Breast MRI update on new techniques: 3T vs. 1.5T

When breast MRI results were first reported in the late 1980s and early 1990s, the research efforts were nearly exclusively made on high-field 1.5 Tesla magnets, as this was the standard high-field imaging equipment available at the time. Since then, with the expansion of breast MRI indications and use, breast MRI research has similarly expanded, with numerous reports on different technical aspects of breast MRI performance. While these reports have evaluated the use of breast MRI at a variety of scanner strengths—including lower field systems—the majority of reports of breast MRI techniques and results are based on the performance obtained at 1.5 Tesla.

More recently, with the increasing presence of 3.0 Tesla scanners in clinical MRI, researchers have turned toward the potential advantages of higher-field imaging at 3T as a means to improve upon the performance of breast MRI compared to that of 1.5T imaging. The use of higher field breast MR imaging at 3T offers several potential advantages over that of 1.5T imaging. The increased strength of 3T imaging allows for the acquisition of images with higher signal-to-noise ratios than may be achieved with similar imaging protocols at 1.5T. More importantly, imaging at 3T allows one to create imaging protocols in which temporal resolution, spatial resolution, or both may be increased relative to that of routine 1.5T imaging without sacrificing overall image quality. Newer coil designs in particular may allow the radiologist to take advantage of parallel imaging techniques not practically possible at 1.5T.

There are additional potential advantages of 3T breast MR imaging over that of 1.5T. The improved fat-water separation at 3T may allow for the acquisition of more robust fat-suppressed imaging. Magnetic resonance spectroscopy is also potentially improved at 3T, due to the improved opportunity for lipid suppression, as well as the greater spectral resolution of the key metabolites: choline, creatinine, and others. The altered T1 relaxation rates of tumors and normal breast parenchyma also provide opportunities for greater T1-weighted imaging contrast in breast MRI performed at 3T.

However, indiscriminant application of breast MRI at 3T without careful forethought can negate the potential advantages of 3T imaging. Parameter choices which give optimal performance at 1.5T may prove to be detrimental to imaging at 3T, thus offsetting the gains of higher signal-to-noise imaging. The changes in relaxivity of gadolinium can also alter performance of breast MRI, and may require attention to the thresholds of enhancement that are used as benchmarks for significance in one’s breast MRI practice.

At the current time, technical improvements in breast MRI at 3T have been reported. However, it has not been shown unequivocally that actual clinical performance (i.e. improved diagnostic accuracy) can be achieved simply by performing breast MRI at 3T. Further research in this area will be useful to define the key aspects of 3T imaging performance that can and should be harnessed in order to maximize imaging quality—and most importantly—diagnostics results.