Original Article

Diagnostic Value of Digital Breast Tomosynthesis and Synthetic Images in Patients with Breast Cancer

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Abstract

Background: Different imaging techniques are used in the diagnosis of breast cancer. The low sensitivity of mammography to detect cancer in the dense breast parenchyma and the lack of standard application of digital breast tomosynthesis (DBT) are some of the problems. Therefore, breast cancer imaging techniques should be compared in terms of conspicuity and characterization of lesions. **Aim:** Full-field digital mammography (DM) and synthetic mammography (SM) which are obtained from the slices of digital breast tomosynthesis (DBT) give similar results in terms of conspicuity and characterization of the lesions in detecting breast cancer. **Patients and Methods:** In this retrospective study, 47 women diagnosed with breast cancer were included in the study. DM, SM, and DBT images were evaluated by scoring the conspicuity of the index lesion in the parenchyma and its characterization in terms of contour and shape with a 4-point scale. In addition, the conspicuity of the lesions in relation to lesion size and breast density was examined with these three techniques. **Results:** There is no significant difference between DM and SM techniques for index lesion conspicuity and characterization; however, the imaging score of DBT is significantly higher than other techniques for the conspicuity and characterization of the lesions. In terms of the conspicuity of the lesions in relation to lesion size, DM and SM techniques show significant difference according to the size of the lesion, whereas the DBT technique did not show significant difference. While mammography type is a determinant of lesion conspicuity in only DM and SM techniques, conspicuity findings do not differ significantly in the DBT technique. **Conclusion:** In conclusion, it was shown that standard images and SM images obtained from DBT did not differ significantly in terms of conspicuity and characterization of lesions. Thus, DBT is significantly superior to the DM and SM images. While the DM and SM images are more successful in showing large lesions and lesion detection in nondense breasts, DBT images were not affected by lesion size and breast density.

Keywords: *Breast cancer conspicuity, breast neoplasms, digital breast tomosynthesis, digital mammography, synthetic mammography*

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Introduction

Since mammography screening reduces the mortality in breast cancer, it has made the diagnostic position of mammography indispensable in this disease. However, the biggest problem of mammography is its low sensitivity to detect breast cancer, especially in cases with dense breast parenchyma. Therefore, complementary imaging methods are usually needed especially in the patients mentioned. The development of digital imaging techniques has led to the emergence of new methods that reduce the limitations of mammography. One of

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the most important of these techniques is digital breast tomosynthesis (DBT).[1] The most remarkable difference of DBT, which provides three-dimensional images with the sectional imaging method, is the elimination of parenchymal superposition. This enables both the detection of lesions and the characterization of detected lesions. On the other hand, there is no clear standard for the implementation of DBT protocols. Some centers perform DBT for both projections (craniocaudal—CC and mediolateral oblique—MLO) in addition to the standard digital mammography of both breasts. While in some centers, DBT is applied in only one projection, and synthetic images (SM) obtained from cross-sectional images are used for diagnosis. The purpose of this application is to reduce the dose which is accepted as the biggest disadvantage of DBT.[2] However, there are a limited number of studies on the diagnostic value of these synthetic images. The aim of this study is to evaluate DM, SM, and DBT techniques in cases diagnosed with breast cancer in terms of lesion detection and characterization.

Material And Methods

Approval for this retrospective study was obtained from the scientific board of our hospital. The sample of the study consisted of 47 women who were diagnosed with BIRADS 5 (Breast Imaging Reporting and Data System) in mammographic and sonographic examinations in the Picture Archiving and Communication System (PACS) of our hospital and were diagnosed with breast cancer by histopathologic examination. The cases that previously had a history of breast surgery, breast cancer-related chemotherapy, or radiotherapy were not included in the study.

Image acquisition

As a part of the routine mammographic study used in our clinic, full-field DM was performed with Senographe DS (GE Healthcare, Chalfont St. Giles, UK), at standard views with a craniocaudal projection. DBT images were taken in mediolateral oblique projection and SM images were obtained from sectional images using the software program of the device.

Image interpretation

Anonymized images were sent to a dedicated mammography workstation (Seno Iris, GE Healthcare). All images were reviewed by a radiologist (Radiologist A, 16 years of breast imaging experience). The radiologist was blinded to the clinical data of the patients, but he was aware that the study included only patients with a suspicion of breast cancer. The radiologist examined DM, SM, and DBT images at independent two viewing sessions. In each session, he evaluated one-half of the DM, SM, and DBT images of the patients in random order.

Breast parenchyma was evaluated in terms of density according to ACR-BIRADS criteria for each case. The researcher scored the detectability of the index lesion in the parenchyma and its characterization in terms of contour and shape with a 5-point visual ordinal scale ranging from 0 to 4. Accordingly, the scale was considered as "0: not visible," "1: mild," "2: moderate," "3: good," and "4: very good" for lesion detection and characterization. Lesions were classified as "small" if they were 20 mm in maximum diameter and below, and "large" if they were 21 mm and above.

Statistical analysis

On evaluating the findings obtained in the study, the IBM SPSS Statistics 22 (SPSS IBM, Turkey) program was used for statistical analysis. While analyzing the data, first of all, descriptive statistical methods (mean, standard deviation, frequency) were examined, as well as Friedman test was used to understand whether at least one of the three different imaging techniques gave different results from the others and variance differences were determined between the methods. A nonparametric Wilcoxon test was used to determine which of the imaging methods gave different results. Besides, the Mann–Whitney U test was used to determine if there was a significant difference in the conspicuity and characterization characteristics of the lesion size according to the imaging techniques. Whether the mammography type made any difference in terms of the findings related to the imaging methods used in the research was tested with the Kruskal–Wallis test because there are more than two subgroups.

The significance level was accepted as $P < 0.05$.

Results

The ages of the cases ranged from 34 to 86 and the mean age was 56.55 ± 11.04. The lesion sizes ranged between 4 and 92 mm and the mean was calculated as 26.45 ± 16.18 mm. 8.5% of mammography types were noted as Type 1, 53.2% as Type 2, 23.4% as Type 3,

Table 1: Mammographic density categories of the patients according to the American College of Radiology (ACR) density of the breast

ACR density category	*n*	%
ACR density 1	4	8,5
ACR density 2	25	53,2
ACR density 3	11	23,4
ACR density 4	7	14,9
Total	47	100

and 14.9% as Type 4 [Table 1]. In terms of lesion size, 19 cases were detected as 20 mm and below (small size), and 28 cases were detected as 21 mm and above (large size).

When the scoring ability of the imaging techniques was evaluated in terms of the conspicuity of the lesion, there was no significant difference between DM and SM imaging techniques according to the Wilcoxon test. However, the DBT imaging technique has a statistically significant difference in terms of conspicuity compared to DM and SM imaging techniques [Figure 1]. Accordingly, the conspicuity average of the DBT method is statistically significantly higher than the other two techniques.

When the imaging techniques were evaluated in terms of lesion characterization, there was no significant difference between the DM and SM methods. According to the Wilcoxon test, the DBT method shows a statistically significant difference compared to the DM and SM methods in terms of characterization [Figure 2]. The characterization average of the DBT method is significantly higher than the DM and SM methods.

In the scope of the study, the ability of imaging methods is compared regarding the conspicuity of the lesions related to lesion size. The conspicuity level of the DM and SM images differs significantly in terms of the size of the detected lesion according to the Mann–Whitney U test. The DM technique shows larger lesions (mean: 3.46) statistically significantly better than smaller ones (mean 2.47). Similarly, the SM technique differs significantly in terms of conspicuity according to the size of the lesion. It was concluded that the DBT technique did not differ significantly with respect to the size of the lesion.

Imaging methods were also compared in terms of mammography type and lesion conspicuity by the Kruskal–Wallis test. According to the test results; the DM technique showed a significant difference in the conspicuity of lesions related to mammography type. Similarly, when the SM technique was examined, mammography type affected the conspicuity of lesions. In the DM and SM images, lesions were significantly better detected in fatty breasts. On the other hand, conspicuity findings did not differ significantly in terms of mammography type in DBT images.

Discussion

This study showed that there was no significant difference between the DM and SM techniques in

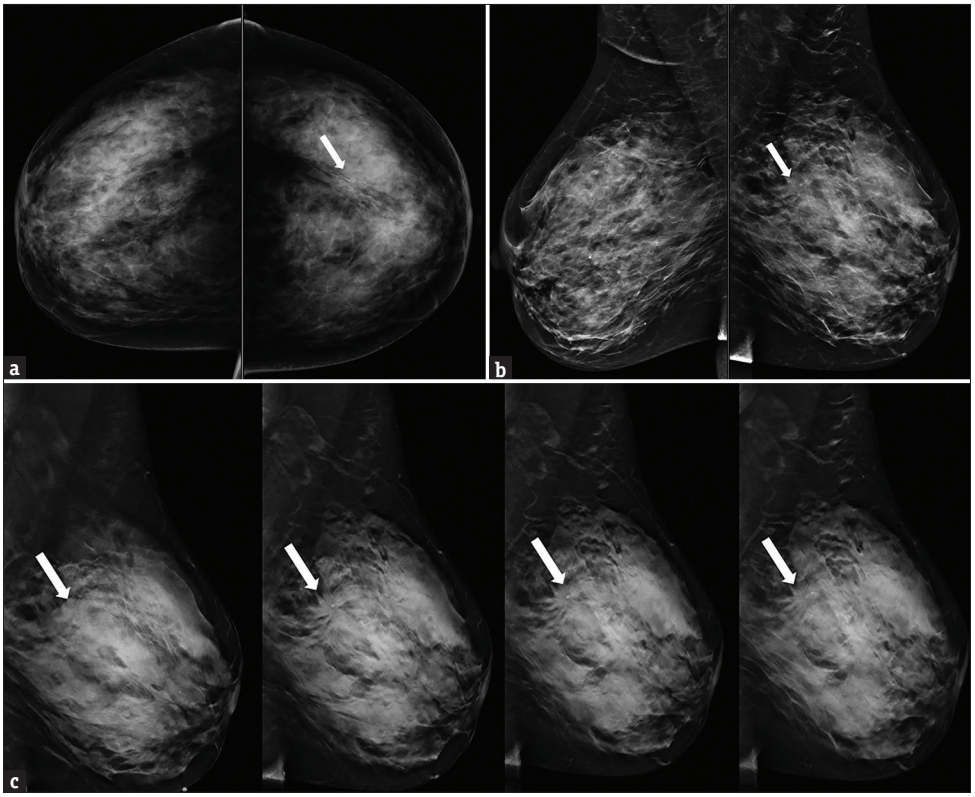

Figure 1: Example of a 58-year-old woman presenting with an invasive ductal carcinoma on the left breast. Digital mammography image (a) in craniocaudal projection and synthetic mammography image (b) in mediolateral oblique projection show dense breast parenchyma and a parenchymal distortion in the left breast (arrows) with no apparent difference between imaging techniques regarding conspicuity and characterization of the lesion. Digital breast tomosynthesis slices (c) in mediolateral oblique projection more clearly demonstrate the spiculated tumor with a 20 mm in diameter in the left breast (arrows)

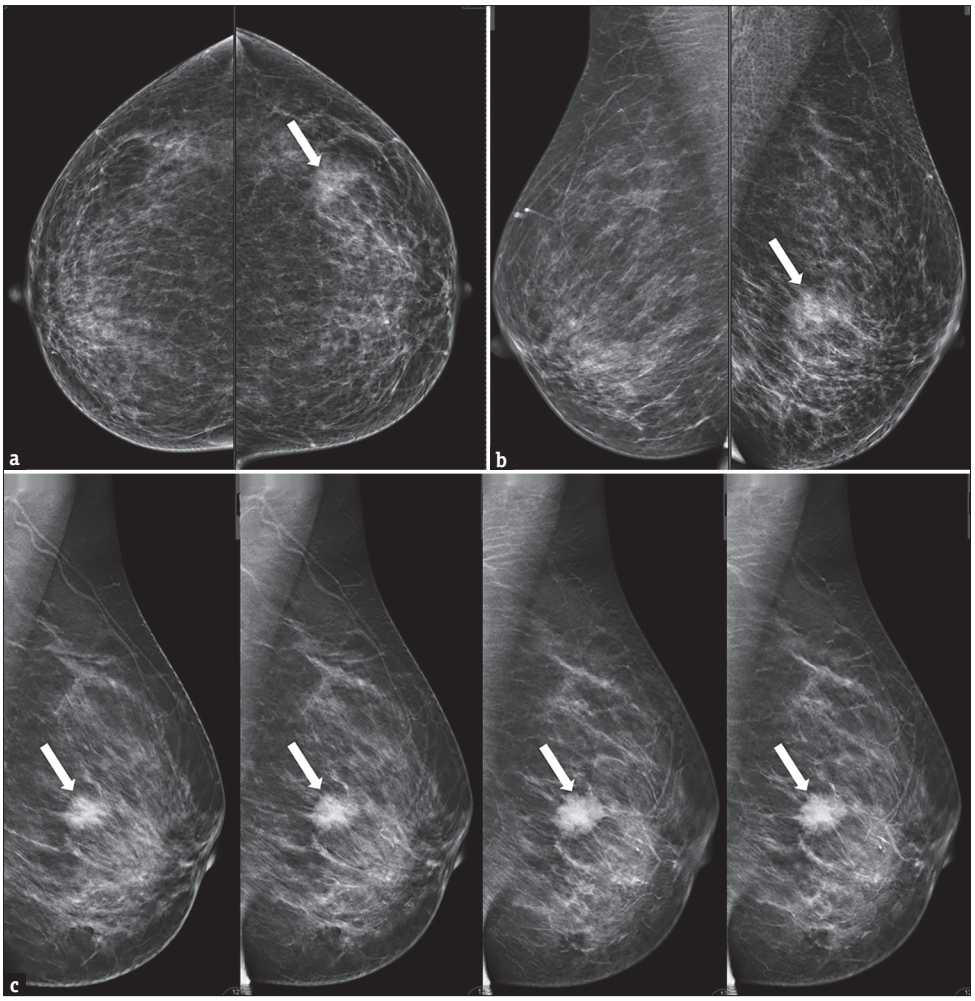

Figure 2: Example of a 40-year-old patient who had a histopathologic diagnosis of invasive ductal carcinoma in the left breast. Digital mammography image (a) in craniocaudal projection and synthetic mammography image (b) in mediolateral oblique projection show an asymmetry in the left breast. Conspicuity and characterization of the lesion are moderate and scored as 2 with these two techniques, respectively. Digital breast tomosynthesis slices (c) in mediolateral oblique projection apparently demonstrate an irregularly shaped tumor with a 24 mm in diameter in the left breast (arrows) which was scored as 4

the evaluation of breast cancer in terms of lesion conspicuity; however, the DBT technique could show lesions significantly better than the DM and SM techniques. The SM technique is 2D images, where the DBT cross-sectional dataset information is collected in a single image. The purpose of the SM technique is to reduce the radiation dose and shorten the duration of the examination in the cases where DBT is applied, without the need for an additional standard image. The result reached in this research is consistent with other studies in the literature that support that SM images do not show lower diagnostic performance than DM images.[3-5] DBT images are known to increase the rate of cancer detection compared to standard images. The result of our study also supports this information.[6,7]

In addition, this study revealed that DBT images show the contour and shape characteristics of the lesions significantly better than DM images. The superiority of the DBT technique in lesion characterization compared to standard images provides decreasing false positives and increasing accuracy.[8,9] In this study, it was revealed that SM images are not inferior in terms of lesion characterization compared to DM images.

In terms of lesion size, our findings showed that the DM and SM techniques are found more successful in showing large lesions than small lesions. In contrast to this finding, it has been reported that SM images can show smaller-sized lesions better than the DM technique in a previous study.[10] In another study aiming to detect early-stage cancers, no significant difference was found between SM images and DM.[4] In our study, it was concluded that the DBT technique did not differ significantly according to lesion size. This finding is consistent with similar studies in the literature.[11,12]

Our study revealed that DM and SM techniques were more effective in detecting the lesions in nondense

breasts when these techniques were evaluated according to mammography types. Besides, the DBT technique did not show any significant difference between dense breasts and nondense breasts in terms of detecting the lesions. In the literature, the increase of DBT's success in showing lesions in dense breast types in the BIRADS 3 and 4 categories is also reported.[13]

Our study has some limitations. First, there were inherent limitations due to its retrospective study design. The second is that the number of cases is relatively limited. Thirdly, the study included only patients in BIRADS category 5. In future research, this can be overcome by using a larger sample size or by considering a different data composition method.

Conclusion

It was shown in this study that standard images and SM images obtained from DBT images did not differ significantly in terms of conspicuity and characterization of lesions. In this sense, DBT images are significantly superior to the DM and SM images. While the DM and SM images are more successful in showing large lesions and lesion detection in nondense breasts, DBT images have been shown to be unaffected by lesion size and breast density.

Informed consent

Written informed consent was waived by the Scientific Committee

Ethical approval

Institutional Review Board approval (dated 2020) was obtained

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Nil.

Conflicts of interest

There are no conflicts of interest.

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