ORIGINAL ARTICLE

European Journal of BREAST HEALTH

DOI: 10.4274/ejbh.galenos.2026.2026-2-5
Eur J Breast Health 2026;22(4):407-416

Rethinking Preoperative MRI in Early Breast Cancer: Who Truly Benefits?

Burak Çelik[1], Sevcan Koç[1], Yusuf Hüseyin Berrak[2], Gizem Yaşa[2], Medine Böge[3], Ece Dilege[1]

[1]Department of General Surgery, Koç University School of Medicine, İstanbul, Türkiye
[2]Koç University School of Medicine, İstanbul, Türkiye
[3]Department of Radiology, Koç University School of Medicine, İstanbul, Türkiye

ABSTRACT

Objective: In light of existing evidence on the use of preoperative magnetic resonance imaging (MRI) in breast cancer (BC) patients undergoing upfront surgery, this study evaluated whether adding MRI to conventional imaging improved the definition of disease extent, subsequent surgical management, and survival outcomes.

Materials and Methods: This retrospective study reviewed patients with stage I–II BC who underwent upfront surgery between January 2014 and September 2025. Patients were divided into an MRI cohort and a non-MRI cohort, and clinicopathologic characteristics, the diagnostic performance of ultrasound and MRI in detecting additional malignant foci, the type of surgery, and recurrence during follow-up were compared.

Results: A total of 261 patients were included, with 149 assigned to the MRI cohort and 112 to the non-MRI cohort. Patients in the MRI group were younger, more often premenopausal, and more likely to have dense breasts. MRI detected additional malignant foci, including ductal carcinoma *in situ* and invasive carcinoma, in 38 patients of 149 (25.48%). MRI findings led to the conversion from planned lumpectomy to mastectomy in 16/149 patients (10.7%), mainly due to the detection of new multicentric disease. With a median follow-up of 30–36 months, there has been no significant difference between the two cohorts concerning local recurrence ($p>0.99$) or distant metastasis ($p = 0.39$).

Conclusion: Preoperative MRI occasionally changed surgical plans but offered no diagnostic advantage over standard imaging, supporting its selective rather than routine use in upfront BC surgery.

Keywords: Breast MRI; early breast cancer; surgical management; ultrasound

KEY POINTS

- Preoperative magnetic resonance imaging (MRI) detected additional malignant or ductal carcinoma *in situ* foci in a subset of patients, but this did not translate into lower re-excision rates or improved early oncologic outcomes.
- Although MRI showed higher sensitivity than ultrasound for identifying malignant lesions, this diagnostic advantage did not reach statistical significance.
- These findings support a selective rather than routine use of preoperative MRI, particularly in patients with dense breasts or inconclusive conventional imaging.

Corresponding Author: Burak Çelik, MD;
E-mail: burakcelikgc@gmail.com **ORCID:** orcid.org/0000-0002-8626-7675
Received: 16.02.2026 **Accepted:** 22.04.2026 **Available Online Date:** 23.09.2026
Cite this article as: Çelik B, Koç S, Berrak YH, Yaşa G, Böge M, Dilege E. Rethinking preoperative MRI in early breast cancer: who truly benefits? Eur J Breast Health. 2026;22(4):407-416

Introduction

Breast cancer (BC) remains the most diagnosed cancer among women worldwide. According to recent United States Cancer Registry Data, most BC patients are diagnosed at an early stage, 66% of cases present as localized, and 25% are diagnosed at locally advanced stages. The five-year relative survival rate exceeds 99% for localized and 87% for locally advanced disease, reflecting the effectiveness of treatment in early-stage disease (1).

The high survival rates observed in early-stage BC are mainly attributable to breast-conserving surgery (BCS) with negative surgical margins followed by adjuvant irradiation. This approach has been shown to achieve outcomes equivalent to mastectomy (2). Historically, margin positivity after BCS has been reported to range from 17.5% to 59% in invasive lobular carcinoma and from 6.9% to 43% in invasive ductal carcinoma, which, depending on patient factors and preoperative assessment methods, could necessitate re-excision or even conversion to mastectomy (3). However, in contemporary practice and with standardized margin definitions, recent meta-analyses estimate that only 8–10% of BCS cases result in truly positive margins (4). Effective management of BC first requires determining the extent of disease within the breast and establishing an accurate diagnosis.

Current guidelines recommend mammography (MMG) and ultrasound (US) as standard imaging modalities. Magnetic resonance imaging (MRI) is recommended when standard imaging is uncertain and in specific clinical scenarios, such as familial BC associated with germline mutations, invasive lobular carcinoma, suspected multifocality or multicentricity, and in patients with breast implants (5, 6). It is known that MRI has a sensitivity of over 90% for invasive carcinoma and over 70% for ductal carcinoma *in situ* (DCIS) (7). Although breast MRI is currently not the first-line option in the diagnostic workup, accurate assessment of tumor size and extent is essential for optimal surgical planning in BC. Studies have demonstrated that MRI provides greater concordance with pathological tumor size than conventional imaging modalities (MMG and US), particularly in evaluating multifocal and multicentric disease. While US and MMG tend to underestimate tumor size, MRI has been shown to achieve greater accuracy, though it tends to overestimate in certain lesion types, such as non-mass enhancement (8, 9). In contrast to its high sensitivity, preoperative breast MRI has been associated with an increased likelihood of undergoing mastectomy, without reducing re-excision rates after positive margins, as shown in a large meta-analysis that predominantly included retrospective studies (10). However, in a more recent meta-analysis restricted to randomized controlled trials, mastectomy rates were numerically higher in the MRI group (15% *vs.* 10%), although this difference did not reach statistical significance (11).

In this study, we aimed to evaluate whether preoperative MRI, in addition to US, improved the detection of additional lesions or DCIS extension, altered surgical decision-making, and affected survival outcomes in BC treated with upfront surgery.

Materials and Methods

This was a retrospective analysis of imaging and pathology reports from patients with BC treated at the Breast Surgery Clinic of Koç University Hospital between January 2014 and September 2025. Eligible stage I–II BC patients, all of whom were treated with upfront surgery—were stratified by preoperative imaging into MRI (US + MMG + MRI) and no-MRI (US + MMG) cohorts for comparative analysis. The Koç University Institutional Review Board (approval no: 2024.262.IRB2.112, date: 09.07.2024) approved this study. BC staging was performed according to the 8th edition criteria of the American Joint Committee on Cancer (12). Data were gathered from various medical records, including operative notes, radiological findings, and pathology reports. All data were obtained by comparing imaging and pathology results.

Statistical Analysis

All statistical analyses were performed using SPSS version 26 (IBM Inc., Armonk, NY, USA). The normality of the data was assessed using the Kolmogorov-Smirnov test. Continuous variables are expressed as median [interquartile range (IQR)] or mean ± standard deviation, as appropriate based on the data distribution. Comparisons between two independent groups were performed using the Mann-Whitney U test for non-normally distributed variables. For comparisons among more than two groups, the Kruskal-Wallis test was used. Multivariable logistic regression analysis was performed to identify independent predictors of preoperative MRI use. Categorical variables are presented as frequencies and percentages and were compared using the Pearson's chi-square (χ^2) test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant.

MMG Protocol

All MMGs were acquired using a digital breast tomosynthesis (DBT) system (Selenia Dimensions, Hologic Inc., Bedford, MA, USA). Standard craniocaudal and mediolateral oblique (MLO) views were obtained, with MLO images acquired in combo mode incorporating DBT. For DBT, low-dose projections were captured over a 15° arc and reconstructed into 1-mm slices to improve visualization of overlapping breast structures. Exposure parameters were automatically adjusted according to breast

thickness and density. The average glandular dose ranged from 1.0 to 1.8 mGy for 2D imaging and from 1.5 to 2.2 mGy for DBT. All images were interpreted by an experienced breast radiologist, and breast density and abnormalities were categorized using the Breast Imaging Reporting and Data System (BI-RADS) criteria (13).

US Protocol

All patients underwent bilateral breast and axillary ultrasonographic examination using a Logiq S8 or Logiq E10S US machine (GE Healthcare, Milwaukee, WI, USA). These US units were equipped with high-frequency linear matrix array transducers ranging from 6 to 15 MHz (50-mm ML6-15 MHz). Examinations were performed by two experienced breast radiologists using a handheld US device. The scanning technique was standardized using radial and anti-radial approaches to systematically scan the entire breast and axillary regions. The breast was divided into quadrants, including the retroareolar region, and scanned clockwise. Any detected abnormalities were documented with their positions noted on a clock-face model, and the distance from the nipple was recorded. Each lesion was measured and categorized according to the BI-RADS (13).

MRI Protocol

All patients in the MRI group underwent multiparametric breast MRI, including DCE-MRI, using either a 1.5T (Siemens Aera, Siemens Healthineers GmbH, Erlangen, Germany) or 3.0T (Siemens Skyra, Siemens Healthineers AG, Forchheim, Germany) system. Examinations were performed in the prone position with a dedicated 16-channel breast coil. The protocol included axial T2-weighted fat-suppressed images and axial dynamic, fat-suppressed 3D T1-weighted gradient-echo sequences acquired before and after contrast injection. A total of six dynamic phases (one pre-contrast and five post-contrast) were obtained using a gradient-echo 3D technique (TR/TE: 4.7/1.8 ms; slice thickness: 1-mm; FOV: 320×320-mm; acquisition time: 60 s per phase). Diffusion-weighted imaging was performed with b-values of 50 and 800 s/mm² using SPAIR fat suppression. A gadolinium-based contrast agent (0.1 mmol/kg) was administered at 2–3 mL/s, followed by a saline flush. Subtraction and MIP images were generated automatically. Images were interpreted by experienced breast radiologists, and lesions were evaluated based on their morphological characteristics and kinetic enhancement patterns (types I–III). BI-RADS was used to classify the findings and guide clinical recommendations (13).

Results

A total of 261 patients were included in the study, divided into 149 in the MRI group and 112 in the non-MRI group. The characteristics of the patients, including breast and tumor features, treatment details, and follow-up outcomes, are shown in Table 1.The median (IQR) age was significantly lower in the MRI group than in the non-MRI group [51 (range 29–82) *vs.* 67 (range 35–94) years; $p<0.001$]. Nulliparity rates were similar between the two groups (21.4% *vs.* 17.8%; $p = 0.47$). The menopausal distribution differed significantly: premenopausal women were substantially more frequent in the MRI group (49.6% *vs.* 16.0%), whereas postmenopausal status predominated in the non-MRI group (50.4% *vs.* 84.0%; $p<0.001$). Use of oral contraceptives or hormone replacement therapy was higher among MRI patients (25.6% *vs.* 12.5%; $p = 0.048$). Regarding breast density, dense breast patterns (types C and D) were substantially more common in the MRI group (63.8% *vs.* 18.7%; $p<0.001$). A significant difference in tumor stage distribution was observed between the MRI and non-MRI groups ($p<0.05$). Most patients in the MRI group had T1 tumors (68.46%), whereas the proportion was lower in the non-MRI group (55.36%). Analysis of clinical stage revealed a higher proportion of stage I in the MRI group (57.7% *vs.* 58.03%). The histopathological subtype distribution also differed significantly, with invasive lobular carcinoma being more prevalent in the non-MRI group (16.1% *vs.* 6.7%; $p = 0.028$). There was no significant difference in immunohistochemical subtypes between groups (HR+/HER2– 89.9% *vs.* 90.2%; HER2+ 6.7% *vs.* 2.7%; triple-negative 3.4% *vs.* 7.1%; $p = 0.39$). Surgical type did not differ significantly between groups, with BCS performed in 67.1% of MRI patients and 68.8% of non-MRI patients ($p = 0.79$). Among those who underwent BCS, re-excision during the same operation was required in 65% of MRI and 72.7% of non-MRI cases, and second-stage re-excision was rare (0 *vs.* 1.3%; $p = 0.42$). The median follow-up was 30 months (0–113) in the MRI group and 36 months (0–130) in the non-MRI group ($p = 0.31$). During follow-up, locoregional recurrence occurred in one patient from each group one with areolar recurrence in the MRI group and one with axillary recurrence in the non-MRI group (0.7% *vs.* 0.9%; $p>0.99$), while distant metastasis was detected in two MRI (1.4%) and four non-MRI (3.6%) patients ($p = 0.39$).

Multivariable logistic regression analysis demonstrated that breast density was independently associated with preoperative MRI use ($p<0.001$), as shown in Table 2. Compared with patients with type A breast density, those with type C and type D breast density had significantly higher odds of undergoing MRI [odds ratio (OR): 7.31, 95% confidence interval (CI): 2.31–23.13, $p<0.001$; OR: 11.80, 95% CI: 2.00–69.57, $p = 0.006$, respectively]. Age, menopausal status, and tumor stage were not significantly associated with MRI use in this study.

As shown in Table 3, clinicopathologic characteristics were compared among patients with additional lesions detected on MRI but missed on US, classified as benign, DCIS, or malignant. Overall, no significant differences were identified between the groups, although a tendency toward younger age and a higher proportion of premenopausal women was observed in cases with DCIS foci.

Table 1. The characteristics of the patients who underwent or did not undergo preoperative breast MRI

	MRI group (*n* = 149)	Non-MRI group (*n* = 112)	*p*-value
Age (median)	51 (29–82)	67 (35–94)	<0.001[a]
Nulliparity	32 (21.4%)	20 (17.8%)	0.47[b]
Menopausal status			<0.001[b]
Premenopausal	74 (49.6%)	18 (16%)	
Postmenopausal	75 (50.4%)	94 (84%)	
OC-HRT			0.048[b]
Yes	38 (25.6%)	14 (12.5%)	
No	111 (74.4%)	98 (87.5%)	
Density of the breast			<0.001[b]
Type A	10 (6.7%)	28 (25%)	
Type B	44 (29.5%)	63 (56.2%)	
Type C	66 (44.3%)	19 (16.9%)	
Type D	29 (19.5%)	2 (1.78%)	
T stage			<0.05[b]
T1	102 (68.46%)	62 (55.36%)	
T2	45 (30.20%)	44 (39.29%)	
T3	2 (1.34%)	6 (5.36%)	
Clinical stage			0.042[b]
I	86 (57.7%)	65 (58.03%)	
II	63 (42.2%)	47 (41.96%)	
Histopathological sub-type			0.028[b]
IC (NST)/IDC	109 (73.15%)	76 (67.86%)	
ILC	10 (6.71%)	18 (16.07%)	
Mixed	6 (4.03%)	4 (3.57%)	
Other	24 (16.11%)	14 (12.5%)	
Immunohistochemical sub-type			0.39[b]
HR positive/HER2 negative	134 (89.93%)	101 (90.18%)	
HER2 positive	10 (6.71%)	3 (2.68%)	
Triple negative	5 (3.36%)	8 (7.14%)	
Type of surgery			0.79[b]
Breast conserving surgery	100 (67.11%)	77 (68.75%)	
Mastectomy	49 (32.89%)	35 (31.25%)	
Re-excision needed (in lumpectomy group)	*n* = 100	*n* = 77	0.42[b]
Intraoperatively	65 (65%)	56 (72.73%)	
Second surgery	0	1 (1.3%)	
Follow-up (months)	30 (0–113)	36 (0–130)	0.31[a]
Recurrence			
Locoregional	1 (0.71%)	1 (0.89%)	>0.99[c]
Distant metastasis	2 (1.42%)	4 (3.57%)	0.39[c]

[a]Mann-Whitney U test; [b]Pearson's chi-square (χ^2); [c]Fisher's exact test; T: Tumor; HR: Hormone receptor; MRI: Magnetic resonance imaging; IC: Invasive carcinoma; IDC: Invasive ductal carcinoma; NST: No special type; ILC: Invasive lobular carcinoma; OC: Oral contraceptive; HRT: Hormone replacement therapy; HER2: Human epidermal growth factor receptor 2

Table 2. Multivariable logistic regression analysis of factors associated with preoperative MRI use

	OR	95% CI	*p*-value
Age	0.96	0.92–1.01	0.119
Menopausal status (pre *vs.* post)	1.29	0.39–4.23	0.677
Breast density			<0.001
Type B *vs.* A	1.48	0.57–3.81	0.417
Type C *vs.* A	7.31	2.31–23.13	<0.001
Type D *vs.* A	11.80	2.00–69.57	0.006
T stage			0.492
T2 *vs.* T1	0.66	0.33–1.31	0.235
T3 *vs.* T1	0.76	0.05–11.07	0.841

Bold values indicate statistical significance ($p<0.05$). OR: Odds ratios; CI: Confidence intervals; T: Tumor; MRI: Magnetic resonance imaging

Among the 149 patients, preoperative MRI led to a change in surgical management from BCS to mastectomy in 16 (10.7%) cases. The individual surgical outcomes of these patients are detailed in Table 4 below (Figure 1). Among these 16 patients, the most common cause was multicentric disease (56.3%), followed by extensive or multifocal non-mass enhancement (25–31%), and, in a smaller proportion, tumor size >50% larger on MRI than on conventional imaging (12.5%).

Forty-nine mastectomy patients who were evaluated by both MRI and US were further analysed in Table 5. MRI demonstrated higher sensitivity, negative predictive value, and overall accuracy than US for detecting malignant lesions. Specifically, MRI achieved a sensitivity of 76.2% and an accuracy of 69.4%, whereas US achieved sensitivities of 54.5% and 59.2% and accuracies of 69.4% and 69.2%, respectively. Despite these numerical differences favoring MRI, the comparisons of sensitivity and overall diagnostic accuracy did not reach statistical significance ($p = 0.14$ and $p = 0.42$, respectively).

Discussion and Conclusion

Our results indicated that while preoperative MRI identified additional malignant foci, including DCIS and additional malignant tumors, and altered surgical management in around 11% of patients, it did not demonstrate a greaters overall diagnostic superiority compared to US, highlighting the need for a selective rather than routine use of MRI in BC treated with upfront surgery.

When comparing patients who underwent MRI with those who did not, several clinicopathologic differences were evident. Patients in the MRI group were generally younger than 50 years and, more likely to be premenopausal. They had higher breast density, consistent with the common practice of using MRI to improve lesion visualization in dense parenchyma. When US and MRI findings were compared with pathological results in patients who underwent mastectomy, MRI demonstrated higher sensitivity and accuracy in detecting malignant foci than US. In our cohort, additional lesions detected only on MRI included benign lesions in 6 (4.01%) patients, DCIS in 18 (12.08%) patients, and malignant invasive foci in 20 (13.4%) patients. Benign and DCIS foci were more frequently observed in younger, premenopausal women. This pattern suggests that MRI tends to reveal both benign and clinically significant lesions, some of which may not be

Table 3. Characteristics of patients according to MRI-detected additional lesion type (benign, malignant, or DCIS) missed on US

	Benign focus (*n* = 6/149)	DCIS focus (*n* = 18/149)	Malign focus (*n* = 20/149)	*p*-value
Age (median, range)	50.5 (37–72)	42 (35–63)	54.5 (35–72)	0.10[a]
Menopausal status				0.07[b]
Premenopausal	4 (66.7%)	14 (77.8%)	8 (40%)	
Postmenopausal	2 (33.3%)	4 (22.2%)	12 (60%)	
Density of the breast				0.42[c]
Type A	1 (16.7%)	0	1 (5%)	
Type B	1 (16.7%)	3 (16.7%)	6 (30%)	
Type C	3 (50%)	8 (44.4%)	10 (50%)	
Type D	1 (16.7%)	7 (38.9%)	3 (15%)	
Immunohistochemical type				0.65[b]
HR positive/HER2 negative	6 (100%)	16 (88.8%)	18 (90%)	
HER2 positive	0	2 (11.1%)	2 (10%)	
Triple negative	0	0	0	

[a]Kruskal-Wallis test; [b]Fisher's exact test; [c]Pearson's chi-square (χ^2); HR: Hormone receptor; US: Ultrasound; MRI: Magnetic resonance imaging; DCIS: Ductal carcinoma *in situ*; HER2: Human epidermal growth factor receptor 2

Table 4. Patients whose surgical management was changed by MRI findings

Patient	Age (years)	BD	US	MRI	Final pathology	Reasons for management change
Case 1	54	B	Irregular mass 12-mm + Irregular mass 10-mm + Irregular mass 4-mm	Irregular mass 16-mm, irregular mass 15-mm, irregular mass 12-mm, increased periareolar subcutaneous enhancement	Focus 1: IDC 25-mm, Focus 2: IDC 12-mm With DCIS 20%	>50% larger and extensive non-mass enhancement
Case 2	45	D	Irregular mass 5-mm	Irregular mass 7-mm, irregular mass 12-mm, irregular mass 4-mm	Focus 1: IDC 13-mm, Focus 2: IDC 8-mm With DCIS 10%	Multicentric
Case 3	44	B	Irregular mass 9.4-mm	Irregular mass 14-mm, irregular mass 8.5-mm, irregular mass 6-mm	Focus 1: ILC 19-mm, Focus 2: ILC 10-mm, Focus 3: ILC 7-mm, Focus 4: ILC 5-mm, Focus 5: ILC 5-mm	Multicentric
Case 4	57	B	Irregular mass 8.3-mm	Irregular mass 7-mm, irregular enhancing focus 25×8-mm	Focus 1: IC 10-mm (lobular 70%, ductal 30%) Focus 2: IDC 7-mm, Focus 3: IDC 3-mm With DCIS 10%	Multifocal and extensive non-mass enhancement
Case 5	49	C	Irregular mass 35-mm	Irregular mass 22-mm, irregular mass 4-mm, Ductal enhancement lateral to the lesion	IDC 22-mm With DCIS 10%	Multifocal and extensive non-mass enhancement
Case 6	63	C	Multiple lobulated lesions within a 31×5.5-mm area, the largest measuring 8×5-mm	Irregular mass 30-mm, irregular mass 20-mm, irregular mass 4-mm	Focus 1: IDC 30-mm, Focus 2: ILC 9-mm With DCIS 15%	Multifocal and multicentric
Case 7	44	C	Irregular mass 10-mm	Irregular mass 8-mm, ductal enhancement posterior to the lesion	ILC 10-mm, LCIS (pagetoid spread in ducts)	Non-mass extensive enhancement
Case 8	65	B	Regular mass 8-mm, complex breast cyst 11-mm, lobulated mass 14-mm	Regional enhancement from the upper quadrant into the lower inner and outer quadrants with scattered foci	45×38-mm DCIS with multiple invasive foci, the largest 10-m	Non-mass extensive enhancement
Case 9	41	D	Irregular mass 20-mm	Irregular mass 20-mm, architectural distortion 2.5 cm	IDC 20-mm With DCIS 60%	Extensive enhancement with distortion
Case 10	45	C	Irregular mass 8-mm	Irregular mass 8-mm, irregular mass 4-mm	IDC 6-mm With DCIS 95 %	Multicentric
Case 11	67	C	Irregular mass 18-mm, Irregular mass 15-mm, Irregular mass 10-mm	Irregular mass 20-mm, irregular mass 12-mm	Focus 1: IC 19-mm, Focus 2: IC 10-mm With DCIS 1%	Multicentric
Case 12	55	B	Irregular mass 20-mm, Irregular mass 13-mm	Irregular enhancing focus 50×35-mm, architectural distortion, Irregular mass 12.5-mm	IDC 52-mm With DCIS 5%	Multicentric and >50% Larger
Case 13	51	C	Irregular mass 16-mm, Irregular mass 8-mm	Irregular enhancing focus 30×10-mm, ductal enhancement anterior to the lesion	IDC 10-mm With DCIS 15%	Extensive non-mass enhancement
Case 14	75	B	Irregular mass 8.5-mm	Irregular mass 16-mm with additional multi-satellite nodules	ILC 12-mm	Multifocal/multicentric
Case 15	52	C	Irregular mass 17-mm	Irregular mass 20-mm, irregular mass 7-mm, irregular mass 5-mm	Neuroendocrine carcinoma 32-mm and 8-mm with DCIS 10%	Multifocal/multicentric
Case 16	35	D	Irregular cystic lesion 10.6-mm	Irregular mass 9.4-mm + ductal enhancement anterior to the lesion	ILC 9-mm No LCIS or DCIS	Extensive non-mass enhancement

US: Ultrasound; MRI: Magnetic resonance imaging; DCIS: Ductal carcinoma *in situ*; IDC: Invasive ductal carcinoma; NST: No special type; ILC: Invasive lobular carcinoma; BD: Breast density

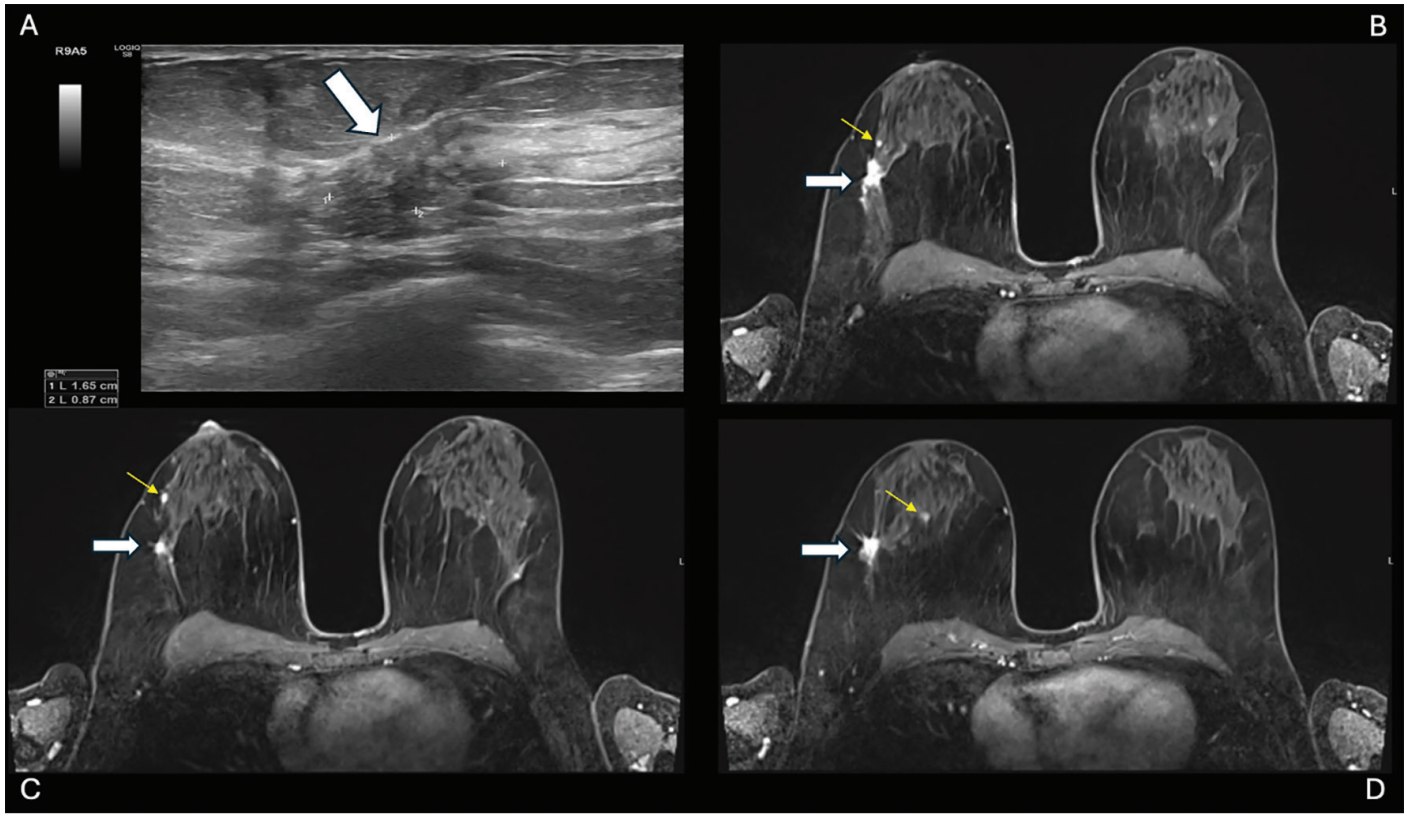

Figure 1. Multifocal invasive ductal carcinoma in a dense breast detected only on MRI. A 51-year-old woman presented with a palpable mass in the right breast. Ultrasound (A) showed a single irregular hypoechoic lesion (bold arrow) at the 9 o'clock position, 5 cm from the nipple, measuring 17×10-mm, with no additional suspicious findings. Breast MRI, performed due to dense parenchyma, confirmed the index circa 20-mm (B) mass (bold arrow) in the mid-outer quadrant and revealed three additional enhancing foci (thin arrows): two up to 5-mm (C) located 2 cm anterior to the index lesion and a 7-mm (D) focus anteromedially, consistent with multifocal disease. Tru-cut biopsy of the index lesion showed invasive ductal carcinoma, and the patient underwent nipple-sparing mastectomy with sentinel lymph node biopsy; final pathology demonstrated two invasive foci measuring 32-mm and 8-mm with approximately 10% surrounding ductal carcinoma *in situ*

MRI: Magnetic resonance imaging

Table 5. Sensitivity of US and MRI in forty-nine patients treated with mastectomy

Parameter	MRI	US	*p*-value
Sensitivity (%)	76.2	54.5	
Specificity (%)	64.3	63.0	
Positive predictive value (PPV, %)	61.5	54.5	
Negative predictive value (NPV, %)	78.3	63.0	
Accuracy (%)	69.4	59.2	0.42[a]

[a]McNemar test; US: Ultrasound; MRI: Mangetic resonance imaging

visualized on US, especially in denser parenchyma. These results support a selective use of preoperative MRI in BC, particularly in patients with dense breasts, invasive lobular carcinoma, or inconclusive conventional imaging, as has previously been suggested. Consistent with previous studies, MRI detected non-mass enhancements and small foci that US missed, many of which represented DCIS or low-grade invasive lesions. Failure to detect these lesions at the time of diagnosis may manifest as locoregional recurrence in the long term (14, 15).

The present study demonstrates that breast density is an independent risk factor for the detection of additional malignant foci on preoperative MRI. This finding is consistent with existing evidence indicating that dense fibroglandular tissue not only increases BC risk but also limits the sensitivity of conventional imaging modalities due to the masking effect (16). In this context, MRI provides a significant advantage by overcoming these limitations and improving lesion detection in dense breasts. Supporting this, the DENSE trial demonstrated that, in women with extremely dense breasts and negative MMG, the addition of MRI significantly increased cancer detection rates and reduced interval cancers by approximately 50% compared to MMG alone. Moreover, tumors detected by MRI were generally smaller and

diagnosed at an earlier stage, highlighting the clinical value of MRI in this high-risk subgroup (17).

After evaluating 149 patients individually, MRI detected additional malignant foci, including DCIS and an invasive component, in 38 (25.48%) patients, and the surgical approach was changed in 16 (10.7%) patients. The main reason for this change was that MRI identified multicentricity in 9 of 16 patients (56.3%), altering the surgical plan for this cohort. In a literature review, Mann et al. (18) reported that preoperative MRI identified additional malignant foci in approximately 32% of patients and led to changes in surgical management in nearly 28% of cases. However, this was not associated with improved oncologic outcomes (18). Similarly, a meta-analysis by Houssami et al. (19) on surgical outcomes demonstrated that preoperative MRI frequently identified additional ipsilateral or contralateral lesions not detected on conventional imaging, many of which were ultimately proven to be DCIS or benign. Although the detection of these MRI-only lesions often led to more extensive surgery and increased mastectomy rates, this escalation in surgical treatment did not translate into improved local control or survival outcomes (19). In the most recent MIPA study, a large multicenter prospective analysis including 5896 patients from 27 centers investigating the impact of preoperative MRI on surgical decision-making and reoperation rates in early-stage BC, which compared patients who underwent MRI with those who did not, the overall mastectomy rate was higher in the MRI group (36.3% *vs.* 18.0%), corresponding to an approximately 11% absolute increase associated with MRI, which was mirrored in our findings. MRI was more frequently performed in younger patients, those with denser breasts, larger tumors (≥20-mm), and lobular histology. In contrast, the reoperation rate was slightly lower in the MRI group (8.5% *vs.* 11.7%) (20).

Randomized controlled trials evaluating the impact of preoperative MRI on re-excision rates have shown variable results. In the COMICE trial, the addition of MRI did not reduce re-excision rates compared to standard imaging (10% *vs.* 11%). In contrast, the MONET trial reported a higher re-excision rate in the MRI group (34% *vs.* 12%), while the rate of conversion to mastectomy did not differ significantly between groups (21, 22). In the preoperative MRI of the breast trial, a prospective randomized multicenter study evaluating the impact of preoperative MRI on surgical planning, reoperation rates, and neoadjuvant treatment decisions, it was demonstrated that MRI provided additional diagnostic information for 38% of patients and altered surgical management in 18%, significantly reducing reoperation rates (5% *vs.* 15% in the control group) (23). In the BREAST-MRI trial, a randomized study evaluating the impact of preoperative MRI on surgical and oncological outcomes, MRI led to changes in surgical management toward mastectomy in a subset of patients but did not reduce reoperation rates (8.7% in both groups) or improve survival (24). The low re-excision rate in our study is attributable to thorough preoperative evaluation and systematic intraoperative assessment of macroscopic margins; furthermore, it can be considered a marker of high-quality care in a dedicated breast center. These results suggest that while MRI may influence surgical planning by detecting additional foci, its routine use does not necessarily translate into improved oncologic outcomes and may increase the risk of overtreatment. Another key finding highlights the critical role of radiologist expertise and the added value of second-look US performed after MRI. The findings, again, are in line with our results, highlighting the importance of careful patient selection and reinforcing the need for shared decision-making when considering MRI as part of preoperative evaluation.

In addition, considering that MRI is not readily accessible in all centers, is associated with higher costs, and cannot be performed in all patients due to technical or clinical limitations, contrast-enhanced mammography (CEM) has recently been investigated as a potential replacement for MRI. While MRI is highly sensitive, CEM is more cost-effective, faster, and accessible. In contemporary practice, CEM may serve as a valuable alternative for patients who cannot undergo MRI due to contraindications, limited access, or time and cost constraints, particularly for local intramammary assessment (25).

This study has several limitations related to its retrospective design and relatively small sample size, which may affect the generalizability of the findings. As this represents a real-world analysis, patients were not prospectively assigned to undergo MRI. The evaluation of re-excision rates is also influenced by institutional practice patterns. As a tertiary referral center, intraoperative macroscopic margin assessment is routinely performed, resulting in an overall re-excision rate below 5%, which is well below the target threshold of 10% recommended by the European Society of Breast Cancer Specialists (26). This low baseline rate may reduce the ability to detect any incremental benefit of MRI in decreasing re-excision rates. Although the study period ran from 2014 to 2025, a substantial proportion of patients were included in more recent years, resulting in a relatively short median follow-up. Therefore, oncological outcomes such as recurrence and survival should be interpreted with caution.

In conclusion, MRI has a selective role in high-risk patients, in cases where breast density causes diagnostic uncertainty, and when there is even the slightest suspicion of additional foci. However, based on our study and the literatüre, the routine use of preoperative MRI in all BC patients considered for upfront surgery may not be warrented.

Ethics

Ethics Committee Approval: The Koç University Institutional Review Board (approval no: 2024.262.IRB2.112, date: 09.07.2024) approved this study.

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: B.Ç., M.B., E.D.; Concept: B.Ç., E.D.; Design: B.Ç., S.K.; Data Collection and/or Processing: S.K., Y.H.B., G.Y.; Analysis and/or Interpretation: B.Ç., E.D.; Literature Search: B.Ç., M.B.; Writing: B.Ç., S.K.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. American Cancer Society. Breast Cancer Facts & Figures 2024-2025 [Internet]. Atlanta (GA): American Cancer Society; 2024. [Crossref]
2. Fisher B, Anderson S, Redmond CK, Wolmark N, Wickerham DL, Cronin WM. Reanalysis and results after 12 years of follow-up in a randomized clinical trial comparing total mastectomy with lumpectomy with or without irradiation in the treatment of breast cancer. N Engl J Med. 1995; 333: 1456-1461. (PMID: 7477145) [Crossref]
3. McGuire KP, Santillan AA, Kaur P, Meade T, Parbhoo J, Mathias M, et. al. Are mastectomies on the rise? A 13-year trend analysis of the selection of mastectomy versus breast conservation therapy in 5865 patients. Ann Surg Oncol. 2009; 16: 2682-2690. (PMID: 19653046) [Crossref]
4. D'Archi S, Carnassale B, Accetta C, De Lauretis F, Di Guglielmo E, Di Leone A, et al. Re-excision after positive margins in breast-conserving surgery: can a risk-based strategy avoid unnecessary surgery? J Clin Med. 2025; 14: 5839. (PMID: 40869666) [Crossref]
5. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in oncology: breast cancer. Version 3.2025 [Internet]. Plymouth Meeting (PA): NCCN; 2025. [Crossref]
6. Cardoso F, Kyriakides S, Ohno S, Penault-Llorca F, Poortmans P, Rubio IT, et al.; ESMO Guidelines Committee. Electronic address: clinicalguidelines@esmo.org. Early breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up†. Ann Oncol. 2019; 30: 1194-1220. Erratum in: Ann Oncol. 2019; 30: 1674. Erratum in: Ann Oncol. 2021; 32: 284. (PMID: 31161190) [Crossref]
7. Bluemke DA, Gatsonis CA, Chen MH, DeAngelis GA, DeBruhl N, Harms S, et al. Magnetic resonance imaging of the breast prior to biopsy. JAMA. 2004; 292: 2735-2742. (PMID: 15585733) [Crossref]
8. Azhdeh S, Kaviani A, Sadighi N, Rahmani M. Accurate estimation of breast tumor size: a comparison between ultrasonography, mammography, magnetic resonance imaging, and associated contributing factors. Eur J Breast Health. 2021; 17: 53-61. (PMID: 33796831) [Crossref]
9. Taydaş O, Durhan G, Akpınar MG, Başaran Demirkazık F. A comparison of MRI and US in tumor size evaluation of breast cancer patients receiving neoadjuvant chemotherapy. Eur J Breast Health. 2019; 15: 119-124. (PMID: 31001614) [Crossref]
10. Houssami N, Turner RM, Morrow M. Meta-analysis of pre-operative magnetic resonance imaging (MRI) and surgical treatment for breast cancer. Breast Cancer Res Treat. 2017; 165: 273-283. (PMID: 28589366) [Crossref]
11. Xie LL, Xu ZH, Wei DH, Xu CS. A meta-analysis of the association between preoperative magnetic resonance imaging and surgical outcomes in newly diagnosed breast cancer. Arch Med Sci. 2024; 20: 1597-1603. (PMID: 39649259) [Crossref]
12. Amin MB, Greene FL, Edge SB, Compton CC, Gershenwald JE, Brookland RK, et al. The eighth edition AJCC cancer staging manual: continuing to build a bridge from a population-based to a more "personalized" approach to cancer staging. CA Cancer J Clin. 2017; 67: 93-99. (PMID: 28094848) [Crossref]
13. Sickles EA, D'Orsi CJ, Bassett LW, Appleton CM, Berg WA, Burnside ES, et al. ACR BI-RADS® Mammography. In: ACR BI-RADS® Atlas, Breast Imaging Reporting and Data System [Internet]. Reston (VA): American College of Radiology; 2013. [Crossref]
14. Washington I, Palm RF, White J, Rosenberg SA, Ataya D. The role of MRI in breast cancer and breast conservation therapy. Cancers (Basel). 2024; 16: 2122. (PMID: 38893241) [Crossref]
15. Cozzi A, Di Leo G, Houssami N, Gilbert FJ, Helbich TH, Álvarez Benito M, et al. Preoperative breast MRI reduces reoperations for unilateral invasive lobular carcinoma: a patient-matched analysis from the MIPA study. Eur Radiol. 2025; 35: 3990–4000. (PMID: 40016317) [Crossref]
16. Sitges C, Mann RM. Breast MRI to screen women with extremely dense breasts. J Magn Reson Imaging. 2025; 62: 58-72. (PMID: 39853811) [Crossref]
17. Bakker MF, de Lange SV, Pijnappel RM, Mann RM, Peeters PHM, Monninkhof EM, et al. Supplemental MRI screening for women with extremely dense breast tissue. N Engl J Med. 2019; 381: 2091-2102. (PMID: 31774954) [Crossref]
18. Mann RM, Hoogeveen YL, Blickman JG, Boetes C. MRI compared to conventional diagnostic work-up in the detection and evaluation of invasive lobular carcinoma of the breast: a review of existing literature. Breast Cancer Res Treat. 2008; 107: 1-14. (PMID: 18043894) [Crossref]
19. Houssami N, Turner R, Morrow M. Preoperative magnetic resonance imaging in breast cancer: meta-analysis of surgical outcomes. Ann Surg. 2013; 257: 249-255. (PMID: 23187751) [Crossref]
20. Sardanelli F, Trimboli RM, Houssami N, Gilbert FJ, Helbich TH, Álvarez Benito M, et al. Magnetic resonance imaging before breast cancer surgery: results of an observational multicenter international prospective analysis (MIPA). Eur Radiol. 2022; 32: 1611-1623. (PMID: 34643778) [Crossref]
21. Turnbull L, Brown S, Harvey I, Olivier C, Drew P, Napp V, et al. Comparative effectiveness of magnetic resonance imaging in breast cancer (COMICE) trial: a randomized controlled trial. Lancet. 2010; 375: 563-571. (PMID: 20159292) [Crossref]
22. Peters NH, van Esser S, van den Bosch MA, Storm RK, Plaisier PW, van Dalen T, et al. Preoperative MRI and surgical management in patients with nonpalpable breast cancer: the MONET - randomised controlled trial. Eur J Cancer. 2011; 47: 879-886. (PMID: 21195605) [Crossref]
23. Gonzalez V, Sandelin K, Karlsson A, Åberg W, Löfgren L, Iliescu G, et al. Preoperative MRI of the breast (POMB) influences primary treatment in breast cancer: a prospective, randomized, multicenter study. World J Surg. 2014; 38: 1685-1693. (PMID: 24817517) [Crossref]
24. Mota BS, Reis YN, de Barros N, Cardoso NP, Mota RMS, Shimizu C, et al. Effects of preoperative magnetic resonance imaging on survival rates and surgical planning in breast cancer conservative surgery: randomized controlled trial (BREAST-MRI trial). Breast Cancer Res Treat. 2023; 198: 447-461. (PMID: 36786946) [Crossref]

25. Tsarouchi M, Hoxhaj A, Portaluri A, Sung J, Sechopoulos I, Pinker-Domenig K, et al. Breast cancer staging with contrast-enhanced imaging: the benefits and drawbacks of MRI, CEM, and dedicated breast CT. Eur J Radiol. 2025; 185: 112013. (PMID: 40036929) [Crossref]

26. Rubio IT, Marotti L, Biganzoli L, Aristei C, Athanasiou A, Campbell C, et al. EUSOMA quality indicators for non-metastatic breast cancer: an update. Eur J Cancer. 2024; 198: 113500. (PMID: 38199146) [Crossref]