Dynamic contrast-enhanced MRI of the breast at 7T and 3T; initial results of an intra-individual comparison of BI-RADS-MRI lesion assessment.

Bertine L. Stehouwer[1], Dennis W.J. Klomp[1], Peter R. Luijten[1], Willem P.Th.M. Mali[1], Maurice A.A.J. van den Bosch[1], and Wouter B. Veldhuis[1]
[1]*Radiology, University Medical Center, Utrecht, Utrecht, Netherlands*

Introduction Moving contrast-enhanced Breast MRI to 7T brings benefits in respect of SNR[1,2], which can be used for high spatial and temporal resolution imaging. However, 7T also comes with limitations [1], for instance increased B_1-inhomogeneity, which may interfere with the interpretation of enhancement kinetics that is essential to the currently achieved diagnostic accuracy at 1.5 and 3.0T[2]. We have compared lesion enhancement and morphological BI-RADS-MRI characteristics between 7T and 3T on an intra-individual basis.

Materials and Methods Six patients with a suspicious breast lesion detected on mammography or US were submitted to 3T and 7T imaging within 1 week of each other. 7T MRI was performed on a whole-body Philips scanner using a two-channel unilateral RF breast coil. Protocol included a dynamic series consisting of 7 3D T1w-TFE sequences with fat suppression [TR/TE 5.0/2.0 ms, binominal flip angle 20°, FOV 160^3 mm^3, acq. res. 1 mm isotropic, temp. res. of 63s.]. During the sequence 0.1mmol/kg Gadobutrol (Gd) was injected. 3T MRI was conducted according to hospital guidelines. The scan protocol included a dynamic series consisting of 6 3D T1w-FFE SPAIR sequences [TI 90ms, TR/TE 3.1/1.17ms, flip angle 10°, FOV 360x360x150 mm^3, acq. res. 1.1x1.1x2.4 mm^3, temp. res. 60s.], during which 0.1mmol/kg Gd was injected. Two radiologists scored all exams independently, prospectively and blinded for clinical information, and only on the breast of interest for 3T images. Image quality was scored using a 4-point scale (1=insufficient, 2=sufficient, 3=good, 4=excellent). Lesion assessment was conducted according to the BI-RADS-MRI lexicon. Results were compared to histopathology. In all patients, only the biopsied lesions were used for analysis.

Results All patient cases are shown in Figure 1. Image quality at 7T was scored sufficient (n=3/2 (radiologist 1/radiologist2)) and good (n=3/4). Image quality at 3T was scored good sufficient (n=1/1), good (n=3/5) and excellent (n=2/0). In one case enhancement kinetics at 3T could not be assessed reliably due to patient movement. In one 7T case no fat-suppression could be applied for technical reasons ("No Fat-Sat" in Fig 1). At both field strengths, all biopsy-proven lesions were identified. Results of BI-RADS-MRI descriptor analysis and final assessment category is shown in table 1.Table 1 displays 8 lesions because one of the radiologist scored one case as two separate entities, and the other scored the lesion as one non-mass lesion. Histopathology showed a ductulolobular carcinoma in 4 cases and a ductal carcinoma 2.

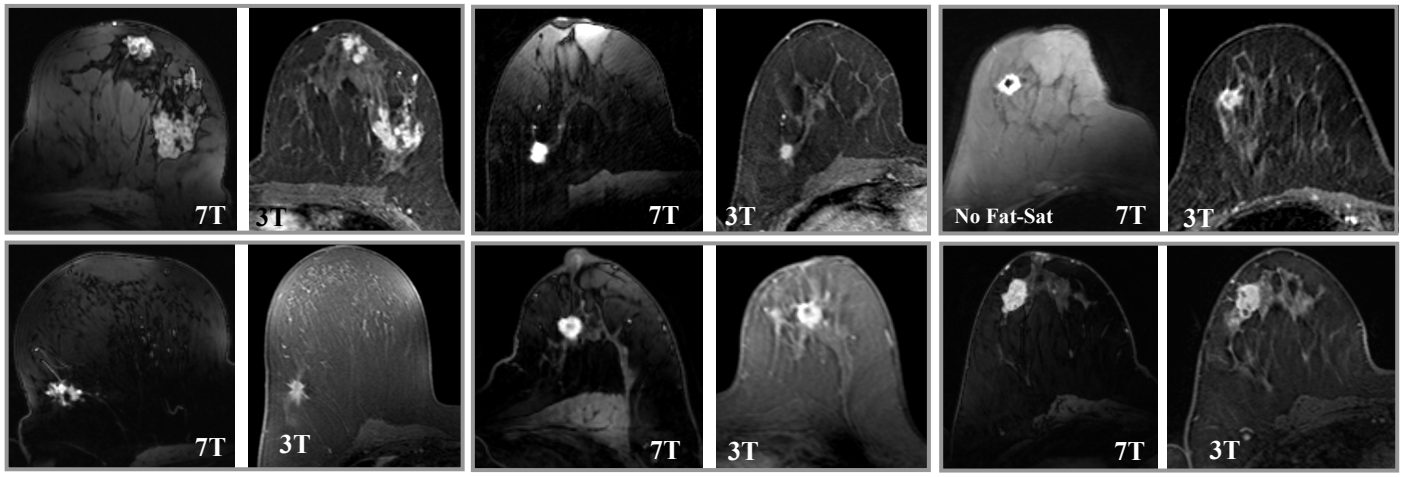

Figure 1 Axial slice through the pathology proven malignant lesion in all 6 patient. Shown is the second post-contrast data set of the dynamic T1-FFE series at both field strengths.

Figure 2 Example of the kinetic curve at 3T and 7T of the 6th (bottom right) patient shown in Fig 1.

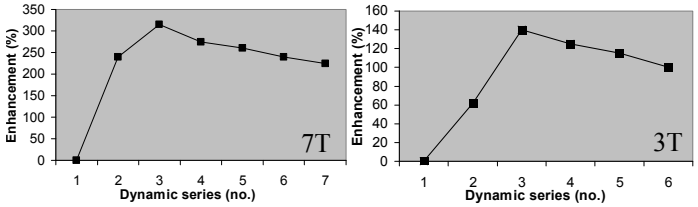

Table 1 BI-RADS-MRI assessment of all lesions

	Lesion type	Shape	Distribution	Margin	Enhancement	Initial rise	Delayed phase	Category
7T	mass	irregular | lobular		spiculated | irregular	heterogeneous	rapid	washout	5
3T	mass	irregular		spiculated	heterogeneous	rapid	washout	5
7T	mass	irregular		spiculated	heterogeneous	rapid	washout	5
3T	mass	round | irregular		irregular	heterogeneous	rapid	plateau	4 | 5
7T	mass	irregular		irregular	heterogeneous	rapid	washout	5
3T	mass	irregular		spiculated	heterogeneous	rapid	washout	5
7T	non-mass		ductal		clumped	rapid	washout	5
3T	mass	lobular		irregular	heterogeneous	rapid	washout	4
7T	non-mass		multiple regions		clumped	rapid	washout	5
3T	non-mass		segmental		heterogeneous	rapid	washout	5
7T	mass	irregular		spiculated	heterogeneous	rapid	washout	5
3T	mass	irregular		spiculated	rim enhancement	medium | rapid	washout | plateau	5
7T	mass	irregular | oval		irregular	heterogeneous	rapid	washout	5
3T	mass	irregular | lobular		irregular	heterogeneous	rapid	washout	5
7T	mass	irregular		irregular	heterogeneous | rim enhancement	rapid	washout	5
3T	mass	irregular		spiculated | irregular	rim enhancement	-	-	5

Discussion All biopsy proven malignant lesions were prospectively and independently identified at both field strengths. An inter-observer variability in the application of BI-RADS descriptors was observed. The final assessment category was scored as at least suspicious in all cases: BI-RADS category 5 for all 7T exams, BI-RADS category 5 (n=4) or 4 (n=2) for the 3T exams. This first intra-individual validation of 7T vs 3T MRI in breast cancer patients paves the way for coming clinical trials to explore new diagnostic possibilities offered by ultra-high field strength imaging; such as for example high-temporal resolution sampling of enhancement kinetics at ultra-high spatial resolution.

References [1] Korteweg MA et al. Invest Radiol 2011; 46:370-376. [2] Brown R et al. ISMRM 2011 Conference Proceedings.