Optimizing Breast Magnetic Resonance Imaging at 3.0 Tesla

H. Rahbar[1,2], S. Partridge[1,2], W. DeMartini[1,2], and C. Lehman[1,2]
[1]Radiology, University of Washington, Seattle, WA, United States, [2]Radiology, Seattle Cancer Care Alliance, Seattle, WA, United States

Purpose The move to higher field strength 3.0T technique holds promise for the advancement of magnetic resonance imaging (MRI) of the breast, with potential benefits including higher signal-to-noise ratio, contrast resolution, and spectral resolution. These advantages have the potential to improve breast cancer detection and characterization. However, technical, physical, and safety considerations present challenges for fully realizing the benefits of breast MRI at higher magnetic field strength. The purpose of this educational poster is to summarize the advantages of breast MRI at 3.0T and discuss the technical considerations to optimize imaging at higher magnetic field strength in a manner that is both effective and safe.

Outline of Content

I. Background on Clinical Utility of Breast MRI
In this section we will discuss current evidence-based clinical applications of breast MRI, morphological and functional information provided by breast MRI, and the clinical strengths of MRI.

II. Potential Advantages of 3.0T over 1.5T for Breast Imaging
In this section we will discuss the effect of increased field strength on improved signal to noise ratio, increased spatial resolution, faster imaging times, and improved fat suppression.

III. Review of Current Data for Breast MRI at 3.0T
We will discuss current published data describing the utility of breast MRI at 3.0T as well as challenges that have been described in clinical practice in this section.

IV. Addressing Specific Challenges at 3.0T for Breast Imaging
In this section we will discuss how specific challenges can be addressed, including the need for higher channel breast coils, B1 and B0 inhomogeneity, susceptibility artifacts, controlling specific absorption rate, and T1 relaxation differences.

V. Advanced Functional Breast MRI techniques at 3.0T
We will discuss the impact on diffusion weighted imaging and MR spectroscopy techniques in this section.

VI. Clinical Perspective
Other clinical issues will be discussed in this section, including increased data sets and need for greater storage, increased time needed to read each scan, effect on kinetics curves, and MR biopsy techniques.

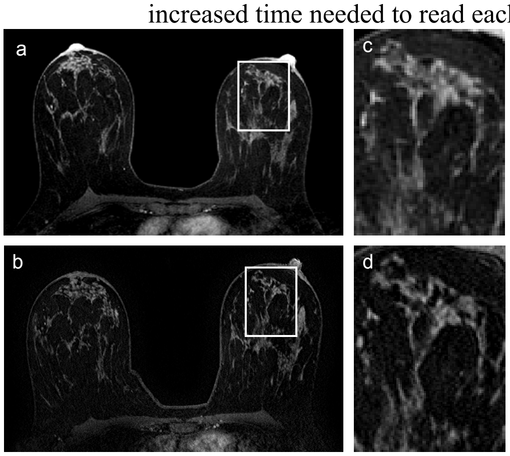

Figure 1: Comparison of breast MR images acquired at 1.5 (a) and 3.0T (b) in the same patient. The improved clarity of the 3.0T images for assessing fine detail is demonstrated in the magnified sections of the 1.5 (c) and 3.0 T (d) images.

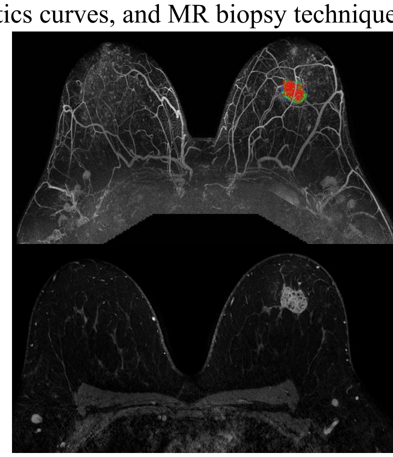

Figure 2: Color-overlay MIP (top) and post contrast T1-weighted with fat suppression (below) images of an invasive ductal carcinoma within the left breast from a clinical breast MRI performed at 3.0T with a 16 channel coil.

Summary Breast MRI with 3.0T scanners provides potential benefits of increased signal-to-noise ratio as well as added challenges of increased specific absorption rate and magnetic field inhomogeneities. Clinically, the greatest advantage of scanning at higher magnetic field strength is through improved spatial resolution, which has the potential to improve morphological detail. However, these improvements can be realized only through optimization of a variety of technical factors including use of a multi-channel breast coil, parallel RF transmission, and high order shimming.