Breast MRI: The Importance of Bilateral Imaging

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One of the most controversial issues related to the use of MRI for the breast is the lack of standardization of imaging protocols. The absence of standardization has not only led to a vast array of imaging techniques performed on different MRI machines with different coils and capabilities, but it has also generated a consequent series of questions for radiologists who specialize in breast MRI. Among these questions are, Should unilateral or bilateral imaging be performed? What is the appropriate length of dynamic sequences? What is the correct amount of contrast material injection? Answers to these and other questions are continually being evaluated in the medical literature and are constantly being debated by radiologists.

The objective of this commentary is to highlight the importance and advantages of performing bilateral breast MRI versus unilateral breast MRI. Also discussed are the improved ease of interpretation with bilateral imaging, its technical simplicity, the improved patient comfort and satisfaction generated from this technique, its potential economic benefits, and the improved detection of breast cancer in both breasts obtained with bilateral imaging.

Breast MRI is continually recognized for its high sensitivity in breast cancer detection, which in some studies approaches 100%. Although not currently recommended for routine screening, breast MRI may benefit women with high-risk factors including genetic predisposition, dense breast composition, personal history of breast cancer, atypia, lobular carcinoma in situ, and family history. MRI can provide additional information for evaluating the extent of disease in women diagnosed with breast cancer, including identification of multicentric and multifocal disease in the ipsilateral breast and additional sites of cancer in the contralateral breast. Patients who have undergone a lumpectomy, patients with positive axillary nodes and unknown primary carcinomas, and patients with breast implants may also benefit from breast MRI [1–3]. However, breast MRI is still questioned because of its low specificity, which ranges from 37–97% [4]. This low specificity often makes breast MRI the less desirable option for patients and referring physicians because of fear of unnecessary biopsies, patient discomfort and anxiety, and higher cost. The low specificity of breast MRI may in part be related to lack of a universally accepted standard technique within the medical community for using MRI.

In this commentary, we present our assessment, based on a 30-month analysis of more than 3,000 cases, that bilateral breast MRI, using the axial plane, has significant advantages over other techniques.

Technical Advantages and Simplicity

Current state-of-the-art MRI scanners contain the necessary hardware and software needed for bilateral breast MRI. With existing parallel imaging technology, the planning of bilateral imaging is simple, straightforward, and not readily subject to user error. At our institution we use the sensitivity-encoding (SENSE) parallel imaging technique [5]. This imaging technique uses multiple receiver coil elements to encode spatial resolution, effectively creating parallel imaging. The multiple receiver coil elements are used to obtain sensitivity-encoded data and are complementary to Fourier preparation by linear field gradients [6, 7]. The combination of parallel imaging with faster sequences, such as turbo spin-echo and turbo field-echo, provides high temporal resolution without compromising spatial resolution. We obtained spatial resolution between 1.2 mm² and 1.4 mm² in plane and 1.5 mm through plane. The temporal resolution was 47 seconds per time point (Figs. 1–3). A large field of view is used to avoid “fold-over” artifact and does not negatively affect or diminish.
spatial resolution because of the parallel imaging technique [6]. Parallel imaging also reduces any possible artifacts from motion caused by respiration and cardiac rhythm. Incorporation of binomial spatial–spectral pulses and adiabatic inversion pulses for active fat suppression also works well in a bilateral acquisition. These techniques have generated homogeneous, complete, and robust fat suppression in more than 3,000 cases that we have performed over a 30-month period. Even when unilateral imaging was performed, the dynamic contrast material injection acquisition of the protocol was always in the bilateral scan. It was obvious to us that the same contrast material injection should flow through the arteries of both breasts, not selectively for the breast with indication. Bilateral acquisition seemed natural and made more sense than relying on a unilateral scan for dynamic contrast material injection acquisition.

Planning of unilateral acquisition is more cumbersome and time consuming than bilateral acquisition, as one needs to mask the side that was not indicated for any lesion. This masking is normally performed using saturation slabs. One also has to use fold-over sup-

Fig. 1—47-year-old woman with family history of breast cancer, extremely dense breasts, and remote history of lobular carcinoma in situ. Breast MRI was performed secondary to high risk.

**A,** Axial image of both breasts from T1-weighted fat-saturated contrast-enhanced dynamic sequence performed with parallel imaging technology. It shows large diffuse area of homogeneous enhancement involving almost entire parenchymal cone in superior aspect of left breast. Marked asymmetry in comparison with right breast accentuates abnormal areas in left breast. Without right breast image for comparison, hormonal-related enhancement may have been suggested. Subsequent second-look sonography and multiple core biopsies revealed multicentric invasive lobular carcinoma. Right breast was negative for significant enhancing lesions.

**B,** Sagittal multiplanar reformatted image shows invasive lobular carcinoma involving superior aspect of left breast and portions extending below plane of nipple. There is no perceptible loss of resolution because of parallel imaging.

Fig. 2—52-year-old woman with left nipple retraction and extremely dense breasts. Findings are suggestive of distortion seen on left mammogram. Breast MRI was ordered for clarification after indeterminate mammogram.

**A,** Axial image of both breasts from T1-weighted fat-saturated, contrast-enhanced dynamic sequence performed with parallel imaging shows irregular mass with heterogeneous enhancement, which was later shown by excisional biopsy to represent 3.0-cm invasive ductal carcinoma. No significant lesions are seen in right breast.

**B,** Sagittal multiplanar reconstructed image shows invasive ductal carcinoma. There is no loss of resolution resulting from parallel imaging technology.
pression to avoid any fold over of the contralateral breast. Our approach to breast MRI using parallel imaging with bilateral coverage in the axial plane is easy to plan for and easy to implement. Although some minor limitations of parallel imaging exist, such as reduced signal-to-noise ratio and reconstruction artifacts, this approach generally reduces potential operator error and obviates recalling patients. By using the multiple receiver coil elements in parallel, scanning time is considerably reduced [7]. The total time it takes to plan and implement this comprehensive protocol is less than 15 minutes [6].

**Economic Benefits**

Using bilateral parallel imaging of the breast is potentially beneficial economically. These benefits are directly related to increased patient satisfaction, shorter scan times, single contrast material injection, and faster interpretation of scans.

The shorter scan times associated with bilateral parallel imaging may enable physicians and imaging centers to perform a greater number of examinations during any given time period, thereby increasing patient throughput and increasing gross revenue.

Only a single contrast material injection is associated with our bilateral parallel imaging technique, which defrays the costs of using additional contrast agents, the need for extra nursing, and the probability of costly adverse events.
reactions. The ease and improvement of interpretation are also economically beneficial on a global scale. Superior diagnostic and high-risk screening capabilities may yield better treatment plans, lead to a reduction in unnecessary costly testing, improve outcomes, and reduce physician liability.

**Improved Ease of Interpretation**

The importance of symmetry has been recognized in mammography for many years and can lead to improved ease of interpretation. Evaluation of asymmetric tissue, versus focal asymmetric densities, may be easier when compared with the contralateral breast. Improved interpretation through symmetry can readily be applied to breast MR examinations. As in mammography, multiple lesions that are similar in appearance on breast MRI in both breasts can be more easily determined to be benign. This is particularly so in patients with multiple fibroadenomas, papillomas, and gross cystic changes.

Bilateral axial MRI of the breasts with parallel imaging [6] provides superior coverage of the axilla, which is particularly important because any differential diagnosis for axillary adenopathy may be altered by the presence of bilateral disease as opposed to a unilateral presentation. This recognition of the essential mirror images of the breasts can be extrapolated to provide improved sensitivity and specificity when interpreting breast MRIs.

During breast MRI examinations, recognized patterns of non–mass enhancement in single or multiple regions may be interpreted differently if they are present bilaterally, as opposed to unilaterally. Areas that are enhancing because of proliferative or fibrocystic change related to hormonal influences are generally bilateral. However, with unilateral imaging, a large area of enhancement thought to be related to hormonal influences could theoretically be disregarded and a neoplasm or neoplastic process could well be missed. Evaluation of the nipple areolar complex can also be aided by the use of symmetry, and the literature has shown the importance of comparing ipsilateral and contralateral nipples in making the diagnosis of neoplasm [6].

The American College of Radiology (ACR) MRI Breast Lexicon has recommended that reports state whether there is symmetry-mirror image enhancement or asymmetry (i.e., more in one breast than in the other) [8]. This is stated only for bilateral imaging. Breast MRIs consist of multiple images, which often range upward to 1,500 slices that need to be evaluated. The interpretation can be made easier if an image of the contralateral breast is available for comparison (Fig. 1).

Proponents of unilateral imaging raise concerns that bilateral imaging may lead to an unnecessary evaluation of a contralateral breast, leading to additional workups and biopsies. This may also increase liability because radiologists are responsible for all portions of both breasts seen on the scans. However, in our experience patients and referring clinicians are often more comfortable having complete information about both breasts before making definitive decisions, which in turn may decrease the need for additional biopsies and follow-ups over time (Fig. 2).

Radiologists can hopefully limit their liability by using the technique of bilateral comparison of symmetry and contrast enhancement to bolster their final impressions. Bilateral imaging in axial or coronal planes (or both planes) can be reviewed rapidly using scrolling techniques, are easy to compare for follow-up examinations, and can be used as a baseline for any future evaluations. Unilateral images may have different technical parameters, including varying degrees of fat saturation motion, which may degrade images, making comparison with the contralateral breast and follow-up examinations difficult.

Even in a situation in which a unilateral indeterminate lesion is being evaluated, symmetry and pattern of contrast enhancement between the two breasts are essential for ensuring that a correct diagnosis is made. Institutions that are performing only unilateral imaging may actually be exposing themselves to increased liability because in some MRI scanners and body coils, portions of the medial aspect of the contralateral breast may be visualized and may be overlooked or not commented on.

**Improved Detection of Breast Cancer**

One of the most significant advantages in using a bilateral breast MRI technique is that it can detect contralateral cancer in patients already diagnosed with breast cancer. Results in some studies have shown lesions that would not be detected through conventional imaging in 5% of patients who underwent contralateral breast imaging [9, 10]. These lesions would obviously not be subject to evaluation if a unilateral scan were chosen (Fig. 3). If a suspicious lesion is found in the breast being evaluated using a unilateral technique, it may be difficult to correctly evaluate the patient’s contralateral breast during her next examination if it is not done at the same time in her monthly cycle. The timing of the scan with respect to the phase of the menstrual cycle can affect the enhancement pattern, possibly adding to false-positives. A patient returning for a separate study of the contralateral breast may also have her interpretation done by a different radiologist, which can lead to interobserver variability and which has been reported as one possible factor for the decreased specificity of breast MRI.

Patients already diagnosed with breast cancer may receive additional benefit from bilateral breast MRI versus unilateral MRI if they have lesions that are known to affect both breasts at a higher rate, including patients with invasive lobular carcinoma, women with high-risk markers (e.g., lobular carcinoma in situ), and women with genetic predisposition [11–14].

**Improved Patient Satisfaction**

The advantage of bilateral breast MRI is that the patient only has to present at the imaging center one time. With shorter scan times, patients are less prone to anxiety and have less discomfort during the examination. After an initial breast MRI, patients may need additional workups or follow-up examinations, and their experiences can have an impact on whether they return to that facility for their additional imaging. A more satisfied patient will follow up with increased regularity, translating into better patient outcomes and an overall economic benefit.

Breast MRI is becoming a routine part of daily practice at many breast imaging centers. Improved access to MRI scanners and the recent development of MR-guided biopsy tools and MR-guided needle localizations have made for a smoother transition for this technology from research institutes to outpatient centers. However, as the number of outpatient centers using this technology grows, the need for establishing preferred practices increases. To that end, for centers that have state-of-the-art MRI hardware and software capable of providing sufficient high spatial and temporal resolution, bilateral imaging should be made the protocol of choice.

**References**

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