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Can a Single-View Digital Breast Tomosynthesis Help in Characterizing Breast Asymmetries?

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Abstract

Background: Breast symmetry is a challenging mam mographic finding for radiologists. Digital breast tomosyn thesis (DBT) offers 3D imaging of the breast, reducing tissue superimposition and enhancing cancer detection. Digital breas tomosynthesis reduces false recalls and false-positive results especially in women with dense breast tissue. Single-view digital tomosynthesis has comparable accuracy to two-view tomosynthesis, but with the advantage of decreasing patien dose and better sensitivity and specificity compared to digita mammography.

Aim of Study: We aimed to evaluate the diagnostic perfor mance of single-view digital breast tomosynthesis combined with digital mammography compared to digital mammography alone in assessing breast asymmetries.

Patients and Methods: The study comprised 61 women with breast asymmetry who underwent full-field digital mam mography and single (MLO) view digital breast tomosynthesis

Results: The diagnostic accuracy of digital mammography was 86.71%, with a sensitivity of 94.74% and a specificity of 71.43%. Using single-view DBT combined with mammography achieved a diagnosis accuracy of 78.69%, a sensitivity of 100%, and a specificity of 83.72%.

Conclusion: Combining single-view digital breast tomo synthesis with digital mammography improves asymmetry characterization. It increases cancer diagnosis while decreasing the recall rate, improving specificity and sensitivity.

Key Words: *Breastasymmetry – Single-view digital tomosyn thesis – Digital mammography.*

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Introduction

EVERY year, about half a million women worldwide die from breast cancer. Many nations have instituted mammography screenings during the past three decades in an attempt to minimize breast cancer-related fatalities. Breast cancer mortality has been reduced by 30% as a result of screening and treatment breakthroughs **[1].**

Mammography has poor specificity and sensitivity in dense breasts, as dense breast parenchyma may obscure occult lesions, and dense breast parenchyma may be mistaken for suspicious lesions **[2].**

The interpretation of breast symmetry is one of the most challenging mammographic findings for radiologists to consider when analyzing mammograms. Regarding size and the distribution of fibro-glandular tissue, radiologists often consider the two breasts similar **[3,4].**

Breast asymmetries are caused mainly by the fact that tissue distribution may differ in both breasts. However, in some situations, they may indicate a more serious underlying process **[5].**

The 3D imaging of the breast provided by DBT reduces the breast tissue superimposition effect. DBT generally diminishes the incidence of false recalls from screening while maintaining or enhancing the cancer detection rate. Moreover, DBT exhibits heightened sensitivity and reduces false-positive results, particularly in women with heterogeneously dense breast tissue, compared to digital mammography **[6].**

List of Abbreviations:

DBT : Digital breast tomosynthesis.
3D : Three-dimensional.
FNAC : Fine needle aspiration cytology.
BIRADS : Breast Imaging Reporting and Data System.

Several studies have shown that single-view digital tomosynthesis accuracy is comparable to two-view tomosynthesis, with the advantage of decreasing the dose to the patient. Also, single-view digital tomosynthesis showed better sensitivity and specificity than digital mammography **[7,8,9]**.

We aimed to evaluate the diagnostic performance of single-view digital breast tomosynthesis combined with digital mammography compared to digital mammography alone in assessing breast asymmetries.

Patients and Methods

Study population:

This research was carried out from February 2021 to September 2023 in the women imaging unit, Radiology Department, Kasr El Ainy Hospital. The participants in this study were 61 women who had breast mammographic asymmetry. All patientsperformed digital mammography and a single MLO view 3D DBT. They were between the ages of 31 and 65, with the average age being 43.5 years old. The research was approved by the ethical committee, and each patient provided written consent.

Patient selection:

Inclusion criteria:

- Patients with mammography-detected asymmetries.

Exclusion criteria:

- Women with a normal mammographic study or an abnormal mammogram other than asymmetry.
- Contraindications to mammography.

Methods:

Equipment:

DM and DBT were conducted on the same machine, a FUJI Full-Field Digital Mammography equipment that had been upgraded to give DBT.

Digital mammography and breast tomosynthesis techniques:

- Conventional views, MLO and CC, and single-view MLO Digital DBT were obtained using FUJI digital mammography system.
- The images were evaluated at the workstation.

Image analysis and interpretation of DM, digital breast tomosynthesis:

- The interpretation of the mammogram was carried out by radiologists who had about ten years of expertise in the field of mammography. These radiologists provided a subjective evaluation of the type of asymmetries using the Diagnostic Mammography workstation.
- Each patient's breast density was assessed.
- The type of asymmetry was evaluated (asymmetry, developing, focal, and global asymmetry), as well as the associated mammographic abnormalities.
- Each lesion was categorized by utilizing the BI-RADS Atlas 2013 **[10]**, guided by clinical data, but was not influenced by the final pathology diagnosis.
- Radiologists reported DBT, according to the BI-RADS Mammography Atlas 2013 **[10]** and clinical data, but was not influenced by the final pathology diagnosis.
- The final diagnosis was determined based on the histological examination (for 30 cases), FNAC (for one case), or close follow-up (for 30 cases for two years conducted biannually).
- The research was approved by the ethical committee, and each patient provided written consent.

Statistical analysis:

Statistical Package for the Social Sciencesversion 26 was used. Standard diagnostic indicators such as specificity, sensitivity, positive predictive value, negative predictive value, and diagnostic efficacy were assessed.

Results

The study comprised 61 women who had breast mammographic asymmetry. All patients performed digital mammography and single (MLO) view DBT. Their ages ranged from 31 to 65 years, with a mean age of 43.5.

Regarding the clinical presentation, 20/61 patients came for screening, 32/61 patients had a lumpy sensation, 16/61 had mastalgia, and three patients presented with persistent nipple discharge.

Final diagnosis:

The final diagnosis was according to histopathology analysis (for 30 cases), FNAC (one case), or close follow-up (for 30 cases), where 42/61 (69%) lesions were benign while 19/51 (31%) lesions were malignant.

Mammography findings:

Regarding breast density, one patient (1.6%) was assigned ACR A, 25/61 (41%) patients were assigned ACR B, 32/61 (52.5%) patients were assigned ACR C, and 3/61 (4.9%) patients were assigned ACR D.

The patients were divided according to the type of asymmetries detected, where 3/61 (4.9%) showed asymmetry, 50/61 (82%) showed focal asymmetry, and 8/61 (13.1%) showed global asymmetry.

There were associated:

- An edema pattern in 16/61 patients.
- Architecture distortion in 15/61 patients.
- Suspicious microcalcifications in 11/61 patients.

Each lesion was assigned a mammographic BI-RADS. Of the 61 lesions, 31 (50.8%) were classified as benign (BIRADS 2 and 3), while 30 (49.2%) were classified as malignant (BIRADS 4 and 5). The diagnostic indices are presented in Table (1), and 18 lesions were true positives, 12 lesions were false positives, one lesion was detected as false negatives, and 30 lesions were true negatives after correlating the mammography findings to the final diagnoses.

Single-view digital breast tomosynthesis combined with digital mammography findings:

- 47/61 (77%) patients presented with asymmetries detected by mammography and single-view DBT (Figs. 1,2).
- 14 /61 (23%) patients presented with mass lesions detected by single-view digital tomosynthesis (Fig. 3).

There were associated findings:

- 16/61 showed an edema pattern.
- 12/61 patients showed associated architecture distortion.
- 11/61 showed associated suspicious microcalcifications.

Each breast was assigned a final single-view DBT combined with the mammography BIRAD category. Of the 61 lesions, 33 (54.1%) were classified as benign (BIRADS 2 and 3), while 28 (45.9%) were classified as malignant (BIRADS 4 and 5). The final diagnoses were determined by correlating the single-view DBT with mammography findings. Nineteen diagnoses were true positives, seven were false positives, no lesions were detected as false negatives, and 35 were true negatives. The diagnostic indices of single-view DBT combined with mammography are shown in Table (2).

Table (1): Sensitivity, specificity, and accuracy results of mammography.

Mammography	Value	95% CI
Sensitivity	94.74%	73.97% to 99.87%
Specificity	71.43%	55.42% to 84.28%
Positive Likelihood Ratio	3.32	2.03 to 5.41
Negative Likelihood Ratio	0.07	0.01 to 0.50
Positive Predictive Value	60.00%	47.89% to 71.00%
Negative Predictive Value	96.77%	81.52% to 99.51%
Accuracy	78.69%	66.32% to 88.14%

Table (2): Sensitivity, specificity, and accuracy results of single-view DBT combined with Digital mammography.

Single-view DBT combined with Digital mammography	Value	95% CI
Sensitivity	100.00%	82.35% to 100.00%
Specificity	83.72	63.3% to 93.19%
6.14	4.67	3.12 to 12.10
Negative Likelihood Ratio	0.00	
Positive Predictive Value	73.08	54.95% to 84.24%
Negative Predictive Value	100.00%	90.26% to 100.00%
Accuracy	88.71%	78.11% to 95.34%

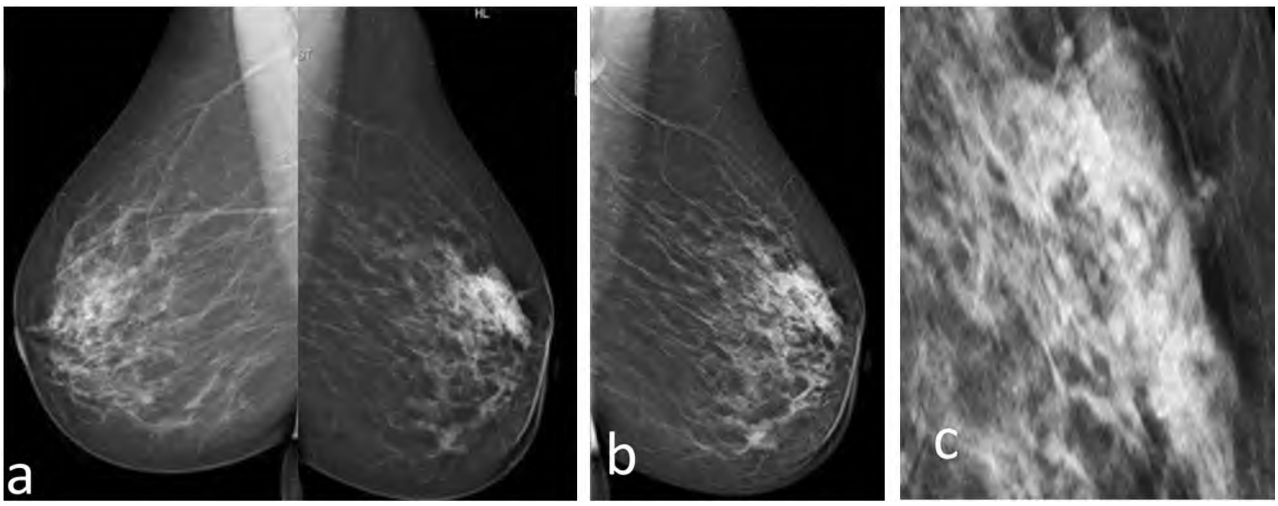

Fig. (1): A fifty-two-year-old female patient presented with a left breast lump. (A) Mammography revealed left breast UOQ area of focal asymmetry extending to the nipple with overlying concomitant amorphous micro-calcification BIRADS4. (B,C) DBT showed left upper outer focal asymmetry with underlying tubular densities harboring amorphous micro-calcification BIRADS4. The final diagnosis was left breast ductal carcinoma insitu.

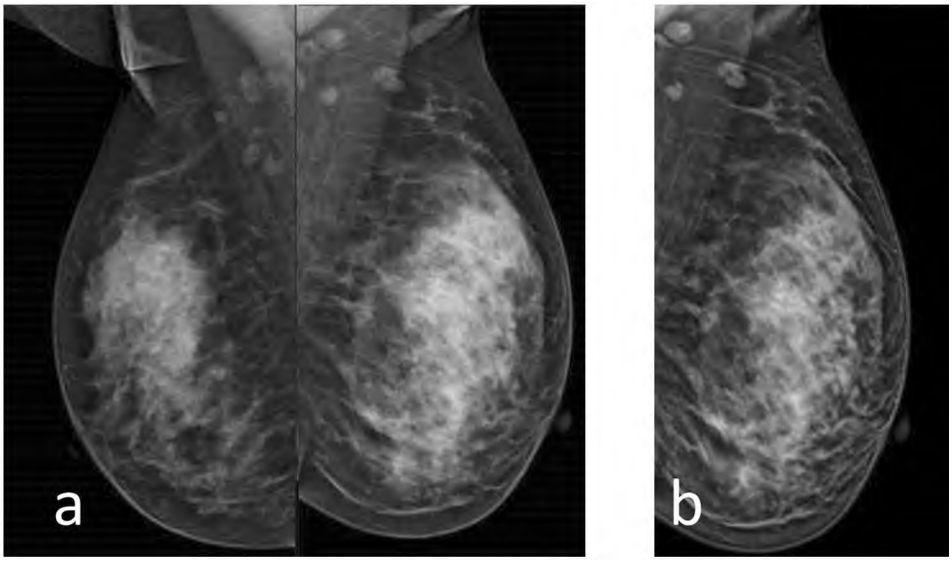

Fig. (2): A thirty-two-year-old female patient presented with mastalgia with no palpable lesions. (A) Mammography revealed left breast global asymmetry. (B) DBT clarified overlapping glandular breast tissues, and BIRADS 2 was confirmed by follow-up for two years.

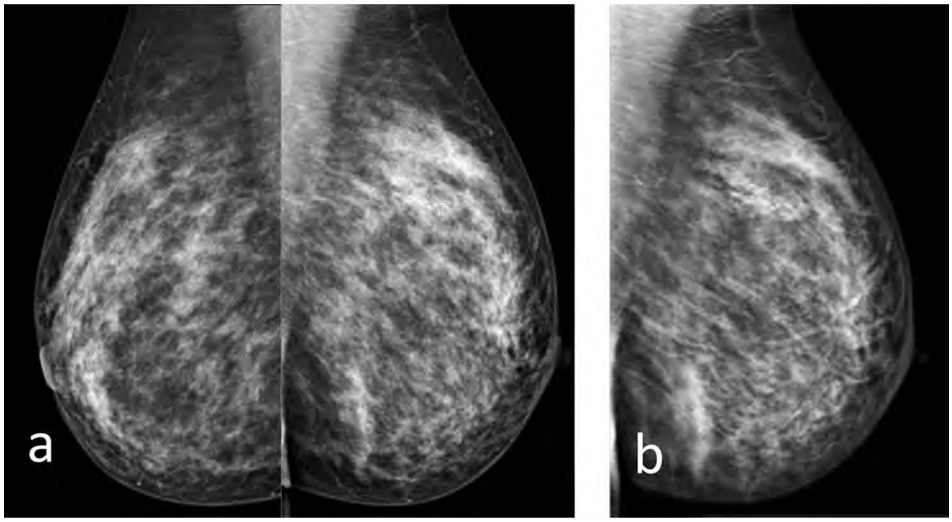

Fig. (3): A forty-four-year-old patient presented with a palpable left breast lump. (A) Mammography showed left breast focal asymmetry with UOQ segmental coarse suspicious microcalcifications, BIRADS4. (B) DBT showed Left breast asymmetry with UOQ irregular mass lesion harboring clustered microcalcifications, BIRADS4. The final diagnosis was left breast Invasive duct carcinoma.

Discussion

Digital breast tomosynthesis is a relatively recent technique in breast imaging. It was designed to circumvent the inherent restriction of tissue overlap that exists in standard two-dimensional cancer screening. DBT can provide a quasi-three-dimensional visualization of breast tissue. DBT is performed by taking many low-dose images of the breast from various angles and then reconstructing the images into thin slices. This approach allows radiologists to localize better, define, and diagnose lesions, especially in dense breast tissue, by reducing the concealing effect of superimposed structures **[11,12].**

Compared to digital mammography alone, DBT has been proven in several studies to improve cancer detection rates while decreasing false-positive recalls. Researchers **[5,6,11]** performed a considerable prospective investigation and found that incorporating tomosynthesis into digital mammography improved diagnostic accuracy while reducing recall rates.

Digital tomosynthesis is usually done in two views, craniocaudal (CC) and mediolateral oblique (MLO), yet some research has been done on the accuracy of single-view digital breast tomosynthesis (DBT). Many studies have indicated that single-view DBT, particularly when evaluating asymmetries or unclear mammographic data, may achieve diagnostic accuracy comparable to dual-view single-view tomosynthesis with reduced exam time and radiation exposure **[6,8,13,14].**

Our study included 61 patients with breast asymmetries detected by mammogram. They all performed mammography and single-view DBT. Of the 61 lesions, 42/61 (69%) were benign, while 19/51 (31%) were malignant upon correlating them with the final diagnosis. Our findings agreed with Dawoud et al. **[15]** and Abelwahid et al., **[16]** studies,concluding that global and focal asymmetries are usually due to benign conditions, yet an underlying malignancy should be excluded.

In reviewing the mamographic findings, each lesionwas assigned a BIRADS score. Thirty-one out of sixty-one lesions (50.8%) were considered benign (BIRADS 2 and 3), whereas thirty out of sixty-one lesions (49.2%) were considered malignant (BIRADS 4 and 5). When the mammography results were compared to the final diagnosis, 18 lesions were determined as true positives, 12 as false positives, 1 as false negatives, and 30 as true negatives. So, mammography showed high sensitivity (94.7%), moderate specificity (71.4%), and moderate accuracy 78.69% indicating an excellent performance in excluding breast cancer, yet with 12 FP cases leading to unnecessary biopsies or recall. These FP results may be attributed to the presence of superadded clinical or suspicious mammographic findings, and since 57.4% of the patients had dense breasts.

According to Lourenco, et al., **[17]**, the addition of DBT had the most tremendous impact on mammographic findings, with a 58% reduction in asymmetry recalls. Also, DBT allows for the assessment of localized asymmetries by demonstrating that the intersection of Cooper ligaments and fibroglandular breast tissue causes them.

A recent study by Gurando et al. **[18]** concluded that DBT could better distinguish benign breast asymmetry caused by summation artifacts from breast malignancies that may seem comparable to normal fibroglandular tissue at FFDM.

Adding single-view breast tomosynthesis to mammography enhanced the cancer detection rate, augmenting their sensitivity while simultaneously reducing the recall rate, which improved their specificity **[19].**

In this study, single-view DBT combined with mammography had a sensitivity of 100%, a specificity of 83.72%, and a diagnostic accuracy of 88.71%.

In our study, the single-view DBT combined with mammography showed better accuracy and specificity compared to that of digital mammography alone, and this is in concordance with Peppard et al., **[20],** who recommended that DBT is frequently effective for assessing focal asymmetry.

Our results regarding the specificity of single-view tomosynthesis combined with digital mammography agreed with Gennaro et al., **[21]** where they showed better specificity than mammography alone with comparable accuracy.

Our study also agreed with Hawley et al., **[22],** who concluded the greater specificity of DBT over mammography and that using DBT did offer numerous advantages over routine mammographic views.

In our study, single-view digital tomosynthesis combined with digital mammography allowed visualization of underlying 14 mass lesions (23%) (Fig. 3). These results are consistent with previous studies by Ahmed et al., **[23]**, and Mokhtar et al., **[24]** which showed increased detection of true mass lesions obscured due to tissue overlap on mammography.

Our research's main limitation was the relatively small sample size.

Conclusion:

Combining single-view digital breast tomosynthesis with digital mammography improves asymmetry characterization. It increases cancer diagnosis while decreasing the recall rate, improving specificity and sensitivity.

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هل يساعد منظور واحد من التصوير المقطعى الرقمى للثدى فى تحديد خصائص عدم تماثل الثدى؟

يعد تشخيص عدم تماثل الثدى باستخدام الماموجرام تحدى يواجه اخصائى الأشعة التشخيصية التصويرالمقطعى الرقمى للثدى يوفر صورة ثلاثية الأبعاد للثدى مما يقلل تراكب الأنسجة ويزيد فرص تشخيص سرطان الثدى والتصوير المقطعى الرقمى للثدى يخفض نسبة النتائج الإيجابية الزائفة ومعدل استدعاء المريضة مرة أخرى وخاصة فى الثدى الكثيف. التصويرالمقطعى الرقمى للثدى بمنظور واحد له نتائج دقيقة مقارنة بالتصوير منظورين مع ميزة خفض جرعة الاشعاع التى تتعرض لها المريضة مع نتائج افضل كحساسية وخصوصية بالمقارنة باستخدام الماموجرام فقط.

الهدف من هذا البحث التقييم والمقارنة بين التشخيص باستخدام الماموجرام كوسيلة منفردة وبين استخدام التصوير المقطعى الرقمى للثدى (منظور واحد) مع الماموجرام فى تقدير وتشخيص عدم تماثل الثدى.

شملت الدراسة ٦١ مريضة كان تشخيصهم عدم تماثل الثدى خضعوا للفحص بالماموجرام والتصويرالمقطعى الرقمى للثدى (منظور واحد) وكانت نتائج البحث كالتالى: باستخدام الماموجرام منفردا بلغت دقة التشخيص ٨٦,٧١٪ والحساسية ٩٤,٩٤٪ وخصوصية ٧١,٤٣٪. وباستخدام منظور واحد من التصوير المقطعى الرقمى للثدى مع الماموجرام بلغت دقة التشخيص ٧٨,٦٩٪ والحساسية١٠٠٪ والخصوصية ٨٣,٧٢٪.

ونستنتج من هذا أن استخدام التصوير المقطعى الرقمى للثدى (منظور واحد) مع الماموجرام يحسن من تحديد خصائص عدم تماثل الثدى وتشخيص سرطان الثدى كما يحسن الحساسية والخصوصية ويخفض معدل استدعاء المريضة مرة اخرى.