MRI Breast Clinical Indications: A Comprehensive Review

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Introduction

Breast cancer is the second most common cancer in women, following skin cancer. It accounts for 1 in 3 cancers diagnosed in women and is one of the leading causes of mortality in the United States. The average relative lifetime risk of breast cancer in women is about 1 in 8 (12%).¹

MRI of the breast has become an important imaging modality in the detection, evaluation, staging, and management of breast cancer. MRI has proven value in numerous clinical settings, including screening for breast cancer in select high-risk patients with the wider use of genetic testing; evaluation for multicentricity or bilaterality of a known cancer; determining the efficacy of neoadjuvant chemotherapy; differentiation of scar tissue versus recurrent tumor in patients who have undergone breast-conservation surgery; and evaluation of patients with metastatic axillary adenopathy with an unknown primary. MRI may also be very useful in problem solving for patients with dense breast tissue, a difficult physical exam, equivocal mammogram and ultrasound findings, or discordant pathology results. This review offers guidelines and indications for breast MRI as represented in the literature.

Technique

Although there is no standardized technique for breast MRI, the American College of Radiology (ACR) has established minimum standards for breast MRI accreditation. The standards include a T2-weighted sequence, and most importantly, a multi-phase T1 weighted sequence. In accordance with the ACR standards, both breasts must be examined simultaneously. Acquisition during pre and post-contrast T1 weighted sequences must have a slice thickness ≤ 3.0 mm. There should be no gap, and the maximum in plane pixel dimension for phase and frequency should be ≤ 1.0 mm.² T1 weighted GRE imaging should be performed quickly with dynamic enhancement and delayed imaging performed. Computer aided detection may be beneficial in interpretation of the exam. Subtraction images may prove useful as well. Diffusion weighted imaging (DWI) along with ADC evaluation has been shown to be useful for the differentiation of benign vs. malignant tumors.³ Figure 1 shows normal pre and post-contrast T1 weighted images, along with a normal subtraction image.

Evaluation of images and lesions should be based on several factors, most importantly enhancement characteristics and morphology. Delayed imaging may be beneficial, especially with low grade DCIS (Figure 2). In our practice, we also include T1 and T2 weighted open field of view (FOV) sequences to evaluate the chest wall and other surrounding soft tissues. We have discovered lung and liver metastases (Figure 3), as well as associated adenopathy (Figure 4), with open FOV sequences.

Reporting

The most commonly accepted reporting system for breast imaging is Bi-Rads classification.

Bi-Rads for MRI is identical to the Bi-Rads classification in mammography.

| Category 0 | Incomplete: need for additional imaging |
| Category 1 | Negative |
| Category 2 | Benign findings |
| Category 3 | Probably benign findings |
| Category 4 | Suspicious abnormality |
| Category 5 | Highly suggestive of malignancy |
| Category 6 | Known cancer |

For full lesion features and descriptions for MRI, the ACR website has a MRI Lexicon Classification Form which may be used as a guideline.
Indications Breast MR, Walters et al.

Breast Cancer Screening With MRI

Recommendations.

MRI of the breast is increasingly used to screen for breast cancer in the high-risk patient. There are many factors used in the determination of a patient’s overall relative lifetime risk of breast cancer. Breast cancer risk factors include a family history of breast and ovarian cancer, high risk pathology such as lobular carcinoma in situ (LCIS), atypical ductal hyperplasia (ADH), radial scar, and women who have a history of radiation treatment for Hodgkin disease, etc.4-6

Mammography remains the gold standard for breast cancer screening; however, for women with increased risk of breast cancer, other screening modalities, including US and MRI, have been shown to contribute to early the detection of breast cancer. The American Cancer Society (ACS) issued recommendations for breast MRI screening in March 2007:

Recommend Annual MRI Screening

Patients with BRCA mutation; first-degree relative of BRCA carrier, but untested; or lifetime risk ≥ 20-25% as defined by BRCAPRO or other models that are largely dependent on family history.

(Based upon evidence from nonrandomized screening trials and observational studies)
Recommend Annual MRI Screening

Patients with radiation to the chest between the ages of 10 and 30 years or a personal history or first-degree relative with Li-Fraumeni, Cowden, and Bannayan-Riley-Ruvalcaba syndromes.

(Based upon expert consensus opinion/lifetime risk for breast cancer)

Insufficient Evidence to Recommend For or Against MRI Screening

Patients with a lifetime risk of 15-20% as defined by BRCAPRO or other models that are largely dependent on family history; LCIS, ADH, or atypical lobular hyperplasia; heterogeneously or extremely dense breast on mammography; or a personal history of breast cancer, including DCIS. Screening decisions should be made on a case-by-case basis, as there may be particular factors to support MRI. Payment should not be a barrier. More data on these groups is expected to be published soon.7

Recommend Against MRI Screening

Patients with <15% lifetime risk of breast cancer.

(Based upon expert consensus opinion)

BRCA1 and BRCA2 mutations are responsible for 40-50% of all familial cancers. The BRCA mutation increases the average lifetime risk of breast cancer to approximately 60-80% and 40% for ovarian cancer (BRCA1).8 The ACS Guidelines recommend “intensified surveillance” as an alternative to bilateral mastectomy. BRCA1 associated breast cancers tend to have benign morphological appearances (round shapes and minimal asymmetry) but an aggressive biological nature. Thus, screening should start at a younger age and occur more frequently in the case of BRCA mutations. These women are younger at presentation when average breast density is high. Earlier and more frequent screening in this population will result in a substantial cumulative lifetime ionizing radiation dose.9,10 With the additional increased risk of breast cancer associated with mammographic screening (albeit minimal), potentially dense breast

Figure 4. T2W axial image reveals mediastinal adenopathy.

Figure 5. Dense breast tissue in a BRCA positive patient. Bilateral CC views (A) show dense breast tissue bilaterally, which limits the sensitivity of mammography. US (not shown) demonstrated several hypoechoic masses and patchy areas of shadowing. Axial T1W post-contrast image with fat-suppression (B) demonstrates benign bilateral fibrocystic changes, Bi-Rads 2.
tissue in the younger patient, and the need for increased sensitivity in the evaluation of these patients, MRI has become accepted as an integral part of surveillance in the high risk population (Figure 5).

For women with an average risk of breast cancer, there is no data that supports breast MRI for screening at this time. Although MRI does have increased sensitivity in the detection of breast cancer, the positive predictive value (PPV) is much lower than in the high risk population; therefore, the cost of routine MRI screening is not justified. Long-term studies and further surveillance may change this perspective in the future.

**Third Party Reimbursement**

Insurance companies tend to follow the above guidelines for reimbursement. For the lower risk patient with dense breast tissue, a difficult physical exam, or significant fibrocystic changes, there are less objective recommendations and MRI of the breast may not be covered by insurance. Most insurance companies utilize a calculation of risk factors using one of several methods: BRCAPRO - Claus model - Gail model – Tyrer-Cuzick. The major carriers have policy guidelines for breast MRI.

**Sensitivity and Specificity in MRI Breast Screening**

Sensitivity of mammography alone decreases in proportion to the increased density of the breast tissue. However, breast density does not affect the sensitivity of MRI (Figure 6). There are numerous literature references for sensitivity and specificity of mammography, US, and MRI. The references vary but all clearly state that MRI is by far more sensitive than mammography and US in the detection of breast cancer for high-risk patients, dense breast tissue,

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**Figure 6.** Patient with personal and family history of breast cancer. Bilateral MLO views (A) demonstrate findings of prior lumpectomy on the left for invasive ductal carcinoma; right breast is very dense. US (not shown) demonstrated several hypoechoic masses bilaterally with patchy areas of shadowing. T1W pre (B), post-contrast (C), and MIP (D) images reveal a cobblestone enhancement pattern in the right breast at the 9-10 o’clock position. Biopsy revealed high-grade DCIS with central necrosis.
patients on hormone replacement therapy (HRT), and in the younger population.\textsuperscript{12,13} According to the National Cancer Institute (NCI) Breast Cancer Surveillance Consortium (BCSC), the sensitivity of screening mammography in the detection of breast cancer (starting at age 40) ranges from as low as 64% to as high as 100% based upon age and time from prior mammogram. Specificity was as low as 78% to as high as 94%.\textsuperscript{14}

MRI breast does not replace screening mammography or diagnostic mammography with US evaluation. Rather, MRI is used in conjunction with these modalities (Figure 7). Although breast MRI is more sensitive in the detection of breast cancer when compared to mammography and US, it has been reported as less specific overall.\textsuperscript{15} It should be noted, however, that in a recent ACRIN trial, the specificity of MRI breast was as high as 88%.\textsuperscript{16} MRI’s imperfect sensitivity comes from its inability to detect low grade DCIS due to the lack of enhancement. Mammography, on the other hand, may detect low grade DCIS as amorphous calcifications or small foci of architectural distortion, which may not be detected or be very subtle on breast MRI. Overall, however, MRI has been shown to be superior to mammography in detecting cases of unsuspected DCIS.\textsuperscript{17} Contrast-enhanced MRI of the breast has shown relatively high sensitivities, ranging from 94-99% for invasive cancer and 50-80% for in situ cancers.\textsuperscript{18}

MRI Breast in the Newly Diagnosed Breast Cancer Patient

Clinical Indications and Applications of Breast MRI.

The National Comprehensive Cancer Network (NCCN) discussion of breast MRI recommends the use of MRI for the following clinical indications and applications:

- Staging evaluation to define extent of cancer or presence of multifocal or multicentric cancer in the ipsilateral breast.
- Screening for contralateral breast cancer at time of initial diagnosis.
- Evaluation before and after neoadjuvant therapy to define extent of disease, response to treatment, and potential for breast conserving therapy.

![Figure 7](image-url) Complimentary role of mammography and MRI. Bilateral MLO views (A) demonstrate suspicious calcifications in the posterior left breast (biopsy proven DCIS), as well as faint, scattered calcifications in the upper, posterior right breast; the calcifications on the right could not be seen well or biopsied on stereotactic technique. Pre (B) and post (C) contrast MR images reveal very minimal nodular enhancement in the far posterior, lateral right breast. Due to the faint calcification in this area, the patient underwent biopsy with the pathologic diagnosis of low-grade DCIS. Patient also had lumpectomy changes on the left for intermediate grade DCIS. She subsequently opted for bilateral mastectomies.
- Detect additional disease in women with mammographically dense breasts.
- Identify primary cancer in women with axillary nodal adenocarcinoma or Paget’s disease of the nipple (Figure 8) with a breast primary not identified on mammography, ultrasound, or physical examination.

The utility of MRI in follow-up screening of women with prior breast cancer is undefined. It should generally be considered only in those whose lifetime risk of a second primary breast cancer is greater than 20% based on models largely dependent on family history, such as in those with a risk associated with inherited susceptibility to breast cancer.

There is no data demonstrating that the use of MRI to affect choice of local therapy improves outcomes (local recurrence or survival). Although breast MRI is more sensitive than mammography or US, false positive findings on MRI are common. Therefore, surgical decisions should not be based solely on MRI findings. Tissue sampling of areas of concern identified by breast MRI is recommended prior to treatment planning.

**Staging.**

Treatment options for breast cancer are based upon staging. Breast cancer staging is determined by the extent of disease in the breast and axilla, as well as metastatic disease determination. The current TNM staging of breast cancer is outlined in the 7th Edition of the American Joint Committee on Cancer. Key staging components include tumor size; involvement of overlying skin or chest wall; involvement of local or regional lymph nodes, to include mobile or fixed, conglomerate, or extracapsular spread; and presence or absence of distant metastases.

MRI has been shown to increase the sensitivity in the evaluation of local-regional disease involving the breast and axilla. When combined with mammography, US, and clinical exam, the sensitivity of MRI is as high as 99% in cases of newly diagnosed breast cancer (Figure 9). The reported low sensitivity of clinical exam (50%), mammography (60%), and US (83%) alone substantiate the use of MRI in the preoperative staging of breast cancer patients. Breast MRI has been shown to detect both multicentric and bilateral breast cancers with increased sensitivity over clinical exams, mammography, and US (Figures 10 and 11). Ipsilateral multicentric disease detected with MRI has been reported in 10-27% of patients. MRI detects occult contralateral breast cancer in about 3% of patients with invasive ductal carcinoma and in 6% of patients with invasive lobular carcinoma. Bilaterality has been reported in up to 10% in selected series.

Overall tumor size is more accurately depicted on MRI compared to mammography when correlated with pathology specimens (Figure 9). Although it was thought that this may decrease the need for reexcision due to unclear margins, this has recently
Figure 9. Patient presents with palpable mass on right. Bilateral MLO views of the breast (A) demonstrate a mass in this region with an US correlate (B). Biopsy revealed invasive ductal carcinoma. MRI breast (C and D) demonstrates more anterior and superior lateral extension than is perceived by mammogram or US.

Figure 10. Bilateral/contralateral breast cancer. MLO (A) and CC (B) views demonstrate a mass in the upper outer left breast, which was confirmed as suspicious on US (not shown). Post-contrast (C), MIP (D), and color-coded (E) images reveal the known breast cancer on the left, as well as an unsuspected enhancing mass in the right breast. Second look US was performed with subsequent biopsy; pathological diagnosis was invasive ductal carcinoma.
been shown not to be true. The COMICE trial performed in the UK demonstrated similar need for reexcision in patients who had pre-operative MRIs versus those who did not. However, further study with long-term evaluation and follow-up is needed.\(^\text{26}\)

In the clinical setting of DCIS, MRI is useful to rule out underlying invasive carcinoma. This can be accomplished with MRI due to its high negative predictive value (NPV) in the diagnosis of invasive breast cancer. MRI and mammography compliment each other in the diagnosis of DCIS. Although MRI has greater overall sensitivity, it does not detect all DCIS cases, especially those which are non-enhancing and are only seen as calcifications on mammography. Mammography is similarly limited in the detection of DCIS, especially in the absence of calcifications where lesions are only detected as abnormal enhancement on MRI. Research has shown that the overall sensitivity of MRI for high-grade DCIS is higher than that of mammography.\(^\text{27}\)

Controversy.

Breast surgeons have concerns regarding MRI causing a delay in treatment and/or increasing mastectomy rates. In most cases, the delay in treatment is minimal, since an MRI can be performed quickly after biopsy with the diagnosis of cancer. As for the increase in mastectomy rates related to breast MRI and the opinion that radiation therapy eradicates or delays progression of residual disease, these are not proven. While there have been reports of unnecessary mastectomies based upon false-positive MRI exams, this emphasizes the point that surgical management of breast cancer should be based upon confirmed histology, i.e. MRI-guided biopsy.\(^\text{28}\)

With breast conservation therapy, the rate of recurrence is low but not zero. The statement that outcomes in women who undergo breast conservation
Figure 12. Good response to neoadjuvant chemotherapy. Color-coded post-contrast MR images pre (A) and post (B) treatment reveal markedly decreased enhancement of the mass within the inner, posterior right breast.

Figure 13. Good response to neoadjuvant chemotherapy. Color-coded post-contrast MR images pre (A) and post (B) treatment reveal markedly decreased rim-enhancement of the mass within the mid, anterior right breast, as well as the multicentric masses in the left breast.

are equivalent to the outcomes in women who undergo mastectomy is debatable. The trials that have been performed to date have shown that women who undergo breast conservation have a higher risk of local recurrence. Thus, disease free survival is not equivalent.\(^{29}\) It was previously thought that local recurrence did not affect overall survival. However, it is now well accepted that local relapse does affect overall survival. Therefore, preventing local recurrence is considered as important as the early diagnosis of the primary breast cancer. The ability to prevent local recurrence requires more accurate staging and subsequent treatment; this is where MRI can play a critical role.\(^{30-32}\)

The threshold of radiation therapy to eradicate any residual disease has not been established. Each patient should be offered the best treatment for long-term survival. In essence, a staging MRI examination which demonstrates only one focal cancer site allows the patient, surgeon, and oncologist to explore the option of conservation therapy, since the likelihood of any residual disease will be low. It should also be clarified that multicentricity does not necessarily require mastectomy.

It must be stated clearly that there are no published randomized, prospective trials that have assessed the impact of breast MRI on mastectomy rates, or the impact on the recurrence rates or mortality. The long-term determination of this controversy will only come from controlled studies with long-term follow-up. Until that time, MRI should be used in the context of staging and improved pathologic confirmation of local regional disease. Treatment plans in tumor boards can be discussed and implemented with better knowledge of the patient’s disease extent and the treatment needed.

Neoadjuvant Chemotherapy Follow-Up

Neoadjuvant chemotherapy has been increasingly used over the past several years for patients with locally advanced breast cancer (LABC). LABC typically refers to breast cancer lesions that are larger than 5 cm with or without spread to lymph nodes. The primary advantage of neoadjuvant chemotherapy is to reduce the size of the overall tumor burden. This allows for a higher percentage of patients to undergo breast conservation therapy, while still offering significant reduction in local recurrence rates and improved overall survival.\(^{33,34}\)
Diagnostic imaging is performed to monitor the tumor response to chemotherapy as early as possible and to identify any residual tumor. Information regarding tumor response during the early stages of neoadjuvant chemotherapy is useful for treatment optimization. Tumor size may not necessarily decrease immediately in the early phase of treatment; therefore, evaluation of metabolic response becomes important. PET scanning and MRI have established roles in the early assessment of metabolic “functional” response. MRI demonstrates a positive response to chemotherapy as a decrease in the enhancement characteristics of the tumor (Figures 12 and 13). The enhancement curve changes and typically flattens with a diminished wash-out pattern. Wash-in changes occur as well; the wash-in will be slower. A decrease in tumor size typically occurs later.\textsuperscript{35} MR Spectroscopy and diffusion-weighted (DWI) MRI have been shown to help evaluate “responders” versus “non-responders” as early as 24 hours after the first cycle of chemotherapy. DWI detects cytotoxic effects of the chemotherapy by the change in the free interstitial water diffusion rates. There are standard protocols for DWI and ADC mapping; the literature provides suggestions for protocols and visual and numerical references. As protocols become standardized and controlled studies are performed, DWI and ADC may become standard in the evaluation for initial response to chemotherapy.\textsuperscript{36}

After neoadjuvant chemotherapy, MRI is often used to evaluate for any residual tumor. A recent ACRIN study (Protocol 6657) concluded that tumor response to chemotherapy as measured volumetrically by MRI was a much stronger and early predictor of pathologic response than clinical or tumor diameter. Several studies have demonstrated similar findings, indicating that MRI is superior to conventional mammography, US, and clinical exam.\textsuperscript{37,38} However, MRI correlation with tumor response is not 100%. It has been shown in some cases, particularly with chemotherapeutic agents that demonstrate antivascular effects, that residual vital tumor may be identified in up to 30% of patients whose MRI showed no residual abnormal enhancement. The accuracy of MRI in post-neoadjuvant chemotherapy evaluation also appears to vary with tumor subtype. It appears to be more accurate in ER-/HER2+ and triple negative and less accurate in luminal tumors.\textsuperscript{39,40}

**Problem Solving**

MRI can be used for problem solving in clinical scenarios such as discordant pathology results (Figures 14 and 15), markedly dense breast tissue with multiple palpable lumps (Figure 16), or complex mammographic findings (Figure 17). MRI is also useful in cases with equivocal or inconclusive findings on mammograms or US. Patients who have undergone breast conservation therapy may benefit from MRI if there is clinical concern of recurrent tumor versus developing scar tissue.

If there is a single abnormality on either US or mammogram, then US-guided or stereotactic biopsy is more efficient. These two biopsy techniques are readily available, relatively safe, easy to perform, and provide a histologic diagnosis.

In the patient with multiple areas of asymmetry on a mammogram (without calcification) and no US abnormality; a mammographic abnormality seen only on one view; or for the patient with multiple round, smooth masses that are equivocal on mammogram and US (i.e. breast cancer vs. multiple sclerotic fibroadenomas or multiple complex cysts), MRI has a very high negative predictive value (NPV). Some institutions may put these patients in short-term 6 month follow-up, Bi-Rads 3, diagnosis; however, rather than short-term follow-up or biopsy, MRI may also be considered. A 3-year consecutive study recently reported that breast MRI should be used in the diagnostic work-up of non-calcified Bi-Rads 3 lesions. It was stated that malignancy is ruled out with a very high level of confidence in the majority of patients, thus avoiding invasive diagnostic procedures.\textsuperscript{41}

Abnormal nipple discharge is most often caused by benign etiologies, such as ductal ectasia or solitary or multiple papillomas.\textsuperscript{42} Mammogram and US are performed initially to evaluate for the underlying cause and to rule out associated or causative breast cancer. Mammography and US are complimentary in evaluating abnormal nipple discharge. However, in the majority of cases, both exams will often be normal. Galactography may be performed and can be helpful; however, oftentimes (up to 10% of cases) a galactogram cannot be performed due to technical reasons (i.e. intermittent discharge, discharge from more than one orifice, etc). Also, the diagnostic information obtained with a galactogram is limited.
Figure 14. Problem solving with discordant results. Bilateral CC views (compressed and magnified on the left) (A) demonstrate suspicious calcifications within the outer, posterior left breast, as well as a mass in the posterior right breast. Right breast US (B) reveals a suspicious, lobulated, hypoechoic mass with posterior shadowing. Left breast biopsy demonstrated invasive ductal carcinoma. Right breast US-guided biopsy demonstrated sclerosing adenosis, which was felt to be discordant with the imaging findings. Post-contrast color-coded MR image (C) reveals extensive tumor in the left breast and findings highly suggestive of malignancy (abnormal rapid enhancement as well as irregular margins) on the right. MRI-guided right breast biopsy revealed infiltrating carcinoma with apocrine features.

Figure 15. Problem solving with discordant results. Initial bilateral MLO analog images from 6 months earlier (A) are normal. Follow-up MLO (B) and CC (C) digital images of the left breast demonstrate an area of spiculation (best seen on the MLO view) underlying the palpable marker. Left breast US (D) reveals an ill-defined area of low level echoes. Biopsy was performed with US guidance and the pathology results were fibrosis and chronic inflammation, which was felt to be discordant. Post-contrast MR images demonstrates two irregular suspicious enhancing masses in the left breast (E), as well as a very large enhancing mass in the inferior left lateral axilla (F). Biopsy under MR guidance revealed infiltrating ductal carcinoma with axillary metastasis.
Figure 16. Young woman with dense breast tissue and palpable mass on the right. MLO (A) and CC (B) views demonstrate a mass in the mid, posterior right breast. US (C) with biopsy revealed mucinous carcinoma. Post-contrast MR image (D) is beneficial in determining size and extent of tumor, especially in the setting of markedly dense breast tissue and difficult US and physical exams.

Figure 17. Problem solving with complex mammogram. Bilateral MLO views (A) reveal numerous silicone injection granulomas, greatly reducing the sensitivity of mammography. Post-contrast color-coded MR image (B) demonstrates normal enhancement of underlying breast tissue. There may be normal rim enhancement of some of the silicone granulomas.
Sensitivity for detection of a malignant lesion has been reported as very low (0-55%). MRI can help detect intraductal lesions not seen on mammogram and/or US and allows for localization of the lesion (Figure 18); subsequent image-guided biopsy may be performed. Axillary Adenopathy With Unknown Primary

Few women diagnosed with breast cancer initially present with metastatic axillary adenopathy. Historically, mastectomy was the treatment of choice in a patient with adenocarcinoma metastasis to the axillary lymph nodes in which the clinical exam, conventional mammogram, and/or US were unable to detect an abnormality, as it was usually thought to originate from a primary breast cancer in the ipsilateral breast. MRI can detect the primary tumor in up to 70% of these patients (Figure 19). This effectively changes their staging from T0 (unknown primary) to a defined TNM classification. The patient can then undergo more appropriate and focused surgical and oncologic therapy.

Due to the negative predictive value of MRI in the detection of invasive breast cancer, a negative MRI can be used to suggest that a mastectomy is not needed. Some oncologists advocate the use of radiation therapy alone in women with a negative MRI.

Ongoing Screening Debate

Recent controversial opinions concerning the value of breast cancer screening have challenged the very basis of why we offer mammography and by extension, breast MRI. It is critical that breast imagers base their practice on the firm conviction that mammography - and by extension MRI of the breast - saves lives. Nearly 20% of cancers which are detected with screening mammograms are found in women 40-50 years old. Recent negative opinions have been the products of retrospective analysis by physicians who do not directly treat or diagnose breast cancer. The mantra that “early detection save lives” is still as true as ever before. Breast MRI allows very early detection of cancers in women who are at high risk. Breast MRI also allows for a less invasive means of follow-up for those women at moderate risk. It is important to support prospective studies related to breast cancer detection while we continue to offer the safest means possible to detect and manage breast cancer in our patients.
Summary

In summary, breast MRI has proven to be a valuable tool in the diagnosis, work-up, and management of breast cancer. Common indications include screening for breast cancer in select high-risk patients, problem solving in cases of dense breast tissue or equivocal or discordant findings on mammogram or US, evaluation for multicentricity or bilaterality of a known cancer, determining the efficacy of neoadjuvant chemotherapy, differentiation of scar tissue versus recurrent tumor, and evaluation of axillary adenopathy with an unknown primary. The clinical indications will likely continue to expand as clinical trials demonstrate additional benefits of MRI in breast imaging. When used in conjunction with mammogram and US, this useful tool will assist in decreasing morbidity and mortality associated with breast cancer.

Figure 19. Axillary adenopathy with unknown primary. Bilateral MLO views performed at an outside institution (A) were read as benign and unchanged from an exam two years prior. Patient felt a mass in her right underarm one week after the mammogram. A surgeon performed a biopsy in his office, and the pathology came back as cancer. Post-contrast MR images demonstrate a mass far lateral posterior right breast at the 7 o’clock position with abnormal enhancement and abnormal morphology (B), as well as an enlarged right axillary lymph node (C) which was previously biopsied. MRI-guided biopsy demonstrated invasive lobular carcinoma.
References


2. ACR Breast Magnetic Resonance Imaging Accreditation Program Requirements.


