed for* margin, density, and shape.
- *Asymmetry:* focal, global, or developing.
- *Parenchymal distortion:* Yes, or no.
- *Calcifications:* Benign or malignant.

We classified the findings in each of the two imaging techniques separately utilizing the BI-RADS

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Table 1 BIRADS assessment categories according to BIRADS atlas 2013. D'Orsi CJ (2013)

Category	Assessment
BI-RADS 0	Incomplete—Need additional imaging evaluation
BI-RADS 1	Negative/normal study
BI-RADS 2	Benign
BI-RADS 3	Probably benign
BI-RADS 4	Suspicious malignant
BI-RADS 5	Highly suggestive of malignancy

lexicon 2013 classification [14], (Table 1) as indicated by the results of mammographic findings but blind to final histopathology results and complementary ultrasound.

In view of different BIRADS categories, different further recommendations have been made as follows

- BIRADS 1 or 2: Follow up every year.
- BIRADS 3: Follow up every 6 months for two years at least.
- BIRADS 4 or 5: histopathological correlation (True cut biopsy, stereotactic biopsy).

These findings underwent categorization as either benign or malignant based on the mammography BI-RADS lexicon morphology descriptors [14].

In our study

- Women diagnosed as BIRADS 4 or 5 and some cases of BIRADS3 were subjected to histopathological examination which was the gold standard reference for cancer detection.
- Women with unbiased findings BIRADS 3 were evaluated with ultrasound and subjected to follow-up three times every 6 months.
- Ultrasound was the golden standard for BIRADS 1 and 2 cases with annual follow-up.
- The patient had more than one lesion on the same side of the breast we wrote the highest BIRADS for this side.
- Cases diagnosed with multifocal/ multicenteric lesions confirmed by contrast-enhanced spectral mammogram (CESM)/ Pathology after surgery.

Statistical analysis

Data went through a process of collection, coding, revision as well as transfer to the Statistical Package for Social Science (Rstudio) version 2.3.2. The data were displayed as numbers as well as percentages regarding the qualitative data, mean, SD as well as ranges as regards the quantitative data with parametric distribution while median with interquartile range (IQR) for the quantitative data with non-parametric distribution. The chi-square test was utilized for comparing both groups with qualitative data while the Fisher exact test was utilized as a substitute for the Chi-square test when the expected count within any cell was deemed to be below 5. The receiver operating characteristic curve (ROC) is produced by plotting sensitivity (TP) on the Y axis versus 1-specificity (FP) on the X axis at different cut-off values. The area under the ROC curve indicates the test's diagnostic performance. An area above 50% indicates acceptable performance while an area about 100% represents the ideal performance for the test. The confidence interval was established at 95% while the margin of error accepted was set at 5%.

Results

Our cohort study was carried out on one hundred and fifty (150 females) with dense breasts who had breast complains, we excluded forty (40) females who didn't have pathology for breast lesions BIRAD 4 and 5, and twenty (20) patients missed follow-up in breast lesions BIRAD 3. Thus, statistical analysis was carried out on ninety (90) females who matched our research's inclusion requirements.

The final cohort consisted of 90 women (whose ages range between (30 and 75) years with mean ± SD (45.7 ± 8.1) years. 52.2% ranged between (40 and 50) years, 27.7% ranged between (30 and 40) years and 15.6% ranged between (50–60) years. Among 90 females, 80% were assigned as ACR C while 20% were ACR D based on the ACR BIRADS lexicon breast density classification.

Breast lump was the most common symptom (43%) followed by breast pain (35%), and nipple discharge (24%), and (15%) were came for breast screening.

Characterization of Breast Lesions by DM: 39 lesions (43%) were defined as breast mass, 33 lesions (36%) breast asymmetry, 10 lesions (11.1%) parenchymal distortion, 31 lesions (34.3%) breast calcification, & 4 (4.4%) were normal breast (Fig. 1)
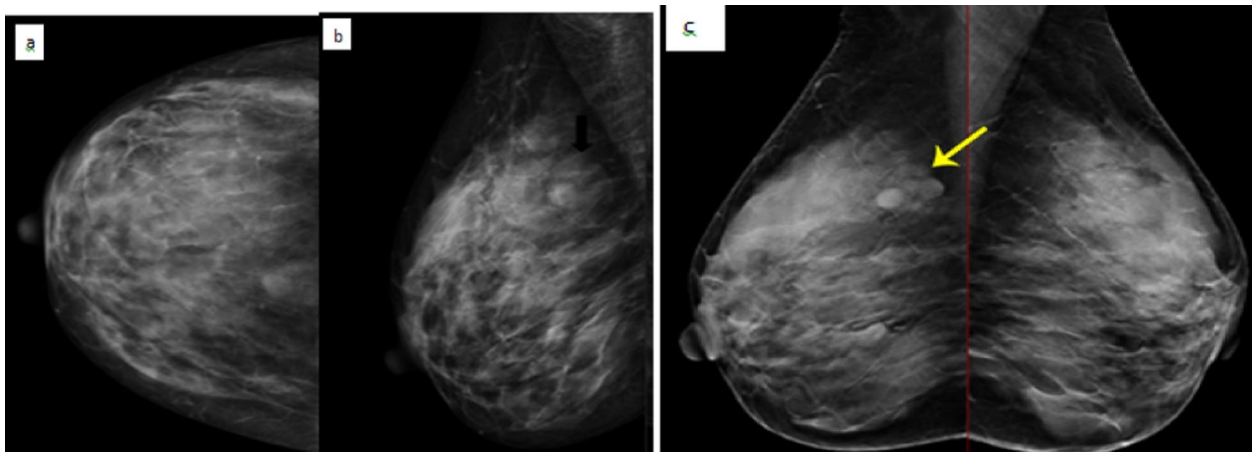
Fig. 1 A 49-year-old female presented with a right breast lump. **a** Right breast craniocaudal & **b** mediolateral oblique DM images showed extremely dense breast parenchyma (ACR d) and right UIQ partially obscured mass lesion (Black Arrow), BIRADS 3. **c** Bilateral breasts mediolateral oblique DBT images showed right breast well circumscribed macrolobulated mass lesion (Yellow arrow) BIRADS 3. The lesion was categorized by DM and by DBT as BIRADS3 with better margins delineation by DBT images and follow-up by the US confirmed mass stability likely fibroadenoma and no need for biopsy

Characterization of Breast Lesions by DBT: 57 lesions (63.3%) were defined as breast mass, 17 lesions (18.8%) breast asymmetry, 27 lesions (30%) parenchymal distortion, 34 (37.7%) breast calcification & 5 (5.5%) were normal breast (Fig. 2).

A statistically significant variation was documented among DM and DBT about asymmetry at ($p=0.02$) as shown in Table 2. DBT improved the assessment of focal asymmetry in 14 cases as it clarified that was condensed parenchyma, not a true lesion. Figure 3

A statistically significant variation was documented among DM as well as DBT regarding parenchymal distortion at ($p=0.003$) as illustrated in Table 2.

As regards the association with the final diagnosis: DBT detected 27 distortions (4) were benign and (23) were malignant however DM detected only 10 distortions (4) were benign and (6) were malignant (Figs. 4 and 5).

Both DM and DBT detected benign calcification (Popcorn 2 (2.2%), Rim 3 (3.3%), Round 8 (8.9%)) and suspicious calcifications (Coarse heterogonous 3 (3.3%), Linear 3 (3.3%), Pleomorphic 8 (8.9%)) however DBT detected more Amorphous calcification 7 (7.7%)than DM 4 (4.4%), with no statistically significant association as regard of benign and suspicious calcification between DM & DBT ($p=0.99$, $p=0.686$ respectively).

As regards the distribution of breast lesions single lesions, multifocal or multicenteric lesions showed a statistically significant variation among DM & DBT ($p=0.004$) as illustrated in Table 3 (Fig. 6).

In correlation with the final diagnosis Table 4

Histopathology was done for 53 cases and revealed 45 were malignant (9 patients were done modified radical mastectomy MRM 36 cases of conservative breast surgery (CBS) and 8 were benign (4 patients did wide local excision (WLE) and 4 patients did core biopsy), Follow up with no need for biopsy for 37 cases.

The BIRADS results by DM & DBT

BY DM the most common breast lesions were categorized as BIRAD 3 (41%) Fig. 5 then BIRAD 4 (36.7%) and BIRAD 5 was the least category (2.2%) However by DBT the most common breast lesions were categorized as BIRAD 4 (45.6%) then BIRAD 2 (22.4%) and cases with BIRAD 5 category were (10%) (Fig. 7).

Comparison between DM and DBT as a regard BIRADS showed a statistically high significant variation at ($p<0.001$) shown in Table 5.

The DM and DBT diagnostic accuracy in characterizing of breast lesions in dense breasts showed higher sensitivity, higher specificity in DBT (98%, 87% respectively). Compared to DM sensitivity and specificity, (58%, 80% respectively) with statistically significant ($p<0.0001$) illustrated on Table 6 and Fig. 8.

Discussion

This Study involved 90 women with dense breast. All participants went through DM& DBT, 80% were ACR C and 20% were ACR D. We evaluate the value of DBT in characterization of breast lesions compared to the DM,
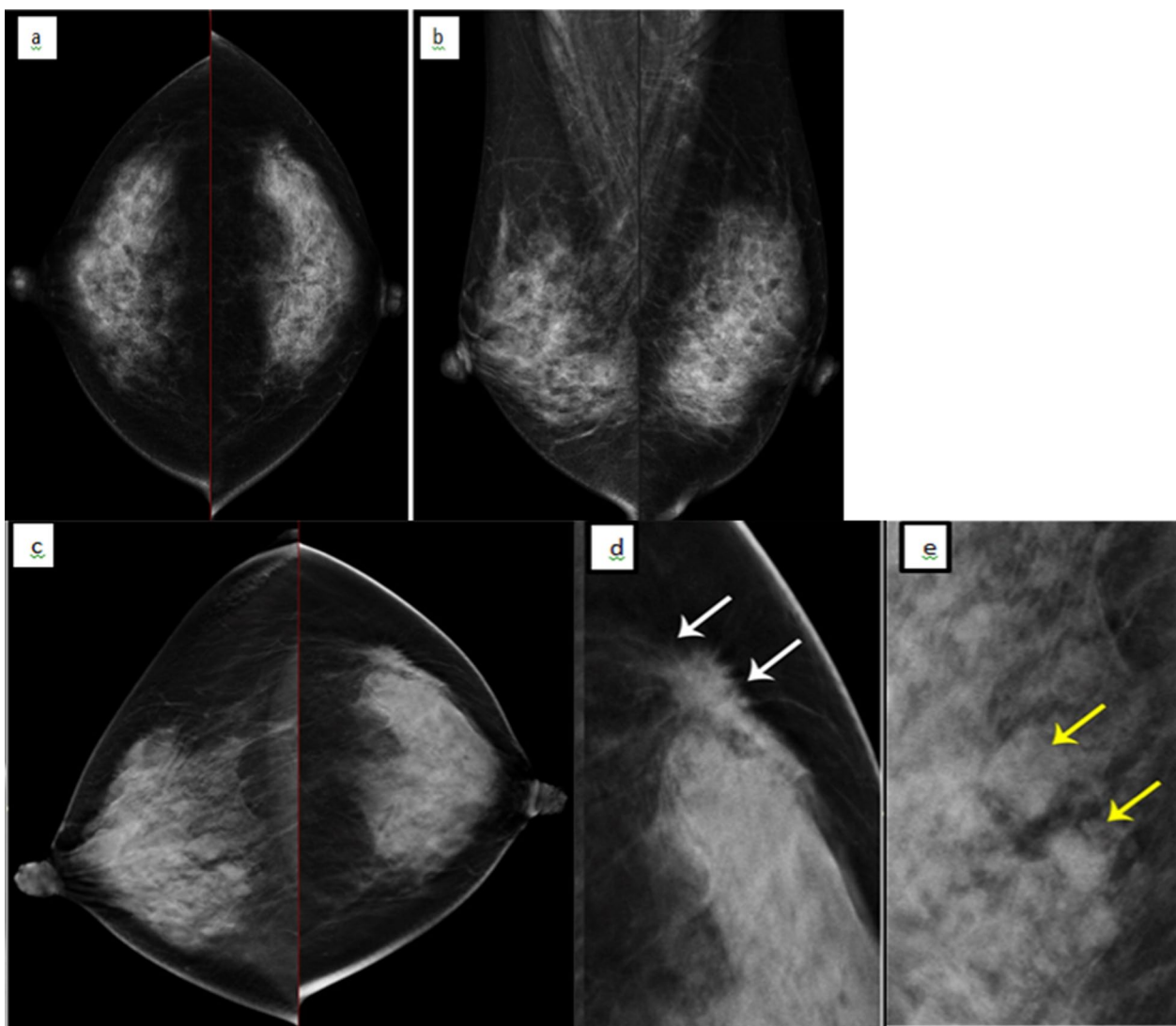
Fig. 2 A 45-year-old female presented with a right breast lump. DM Bilateral **a** CC & **b** MLO images showed extremely dense breasts (ACR d). **c** Bilateral DBT CC & **d** left zoomed DBT images showed Left UOQ speculated mass lesion (White arrows), BIRADS4. **e** Right-zoomed DBT images showed right circumscribed isodense mass lesions (Yellow Arrows), BIRADS2. Proved by a biopsy to be IDC

Table 2 Comparison of Asymmetry and parenchymal distortion between DM &DBT

Asymmetry	DM	DBT	*p*-value
Developing	5 (5.6%)	3 (3.3%)	0.02*
Focal	27 (30.0%)	13 (14.4%)	
Global	1 (1.1%)	1 (1.1%)	
Parenchymal distortion			
No	80 (88.9%)	63 (70.0%)	0.003*
Yes	10 (11.1%)	27 (30.0%)	

*$p < 0.05$ defines a significant difference

the DBT characterized the breast lesions more accurate than DM as in mass lesions DBT detected 57 mass (29 malignant and 28 benign) however DM detected 39 mass (18 malignant and 21 benign)So DBT detected 18 mass lesions not clearly identified in DM, in parenchymal distortion DBT detected 17 cases more than DM (1 benign and 16 malignant), In breast asymmetry DM detected 33 asymmetry, the DBT improved the result as it detected 16 /33 that were seen in DM was overlapping
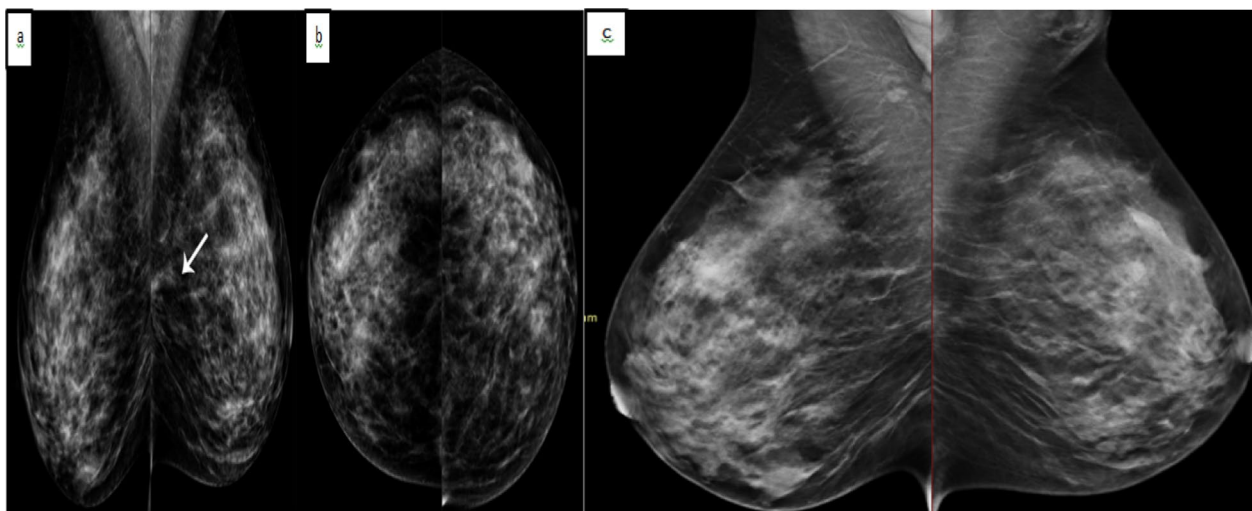
Fig. 3 A 54-year-old female came for screening. **a** Bilateral breasts craniocaudal & **b** mediolateral oblique DM images showed heterogeneously dense breasts (ACR c) and left lower quadrant asymmetry (Arrow). **c** Bilateral mediolateral oblique DBT images showed a left breast lower deeply seated area of focal asymmetry and were confirmed to be an area of overlapping fibro-glandular tissue with no underlying masses or distortion. The lesion was categorized by DM as BIRADS3 and BIRADS2 by DBT
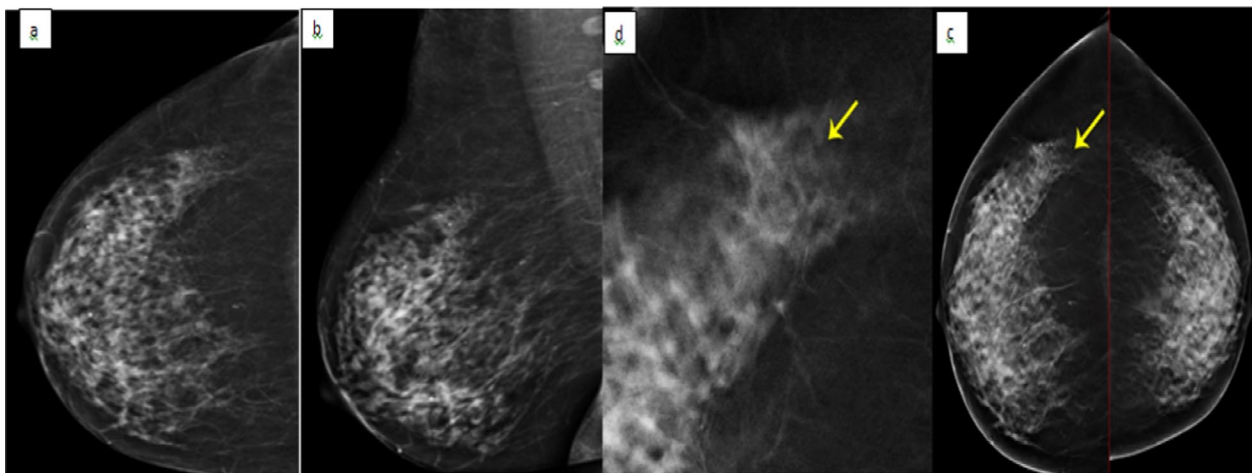

Fig. 4 A 40-year-old female presented with mastalgia. **a** Right breast craniocaudal & **b** mediolateral oblique DM images showed heterogeneously dense breasts (ACR c) and benign-looking calcific foci. **c** Bilateral breast craniocaudal & **d** right zoomed DBT images showed right breast UOQ subtle distortion (Arrow). The lesion was categorized by DM as BIRADS2 and BIRADS4 by DBT. Pathological data after surgery and proved ILC

parenchyma and only 17 cases as asymmetry (1 benign and 16 malignant).

At our study, regarding breast lesions mammography detected 39/90 (43%) mass lesions out of them 21/39 (53.8%) and benign lesions 18/39 (46%) malignant lesions on DBT detected 57/90 (63.3%) mass lesions, out of which 28/57 (49.1%) were benign and 29/57 (50.8%) were malignant. Caumo et al. [16] comparing role of DBT and DM in cancer detection. Using 2DM alone detected 39/7294 cancers while adding DBT to the 2DM detected 59/7294 cancers. Mansour et al. [17] DBT revealed better lesions characterization and categorize masses were benign or malignant.
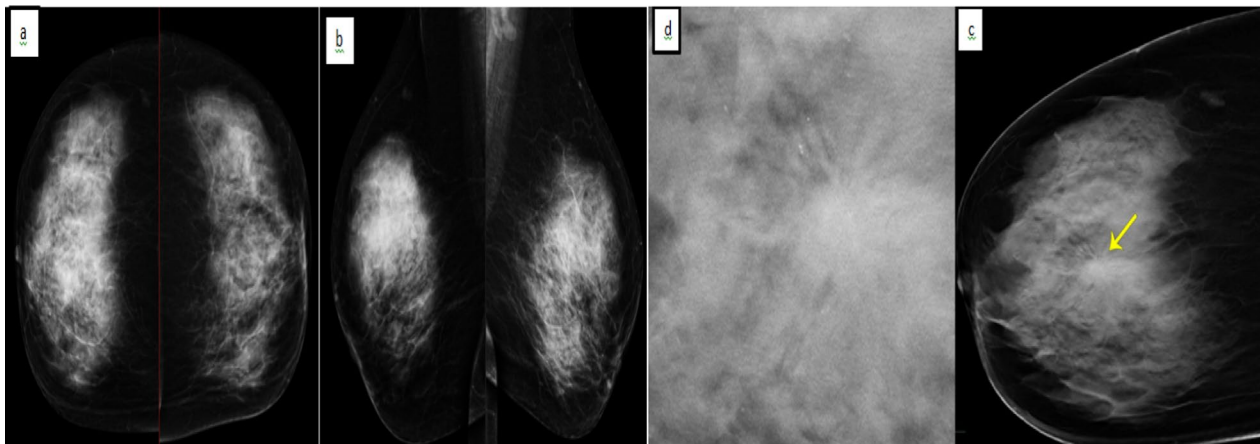
Fig. 5 A 57-year-old female presented with right nipple discharge. **a** Bilateral breasts craniocaudal. **b** mediolateral oblique DM images showed extremely dense breasts (ACR d). **c** Right breast craniocaudal. **d** Right-zoomed DBT images showed the right UOQ area of parenchymal distortion (Yellow arrows), BIRADS4. Biopsy proved IDC & DCIS

Table 3 Comparison of distribution between DM and DBT

Distribution	Mammography	Tomosynthesis	*p*-value
Multicenteric	0 (0.0%)	5 (14.3%)	0.023*
Multifocal	2 (6.25%)	6 (17.1%)	
Single	30 (93.75%)	24 (68.6%)	

*p < 0.05 defines a significant difference

Regarding the parenchymal distortion, we detected better assessment by DBT compared to DM as DM detect only 10/90 (11.1%) cases while DBT detected parenchymal distortion in 27/90 (30%), DBT was of added value as it detected 17 distortions not seen by DM. as Skaane P [18]. study proved that DBT improve the detection of subtle architectural distortion especially in women with dense breasts.

Also as breast asymmetry DM detected 33/90 (36.6%) cases out of which 1/33(3%) were diffuse asymmetries, 5/33 (15%) developing asymmetry and 27/33(81%) were focal asymmetries. In DBT it verified the asymmetry in 17/90 (18.8%), 10/17 (58.8%) as malignant mass lesions and 7/17 (41.2%) as benign mass lesion. Sixteen of lesions (16/33) 48% were simply overlapping tissues and avoided unnecessary biopsy. Poplack SP etal. [19] they concluded that DBT has the potential to decrease the recall rate by 40% (37/92) when used adjunctively with digital screening mammography.

At our study, adding DBT to a conventional mammography substantially increases sensitivity for multifocal/multicentric disease from 6.2 to 34.3% (p = 0.02). Bian T et al [20] showed higher overall detection rates using DBT compared to mammography in a study population of 631 breasts assessing benign as well as malignant lesions.

At our study, regarding calcifications by DM showed 31/90(34.4%) patients had calcification, 13/31(42%) lesions were benign calcification, 18/31(58%) lesions were malignant calcifications. While DBT showed 34/90(37.7%) patients had calcification, 13/34(38%) lesions were benign calcification, 21/37(62%) lesions were malignant calcifications. Kopans D et al. [21] after comparison the study found that DBT may display calcifications equal or even slight greater as mammography. DBT didn't add significant value to the detection nor characterization of calcification.

The diagnostic accuracy of DM and DBT in characterization of breast lesions and diagnosis of breast cancer as a regard of pathology results as a gold standard, DBT had a sensitivity of 98%, a specificity of 87%, PPV of 88%, NPV of 98% and accuracy 92%. On the other hand, DM had a sensitivity of 58%, a specificity of 80%, PPV of 74%, NPV of 65% and accuracy 69%. Mansour S [16], The sensitivity, specificity, and accuracy of DM was 60%, 20.7% and 48% respectively have significantly enhanced on applying DBT to be 94.5%, 74% and 89.7% respectively. These results are comparable to those reported by other previous studies: Tamaki K [22], Waldherr C [23], Bernardi D [24] & Hassan RM [25].

Hakim CM et al. [10] the study looked at 25 women's mammograms and wrote masses finding twice: once with the use of the extra views and once with the help of DBT and their BI-RADS. They discovered that in 50% of cases, DM and DBT (used together) were thought to be better for diagnosis. DBT showed better lesion BIRADS classification and significantly decreased the
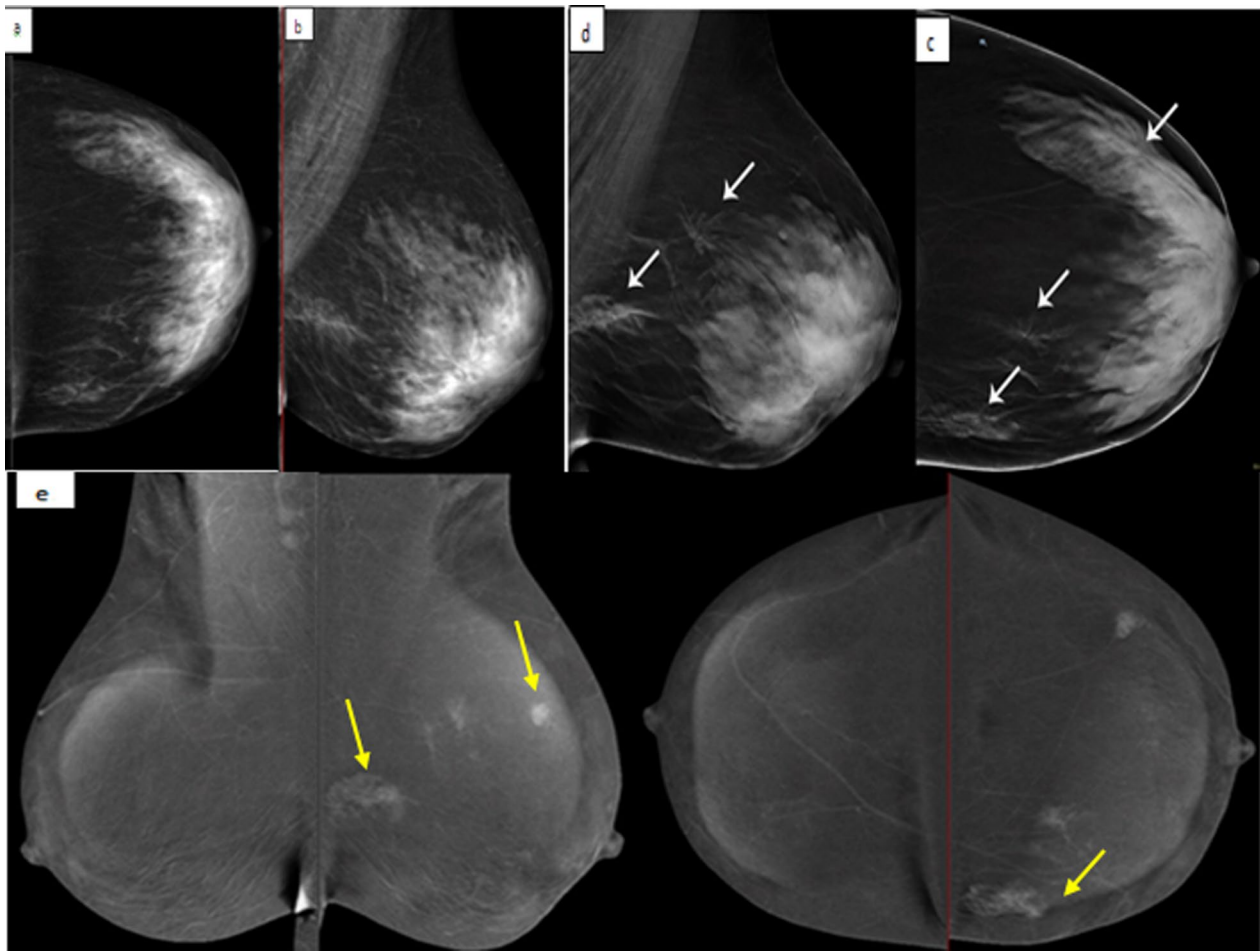
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Fig. 6 A 63 years-old female presented with left breast sweeling (**a**, **b**) DM CC & MLO craniocaudal & **b** mediolateral oblique DM images showed heterogeneously dense breasts (ACR c) and LIQ focal area of asymmetry with subtle distortion. **c** Left breast craniocaudal & **d** mediolateral oblique DBT images showed left breast LIQ focal asymmetry with underling distortion and UIQ irregular mass lesion as well UOQ distortion (Arrows). **e** Further contrast enhanced spectral mammogram (CESM) confirmed multicentrecity. The lesion was categorized by DM as BIRADS4 and BIRADS5 by DBT. Pathological data after surgery and proved IDC

number of indeterminate/suspicious lesions, (BIRADS 3, 4). DBT changed the identified BIRADS category. It upgraded 10/31 lesions and downgraded 8/31 lesions.

In our study, after comparing DM versus DBT BIRADS scoring and different BIRADS for 40 cases (24 were upgraded and 16 were downgraded). The upgraded lesions 60% (24/40) were classified as follows, 70% (17/ 24) upgraded to BI-RADS 4 and 30% (7/24) upgraded to BI-RADS 5. Twenty-three of upgraded lesions were malignant and one was benign. The downgraded lesions 40% (16/40) more evident in lesion scored with BI-RADS 3 by 25% (10/40). All downgraded lesions were benign, this result in reduced

follow-up of lesions that would not have been identified by DM alone and diminished the requirement for biopsy. Andersson I [26], Comparing one-view DM to one-view BT, 21 patients were upgraded on BIRADS classification ($p < 0.01$). Comparing two-view DM to one-view BT, 12 patients were upgraded on BIRADS classification ($p < 0.01$). The results indicate that the cancer visibility on DBT is superior to DM, which suggests that DBT may have a higher sensitivity for breast cancer detection.

Nakashima Kazuaki, [27] the misdiagnosed lesions on DBT were less than that on DM (67 false-positives and 49 false-negatives). The combined DM and DBT

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Table 4 Diagnosis of all lesions

| Biopsy for BIRADS 4.5:		Follow-up/ Biopsy for BIRADS 3:		Follow-up for BIRADS 1.2:	
A- Malignant					
Ductal carcinoma in situ (DCIS)	3 (3.3%)	Fibroadenoma	6 (6.7%) 5 FU& 1 biopsy	Adenosis	1 (1.1%) FU
Invasive ductal carcinoma (IDC)	26 (28.9%)	Focal asymmetry	3 (3.3%) FU	Benign calcifications	2 (2.2%) FU
IDC + DCIS	7 (7.7%)	Intra-ductal papilloma (IDP)	2 (2.2%) biopsy	Fibroadenosis	7 (8.8%) FU
Invasive lobular carcinoma ILC + IDC	1 (1.1%)	Inflamed Montgomery gland	1 (1.1%) FU	Fibrocystic	7 (8.8%) FU
Intraductal adenocarcinoma	1 (1.1%)			Focal fibroadenosis	1 (1.1%) FU
Invasive lobular carcinoma (ILC)	4 (4.4%)			Galactocele	1 (1.1%) FU
Inflammatory carcinoma	1 (1.1%)			Hamartoma	3 (3.3%) FU
Malignant phylloid	1 (1.1%)			Intra mammary LN	1 (1.1%) FU
Pagets	1 (1.1%)			Normal	1 (1.1%) FU
B- Benign				Simple cyst	1 (1.1%) FU
Radial scar	1 (1.1%)			Vessel	1 (1.1%) FU
Sclerosing adenosis	3 (3.3%)				
Unusual ductal hyperplasia (UDH)	1 (1.1%)				

FU: Follow-up
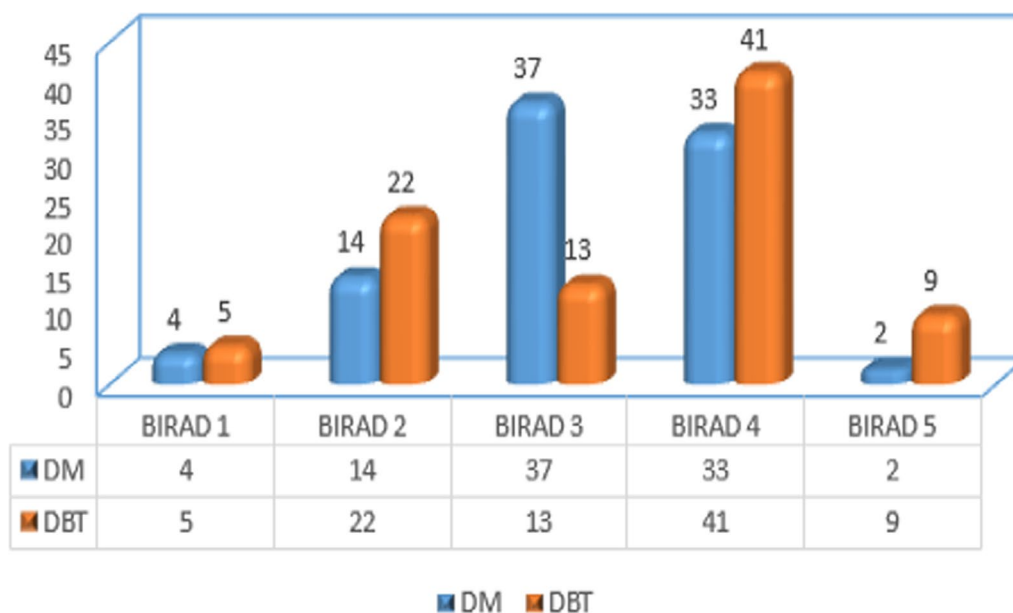
Fig. 7 Distribution of breast lesions BIRADS in DM & DBT in all cases

decreased misdiagnosed lesions (seven false-positives and two false-negatives) when compared to DM or DBT alone. At our study revealed twenty-eight of the breast lesions in this study were misdiagnosed on DM (9 false-positives and 19 false negatives). However, the misdiagnosed lesions on DBT were less than that on DM (6 false-positives and 1 false-negative).

Limits of the study was small sample size especially at females with ACR D, so further larger study for females with ACR D is recommended.

Conclusions

Digital breast tomosynthesis has a significant impact on the BI-RADS classification as it effectively visualizes overlapping tissue in dense breasts especially in breast lesion BIRAD 3 & 4, along with decreasing recall rates for false-positive results.

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Table 5 Changes in BIRADS scoring from DM techniques to DBT techniques

	DBT BIRADS					Total	*p*-value
	1	2	3	4	5		
DM BIRADS:							
1	0 (0.0%)	1 (4.5%)	0 (0.0%)	2 (4.9%)	1 (11.1%)	**4 (4.4%)**	**< 0.001***
2	1 (20.0%)	13 (59.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**14 (15.6%)**	
3	3 (60.0%)	7 (31.8%)	11 (84.6%)	15 (36.6%)	1 (11.1%)	**37 (41.1%)**	
4	1 (20.0%)	1 (4.5%)	2 (15.4%)	24 (58.5%)	5 (55.6%)	**33 (36.7%)**	
5	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (22.2%)	**2 (2.2%)**	
Total	5 (5.6%)	22 (24.4%)	13(14.4%)	41 (45.6%)	9 (10.0%)	90 (100%)	

*p < 0.05 defines a significant difference

Table 6 The diagnostic accuracy of DM and DBT characterization of breast as a regard the gold standard

	Gold Standard Total sample (n = 90)				Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy	*p*-value
	Malignant (*n* = 45)		Benign (*n* = 45)							
	No	%	No	%						
Mammography Malignant Benign	26 19	57.8 42.2	9 36	20% 80%	58	80	74	65	69	0.0005*
Tomosynthesis Malignant Benign	44 1	97.8 2.2	6 39	13.3% 86.7%	98	87	88	98	92	< 0.0001*

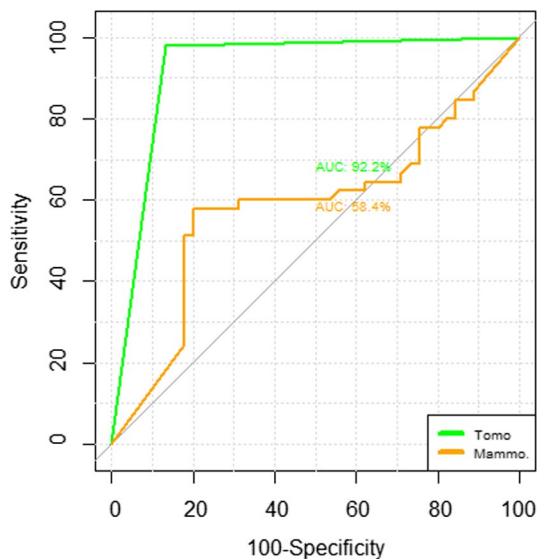*p < 0.05 defines a significant difference

Fig. 8 ROC Curve for the assessment of DM and DBT as a regard the gold standard in characterization of breast lesions

Abbreviations

3D	Three-dimensional
CBS	Conservative breast surgery
CC	Craniocaudal
CESM	Contrast-enhanced spectral mammogram
DBT	Digital breast tomosynthesis
DM	Digital mammography
MLO	Mediolateral oblique
WLE	Wide local excision

Availability of data and materials
Data remains available when needed by the editorial board.

Declarations

Ethics approval and consent to participate
We commenced this research following the Faculty of Medicine Helwan University, Research Ethics Committee's approval. All participants received a signed informed consent to analyze anonymized data.

Consent for publication
Not applicable.

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