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Research Article

Diagnostic Accuracy of Full-Field Digital Mammography and Digital Breast Tomosynthesis in the Evaluation of Breast Lesions

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Abstract

Aim/Objectives: This study aimed to evaluate the diagnostic accuracy of full-field digital mammography (FFDM) and digital breast tomosynthesis (DBT) in detecting and characterizing the lesions. Also, we compared both modalities in detecting breast lesions.

Methods: A prospective study was conducted from January 2021 to June 2022 on 76 patients. All of them underwent FFDM, DBT, and ultrasonography (USG), and the features of breast lesions were characterized based on the BIRADS followed by histopathological confirmation.

Results: This study found that DBT (97.3%) was more accurate than FFDM (88.4%) in detecting breast lesions and is superior to FFDM when used alone or as an adjunctive tool for FFDM. The sensitivity of DBT vs FFDM (100% vs 92%) and DBT +FFDM vs FFDM (100% vs 92%) was relatively higher. Also, the specificity of DBT vs FFDM was 91.4% vs 76.7% and FFDM+DBT vs FFDM was 89.8% vs 76.7%.

The individual characteristics of breast lesions with the highest sensitivity were spiculations, lobulations, and architectural distortion being 100% for all on DBT and 90.9%, 88%, and 80.8% on FFDM respectively. They also showed high specificity of 96% for spiculations and architectural distortion, 90% for lobulations on DBT and 90% for spiculations, 50% for lobulations, and 84.3% for architectural distortion on FFDM. Calcifications showed high sensitivity of 95.2% on DBT. The features favoring malignancy on DBT and FFDM were spiculated margins, architectural distortion, microlobulations, microcalcifications, irregularly shaped lesions with irregular margins, and also, >2cm size of the lesion. With the addition of DBT to FFDM, 14 out of 76 lesions had shown up gradation on BIRADS.

Conclusion: The performance of DBT was significantly higher for the detection and characterization of breast lesions. Evaluation of the features of breast lesions on DBT can help to identify the malignant and benign potential of the lesions. The addition of DBT as a screening tool can decrease false positives and recall rates as well.

Keywords: Digital Breast Tomosynthesis; Digital Mammography; Breast Lesions; BIRADS; Breast Cancer

Abbreviations

BIRADS: Breast Imaging Reporting Data System; CC: Cranio-Caudal; CT: Computed Tomography; DBT: Digital Breast Tomosynthesis; FFDM: Full Field Digital Mammography; FNAC: Fine Needle Aspiration Cytology; HPE: Histopathological Examination; MLO: Medio-Lateral-Oblique; MRI: Magnetic Resonance Imaging; NPV: Negative Predictive Value; PPV: Positive Predictive Value; ROC: Receiver Operating Characteristic Curve; USG: Ultrasonography

Introduction

Breast cancer is one of the leading cancers in females worldwide. Over the last 10 years, breast cancer has been increasing and is way ahead of cervical cancer, according to GLOBACON 2012 [1]. Breast cancer represents 1.67 million new cancers diagnosed in 2012 with the incidence in Indian women being high as 25.8 per 100,000 women and mortality 12.7 per 100,000 women [2]. The way to ensure the declining rates of breast cancer-related deaths should be early detection. In addition to this differentiation of benign lesions from that of malignant lesions also plays an important role in the early and appropriate management of patients.

The doubling time for breast cancer varies from 23-209 days with an average of 100 days, being compatible that the average breast cancer is present for 6 to 8 years before it reaches the size of 1 cm which is palpable, which has been first reported by Gershon-Cohen and his associates [5]. Hence regular screening is the way to detect non-palpable lesions in the early stage and to prevent cancer-related deaths and morbidity.

Full Field Digital Mammography (FFDM), Digital Breast Tomosynthesis (DBT), Ultrasonography (USG), Computed tomography (CT), and Magnetic resonance imaging (MRI) are the widely accepted modalities in detecting breast lesions [4].

Screening mammography is the most important and widely used tool for breast cancer and it has been demonstrated to reduce the rate of death from breast cancer among the age group of 40 years and above [1]. FFDM is used as a screening tool for the early detection of breast lesions and breast cancers and is a widely accepted practice in many countries. It detects masses, calcifications, architectural distortion, and asymmetry, and helps in grading breast masses according to Breast Imaging Reporting and Data System (BIRADS) score. However, the sensitivity of FFDM is limited by the overlapping tissues which obscures the masses and other important structures [6]. This has led to the advancement in imaging techniques and the development of DBT.

DBT is a modification of the FFDM unit and uses an X-ray tube that moves in an arc around the breast to capture multiple images. The advantages of DBT over FFDM are the manipulation of images for accurate detection of lesions, easier storage of films, and the examination performed quickly [6]. DBT outdoes mammography, providing the advantage of being sensitive to find abnormalities and specific enough to separate the abnormality from the overlying tissues, allowing to see subtle masses and architectural distortion, increasing the ability to detect abnormalities and decreasing call-back rates. The better visibility of lesions on DBT or FFDM is due to the relative difference in the density of the lesion as compared to the surrounding breast tissue [4]. The negative predictive value with the combined use of mammography and Sonomammography in the detection of the breast lesions was estimated to be near 100% with higher sensitivity and specificity values and aiding in better characterization of the lesions [7]. The utility of DBT in screening and diagnosing is still under investigation.

USG plays a key role in differentiating cystic and solid masses. It is useful in the evaluation of abscesses, masses that are not completely evaluable with mammography, in young patients [susceptible to radiation damage], and palpable masses that are not visible in radiographically dense breasts. Cytological or pathological correlation is needed in suspicious cases of breast masses to ensure malignant or benign etiology. With this background, this study was aimed to evaluate the accuracy of FFDM and DBT in differentiating benign and malignant breast lesions with a sonomammogram as a supporting modality and confirmation with a histopathological diagnosis for suspicious cases.

Materials and Methods

This study is a hospital-based prospective observational study conducted on patients who were referred to the Department of Radiodiagnosis with clinical suspicion of breast lesions and also for screening purposes between January 2021 to June 2022.

Ethical clearance has been obtained from the Institutional Ethical Committee, Approval number: 117/2019-20. The purpose of the research was explained to the participants. Once verbal

consent was understood and agreed upon, a written form was given. The individuals who gave consent were enrolled in this study.

Pregnant and lactating women, patients with breast implants, open wounds, recent biopsies, and the ones who are already known cases of malignancy were excluded from our study. After satisfying the inclusion and exclusion criteria, the patients underwent FFDM, DBT, and USG as a part of the protocol followed in our hospital. The study included 76 patients who had lesions in the breast detected on mammography. Based on the mammography features, the breast lesions were categorized into benign and malignant lesions and were assigned a BIRADS score. All the breast lesions which have undergone FNAC or biopsy were considered. The findings obtained in FFDM, DBT, and USG in detecting and evaluating the breast lesions were compared and the data was analyzed.

SPSS (Statistical Package for Social Sciences) software version 25 was used for data analysis. Qualitative variables were presented in the form of numbers and percentages. Mean, standard deviation, and confidence interval are used to document quantitative variables. The sensitivity and specificity of FFDM, as well as DBT, were evaluated and documented. $P < 0.05$ will be considered statistically significant.

Results

This study included 76 patients who had breast lesions and undergone DBT, FFDM, and USG examination of the breast followed by FNAC/True cut biopsy with histopathology confirmation. 64.4% (49 cases) of the patients in our study were found to have benign lesions and 35.6% (27 cases) had malignant lesions.

The age range of the patients included in our study was between 29 -75 years with a mean age of 53.70 ± 10.20. The mean age for benign lesions was 48.5 years and for malignant lesions was 55.1 years. Only one patient with malignant lesion was observed to be under < 40 years and 2 patients with benign lesions were seen at > 70 years.

In our study, most common presenting symptom was lump in the breast which was observed in 48.7% of the patients. Among them 30.6% had benign and 81.4% had malignant breast lesions. The second most common presenting symptom was pain (14%) followed by nipple discharge (3%). 25 patients had come for screening mammography (Figure 1).

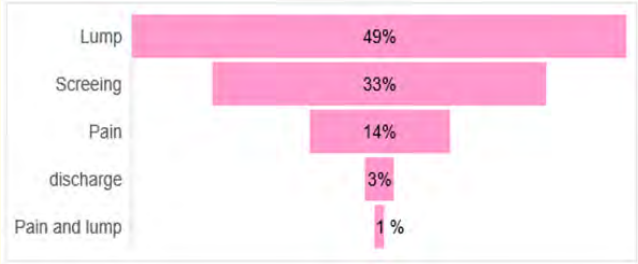

Figure 1: Bar chart showing the distribution of patients according to complaints.

The most common location observed for both benign and the malignant lesions in our study on both DBT and FFDM were the upper outer quadrant. The second common location for the benign lesions on DBT and FFDM was the lower inner quadrant and for the malignant lesions was the lower outer quadrant (Figure 2).

Figure 2: Bar chart showing the location of the breast lesions.

In the study out of 76 breast lesions, only 2 lesions were found to be in the retro-areolar region. Both lesions were detected on DBT (7.4%) out of which only 1 lesion was picked up by FFDM (3.7%). Both these were proven to be malignant lesions on DBT and HPE.

Out of 76 breast lesions in our study, 74 lesions were detected on DBT with an accuracy rate of 97.3%, and 68 lesions were detected on FFDM with an accuracy of 88.4% (Table 1).

	Present	Absent	Total	Accuracy [%]
DBT	74	2	76	97.3
FFDM	68	8	76	88.4

Table 1: Accuracy of DBT vs FFDM in identifying breast lesions.

The features favoring benign lesions in our study were the absence of speculations [89.7% in FFDM and in DBT 91.8%] and architectural distortion [85.7% in FFDM vs. in DBT 91.8%], presence of smooth margins [FFDM vs. DBT were 71.4% vs. 77.5%], presence of round [FFDM vs. DBT were 41% vs. 40.8%] and oval shape of the lesion [FFDM vs. DBT ~ 38.7% vs. 48.9%], less than 1 cm of the size of the lesion [FFDM vs. DBT ~ 36.7% vs. 45.8%] and presence of macrolobulations [FFDM vs DBT ~ 14.2% vs 16.3%] and macrocalcifications [FFDM vs DBT ~ 10.2% vs 16.3%] (Table 2).

In our study it was observed that the features which were more seen in malignant lesions were the presence of spiculations [FFDM vs DBT ~ 81.4% vs 88.8%] followed by architectural distortion [FFDM vs DBT ~ 88.5% vs 81.4%] and the size of the lesion more than 2 cm [FFDM vs DBT ~ 63% vs 81%]. Also, the other features which favored malignancy were the irregular margins of the lesion ([FFDM vs DBT ~ 55.6% vs 66.6%], irregular shape [FFDM vs DBT ~ 51.8% vs 56.5%] of the lesion, microcalcifications [FFDM vs DBT ~ 40.7% vs 56.5%], and microlobulations [FFDM vs DBT ~ 40.7% vs 52.8%] (Table 2).

Characteristics of lesion		**HPE**					
	Benign		**Malignant**		**P value**		
	FFDM N (%)	**DBT N (%)**	**FFDM N (%)**	**DBT N (%)**	**FFDM**	**DBT**	
Location	Upper outer	21 (42.8)	20 (40.8	11 (40.7	13 (48.1	0.27 NS	0.09 NS
	Upper inner	7 (14.2)	7 (14.2)	4 (14.8)	4 (14.8)		
	Lower outer	8 (16.3)	4 (8.1)	4 (14.8)	9 (33.3)		
	Lower inner	9 (18.3)	12 (24.4	3 (11.1)	3 (11.1)		
	Retroareolar	0 (0)	0	1(3.7)	2 (7.4)		
Size	< 1cm	18 (36.7)	22 (45.8)	1 (3.7)	2 (7.4)	0.00* SS	0.00* SS
	1-2cm	14 (28.5)	20 (42.0)	5 (18.5)	3 (11.1)		
	>2 cm	6 (12.2)	6 (12.2)	17 (63.0)	22 (81.0)		
Shape	Round	20 (41.0)	20 (40.8)	4 (14.8)	3 (12.1)	0.00* SS	0.00* SS
	Oval	19 (38.7)	24 (48.9)	5 (18.5)	8 (29.6)		
	Irregular	5 (10.2)	4 (8.1)	14 (51.8)	15 (56.5)		
Density	Iso	31(63.2)	32 (65.3)	13 (48.1)	15 (56.5)	0.34 NS	0.13 NS
	Hyper	12 (24.4%)	12 (24.4)	12 (44.4)	13 (48.0)		
	Hypo	1 (2.0)	2 (4.2)	0 (0.0)	0 (0)		
Margins	Regular	35 (71.4)	38 (77.5)	6 (22.2)	9 (33.3)	0.00* SS	0.00* SS
	Irregular	7 (14.2)	11 (22.4)	15 (55.6)	18 (66.6)		
Spiculations	Present	5 (10.2)	4 (8.1)	22 (81.4)	24 (88.8)	0.00* SS	0.00* SS
	Absent	44 (89.7)	45 (91.8)	5 (18.5)	3 (11.1)		
Lobulations	Micro	2 (4.0%)	2 (4.2%)	11 (40.7)	14 (52.8)	0.00* SS	0.00* SS
	Macro	7 (14.2%)	8 (16.3)	0 (0.0)	1 (3.7)		
Calcifications	Micro	3 (6.2)	2 (4.2)	11 (40.7)	15 (56.5)	0.00* SS	0.00* SS
	Macro	5 (10.2)	8 (16.3)	2 (7.0)	1 (3.7)		
	Rod	1 (2.0)	1(2.0)	2 (7.0)	2 (7.4)		
	Group	1 (2.0)	1 (2.0)	5 (18.5)	4 (14.8)		
	Pleomorphic	0 (0)	0 (0)	1 (3.7)	2 (7.4)		
Architectural distortion	Present	7 (14.2)	4 (15.3)	24 (88.5)	22 (81.4)	0.00* SS	0.00* SS
	Absent	42 (85.7)	45 (91.8)	3 (11.1)	5 (18.5)		
Chi square test;* SS- Statistically significant, p<0.05, NS- statistically not significant							

Table 2: Characteristics of the lesion in favoring benign or malignant nature.

In our study characteristics like margins of the lesions and calcifications within the lesions were appreciated more on DBT than FFDM. This difference was proven statistically significant as well. The other features like, lesion location, shape, density, spiculations, lobulations, architectural distortion and extension of the lesion into surrounding structures and the lymph nodes were almost equally determined on both FFDM and DBT.

In 14 patients the BIRADS was been upgraded based on DBT features to BIRADS 2 in 5 patients, BIRADS 3 in 3 patients, BIRADS 4a in 4 patients, BIRADS 4c and 5 in one patient each. This difference was proven to be statistically significant. In addition, only 4% of the patients were required to go for further investigation of breast following DBT whereas it was of 22% following FFDM (Table 3, Figure 3).

Characteristics of lesion		FFDM	DBT	P value
Extension	Nipple	2 (2.6%)	4 (5.3%)	1.000 NS
	Retroareolar	2 (2.6%)	1 (1.3%)	0.84 NS
	Retromammary	1 (1.3%)	2 (2.6%)	
	Skin	1 (1.3%)	1 (1.3%)	1.000 NS
	Subcutaneous	4 (5.3%)	4 (5.3%)	1.000 NS
	Muscle	6 (7.9%)	7 (9.2%)	0.77 NS
	Cooper's ligaments	7 (9.2%)	12 (15.8%)	0.22 NS
Lymph nodes	Present	12 (15.8%)	12 (15.8%)	1.00 NS
	Absent	64 (84.2%)	64 (84.2%)	
BIRADS	0	17 (22.2%)	3 (3.9%)	0.03 *SS
	2	18 (23.9%)	23 (30.3%)	
	3	15 (20.1%)	18 (23.7%)	
	4a	4 (5.2%)	8 (10.5%)	
	4b	6 (7.9%)	6 (7.9%)	
	4c	3 (3.9%)	4 (5.3%)	
	5	13 (17.1%)	14 (18.4%)	
Total		76 (100%)	76 (100%)	
Chi square test;* SS- Statistically significant, p<0.05, NS- statistically not significant				

Table 3: Comparison of extension of the lesion and BIRADS scoring in both the groups.

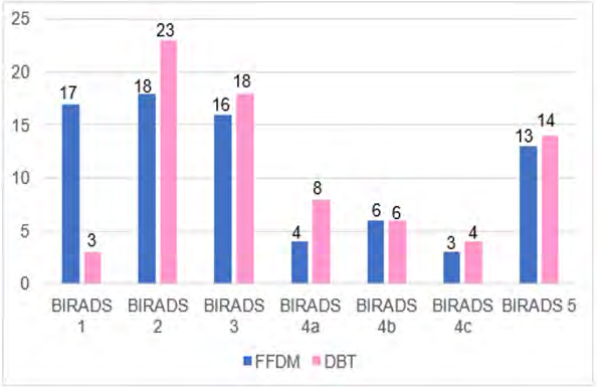

Figure 3: Bar diagram showing BIRADS score on FFDM and DBT.

In our study, considering all the features to characterize a lesion detected on DBT and FFDM, the most sensitive feature was spiculations with sensitivity and specificity were 80% and 90.2% on FFDM and 100% and 96% for DBT respectively, architectural distortion, the sensitivity was 88% on FFDM and 100% on DBT with a specificity of 84.3% on FFDM and 96% on DBT. For the other features like lobulations, the sensitivity was 90.9% on FFDM and 100% for DBT, and the specificity of 50% on FFDM and 90% on DBT. Taking calcifications as the next feature the sensitivity on FFDM and DBT were 72.2% and 95.2% respectively with a specificity of 54.5% on FFDM and 73.3% on DBT. Lastly, the margins were having a sensitivity of 69.5% on FFDM and 84% on DBT with a specificity of 81.4% on FFDM and 89.8% on DBT (Table 4).

Characteristics of lesion	Sensitivity		Specificity		PPV		NPV	
	FFDM	DBT	FFDM	DBT	FFDM	DBT	FFDM	DBT
Size	73.9%	81.4%	84.2%	87.5%	73.9%	78.5%	84.2%	89.3%
Shape	73.6%	78.9%	81.2%	90.2%	60.8%	60.7%	88.4%	91.6%
Margins	69.5%	84%	81.4%	89.8%	66.6%	80.77%	83.3%	91.67%
Spiculations	80%	100%	90.2%	96%	80%	92.59%	90.2%	100%
Lobulations	90.9%	100%	50%	90%	71.4%	91.6%	80%	100%
Calcifications	72.2%	95.2%	54.5%	73.3%	72.2%	83.3%	54.5%	91.6%
Architectural distortion	88%	100%	84.3%	96%	73.3%	92.59%	93.4%	100%

Table 4: Comparison of sensitivity, specificity, and predictive values of FFDM and DBT in relation to every feature for characterizing the lesion.

The sensitivity and specificity of the DBT in detecting the malignant and benign lesions considering HPE as the gold standard were 100% and 91.4%. Whereas sensitivity and specificity for FFDM were 92% and 76.6%. The PPV for DBT was 87.1% and for FFDM it was 69.7% and NPV for DBT 100% vs FFDM 94.2% (Table 5).

In diagnosing breast lesions, our study found that DBT was superior to FFDM when used alone or as an adjunctive tool for FFDM with a higher accuracy rate of 93.3% compared to FFDM (82.3%) and FFDM + DBT (92.1%) (Table 5).

Combining FFDM and DBT, the sensitivity and NPV was similar to that of DBT. The sensitivity of the combination of both modalities (100%) was higher than FFDM (92%) alone (Table 5).

The specificity was higher in DBT (91.4%) alone than in the combined FFDM and DBT (89.8%) However this combined impact had a higher specificity (89.8%) than FFDM alone (76.7%) (Table 5).

The PPV in the combination of FFDM and DBT (84.3%) shows an increase in comparison to FFDM alone (69.7%) while remaining less in comparison with DBT alone (87.1%) (Table 5, Figure 4).

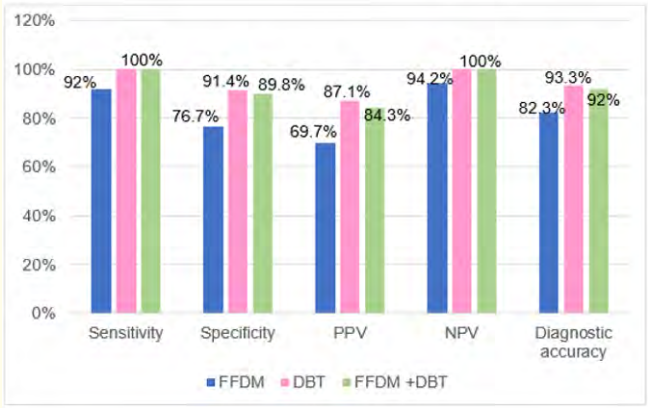

Figure 4: Bar diagram showing sensitivity and specificity of FFDM, DBT, and combination.

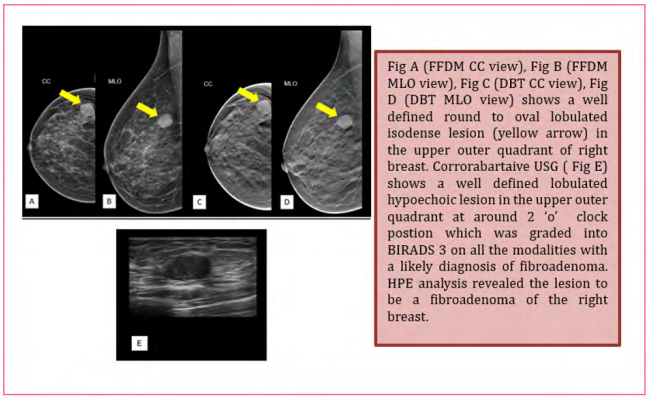

Figure 5: BIRADS 3 lesion on DBT, FFDM, and USG as Fibroadenoma.

Discussion

Breast cancer is one of the leading causes of mortality in women [1]. Detecting the breast lesion and identifying the malignant features of the breast mass at a very early stage are very important

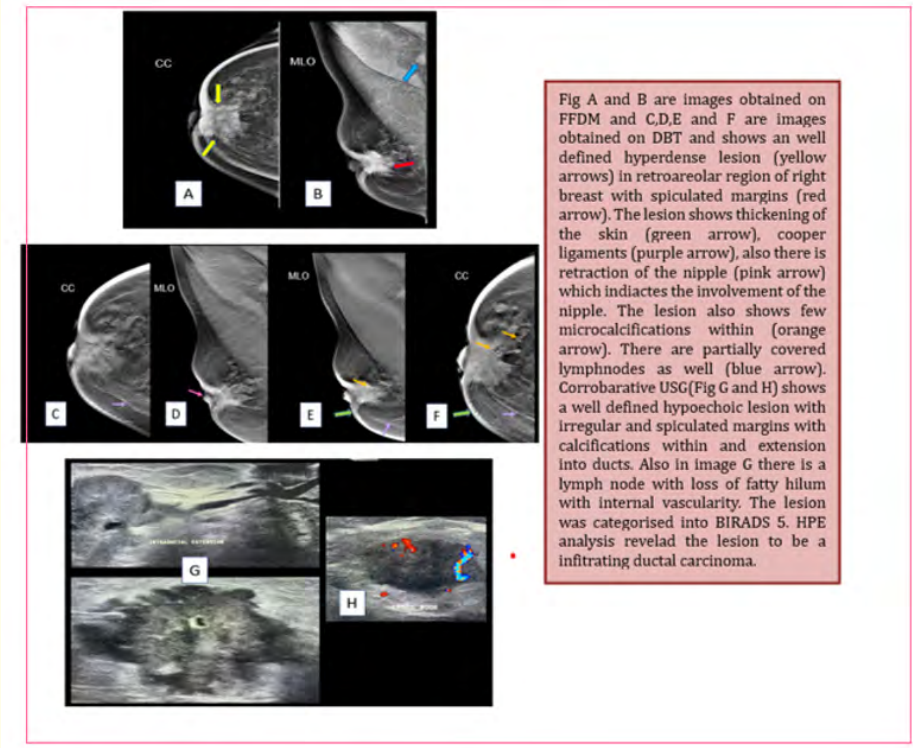

Figure 6: BIRADS 5 lesion with all features favoring malignancy which was HPE proven as Infiltrating ductal carcinoma.

Modality	Sensitivity	Specificity	PPV	NPV	Diagnostic accuracy
FFDM	92%	76.7%	69.7%	94.2%	82.3%
DBT	100%	91.4%	87.1%	100%	93.3%
Combination of FFDM and DBT	100%	89.8%	84.3%	100%	92.1%

Table 5: Comparison of added effect of FFDM and DBT with the individual effect of FFDM and DBT in determining breast lesions along with sensitivity and specificity and predictive values.

to reduce mortality and complications. Mammography is the widely used imaging modality both for diagnosing and screening breast lesions. FFDM and DBT are the advanced mammographic techniques introduced in the recent past. This study was conducted with the main purpose of evaluating the diagnostic accuracy of the FFDM and DBT in breast lesions thereby identifying the better diagnostic tool for a routine imaging investigation. The 76 patients included in the study underwent FFDM, DBT, and USG as a part of hospital protocol and who found to have unilateral, solitary breast masses. The demographic features of the patients and morphological features of the lesions were recorded. The breast lesions were categorized based on morphological features with histopathological confirmation. The total benign masses in our study were 49 and malignant lesions were 27. The most common benign lesion encountered in our study was fibroadenoma (26%) and the malignant lesion was infiltrating ductal carcinoma (13.1%).

Tumour type	N/%
Fibroadenoma	20 (26%)
Cyst	16 (21%)
Infiltrating ductal carcinoma	10 (13.1%)
Invasive carcinoma	6 (7.8%)
Papilloma	4 (5.2%)
Duct ectasia	3 (4%)
Fibrocystic disease	3 (4%)
Invasive lobular carcinoma	3 (4%)
Nonspecific infiltrating ductal carcinoma	3 (4%)
Invasive medullary ca	2 (2.6%)
Ductal carcinoma *in situ*	1 (1.3%)
Invasive papillary ca	1 (1.3%)
Fat necrosis	1(1.3%)
Fibroadematoid hyperplasia	1(1.3%)
Granulomatous mastitis	1 (1.3%)
Atypical ductal hyperplasia	1 (1.3%)
TOTAL	76 (100%)

Table 6: HPE diagnosis of all the breast lesions in our study.

In a study conducted by Ingvar Andersson., *et al*. the mean age of the patients with breast lesions was 59 years [8]. This was similar to our study where the mean age of the patients with breast lesions was 53.70 ± 10.20.

In the current study majority (49%) of the subjects presented with a lump as the most common presenting feature followed by breast pain (14), discharge [3%] pain with a lump in 1%. Also, we found that the majority of the lesions were in the left breast with the upper outer quadrant being the most susceptible to the pathologies. Nikki Mishra., *et al*. in their study found similar findings of lump being the most common complaint, with the lesions involving the left breast's upper outer quadrant. And also they found breast pain is the second most common presenting symptom and screening is the second most common reason for breast investigation [9].

Accuracy of detection of breast lesions on DBT and FFDM

In our study 8 lesions were missed on FFDM which were detected on DBT with an accuracy rate of DBT of 97.3% and for FFDM it was 88.4%. Rana Naeim., *et al*. found that the accuracy rate of DBT in their study was 97.7% which was nearly the same in our study [10]. T M Svanh., *et al*. stated that the diagnostic accuracy of DBT is significantly better than FFDM and as in their study, 10 more lesions were diagnosed on DBT which were absent in FFDM [11]. Singla., *et al*. stated the performance of DBT was better than FFDM and in their study, new lesions were seen on DBT in 8 cases which were missed by FFDM [1].

Characteristics of the breast lesions on FFDM and DBT

The imaging characterization of the breast lesions into benign and malignant depends on the morphological characteristics of the lesions.

Size: In our study majority of the malignant lesions were found to be of larger size, measuring more than 2 cm [81%], and the majority [87%] of the benign lesions ranged from 0.1 – 2 cm. However, a few [7.4%] lesions of <1 cm which was malignant were picked up by DBT and were missed on FFDM. There was an increased risk of malignancy with an increase in the size of the lesion [12]. DBT has a better detection rate of lesions of size < 1 cm [13]. Chae., *et al*, in their study, found that the sensitivity of the lesions <2cm was 73.9% on FFDM and 84% on DBT [6]. In our study, we found that the sensitivity of FFDM and DBT for the size of the lesion ranging from 0-5cm was 73.9% and 81.4% respectively.

Shape

The majority [56%] of the malignant lesions in our study were having irregular shapes while the benign lesions showed round to oval shapes. Jun Min Changa., *et al*. retrospectively observed the diagnostic performance of DBT and FFDM and stated that the benign lesions showed round to oval-shaped lesions while the majority of the malignant lesions were having an irregular shape which was similar to our study [14].

Density of the lesion

In our study majority of the patients had isodense breast lesions followed by hyperdense lesions both on FFDM and DBT. However, the majority of the malignant lesions were isodense comprising 48.1% in FFDM and 56.2% on DBT. Also, the majority of the benign lesions were also isodense on both FFDM and DBT**.** Samia Abeolnour., *et al*. conducted a study on breast lesions which stated that the isodense lesions were favoring benign lesions on both FFDM and DBT while hyperdense lesions were favoring malignant lesions on both FFDM and DBT [15]. This was different in our study

probably due to the relatively younger age group of patients with dense breast parenchyma. And also, the density of the lesion is relative and subjective. In a study done on 119 breast lesions by Jun Min Changa., *et al*. the majority of the lesions were of iso dense followed by hyperdense lesions with the number of benign and malignant cases being nearly equal [14].

Margins

The majority [77.5%] of the benign lesions in our study had regular margins followed by 22.4% having irregular or indistinct margins. Most [67%] of the malignant lesions showed irregular or indistinct margins with 33.3% having regular margins in our study**.** Lamiaa Mohamed Bassam Hashem., *et al*. concluded in their study that 78.6% of the benign lesions had well-circumscribed regular margins on DBT [16]. The lesion having an indistinct margin indicates a lack of demarcation with the surrounding tissue which raises the suspicion of the malignant nature of the lesion with infiltration into the adjacent tissues. Obscured margins are different from indistinct margins and they are a result of the adjacent tissues covering the lesion. Amer H.A., *et al*. found that DBT has a higher sensitivity in determining the margins of the lesions [17]. In our study also we found DBT (84%) has higher sensitivity for margins than FFDM (69.5%).

Calcifications

Microcalcifications were found to be common [56.5%] in malignant lesions and macrocalcifications [16.3%] in benign lesions in our study on both diagnostic methods. A few of the malignant lesions showed rod [7.4%], grouped [14.8%], and pleomorphic [7.4%] patterns of calcifications as well. The accumulations of the mucin secretions produced by the lesion and endoluminal necrotic material due to cell death within the duct might calcify and take a shape such as round, grouped microcalcifications [18]. At times microcalcifications can be the only sign of malignancy with few of them showing the characteristic features of malignancy like the linear rod, branching, and punctuate calcifications [19]. Few of these were seen in our study. In our study, the sensitivity for calcifications was on the higher side on DBT (95.2%) than FFDM (72.2%) which was similar to a study conducted by Juntao Li., *et al*. who had a sensitivity of 90% on DBT and 79.5% on FFDM for calcifications [20].

Lobulations

Lobulations are of two types: Micro and macro. Micro lobulations are the cluster of small lobules seen along the surface of the lesions with a likelihood for malignant etiology [21]. In our study, the presence of lobulations was most sensitive for determining benign/malignant nature of the lesions (100% on DBT and 90.9% on FFDM).

Spiculations and architectural distortion

In our study both spiculations and perilesional architectural distortion were found to be most sensitive (100%) on DBT for detection of the malignant lesions. Benign lesions may also show spiculations due to fibrous tissue, lipid-filled spaces surrounded by histiocytes, or sclerotic stroma. The spicules of malignant lesions are due to tumour infiltration, desmoplastic response, or periductal fibrosis [22]. Mehul P. Sampat., *et al*. stated that architectural distortion is the third most common feature on mammography with 48-60% of the lesions showing architectural distortion were HPE proven to be malignant [23]. In our study 80% of the lesions with architectural distortion were malignant.

On comparison of BIRADS in our study, 14 cases have shown an upgradation of the score when DBT was combined with FFDM. In these 14 patients, the BIRADS was been upgraded based on features on DBT, to BIRADS 2 in 5 patients, BIRADS 3 in 3 patients, BIRADS 4a in 4 patients, BIRADS 4c and 5 in one patient each. Singla., *et al*. conducted a study on 100 patients and showed that 14 cases were upgraded and 31 cases were downgraded on the combined impact of DBT and FFDM on BIRADS scoring [1].

Sensitivity, specificity, PPV, and NPV of DBT and FFDM in detecting benign and malignant lesions.

Our study showed increased sensitivity (92% vs 100% - FFDM vs DBT), specificity (76.7% vs 91.4% - FFDM vs DBT), positive predictive (69.7% vs 86.1% - FFDM vs DBT), and negative predictive values (94.2% vs 100% - FFDM vs DBT) of DBT over FFDM [table]. Juntao Li., *et al*. showed almost similar results with a sensitivity for DBT of 96.9% and FFDM of 88.8%, specificity for DBT being 90.5% and FFDM being 75.2% with PPV of 62% for FFDM and 77.8% for DBT and NPV of 93.6 for FFDM and 96.8% for DBT [20]. Similar higher values of DBT over FFDM for the sensitivity and specificity were observed in several studies and decreased recall rates [15,24].

Sensitivity, specificity, PPV and NPV of combined DBT and FFDM in detecting benign and malignant lesions

The addition of DBT to FFDM had been shown to characterize the lesions accurately with an increase in cancer detection rates [25]. Also, several studies showed that there has been increasing in the sensitivity, specificity, PPV, and NPV with a decrease in the false positive rates when DBT was used as an adjunctive tool to FFDM [1]. In the current study, the sensitivity of FFDM vs FFDM + DBT was 92% vs 100% with a specificity of FFDM vs FFDM +DBT in detecting breast lesions was 76% and 91.5% respectively [table]. Samia showed similar results as in our study [15].

The sensitivity of DBT alone in our study was 100%. And also in our study the Sensitivity, specificity, and predictive values of DBT alone were higher than the combined effect of DBT and FFDM [Table]. No similar analysis and observation were reported in other studies as far as our knowledge is concerned.

Conclusion

The performance of DBT was significantly higher for the detection and characterization of the different breast abnormalities. Also, the sensitivity and specificity of DBT was higher than FFDM when used alone or as an addition to FFDM. This evaluation of the features of breast lesions on DBT can help to identify the malignant and benign potential of the lesions. The addition of DBT as a screening tool can decrease the false positives and the recall rates as well.

Conflict of Interest

None.

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