

# Qualitative and Quantitative Diffusion-Weighted Imaging of Breast Lesions at 3T

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## INTRODUCTION

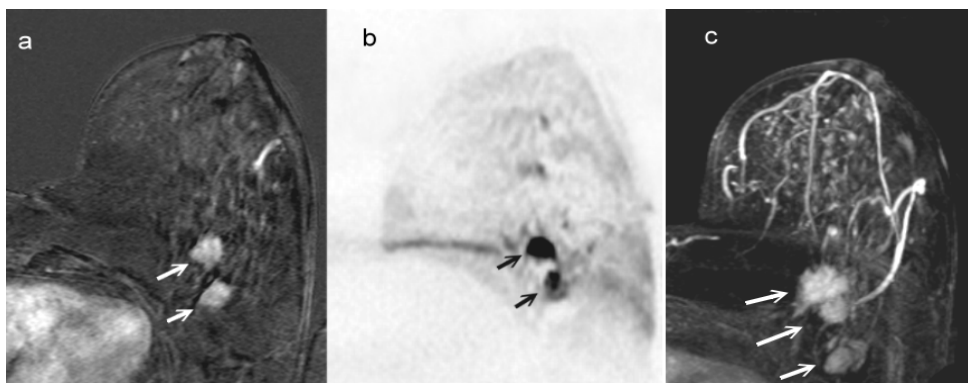
Previous studies have shown that diffusion-weighted imaging (DWI) may be useful to distinguish between malignant and benign breast lesions at 1.5T. In this study, we investigated the ability of DWI to differentiate between malignant and benign breast lesions at 3T. In particular, we evaluated (1) qualitative assessment of the DWI images and (2) quantification of the apparent diffusion coefficient (ADC) values and compared these with contrast-enhanced MRI (CE-MRI) using histology as the gold standard in each patient.

## METHODS

31 consecutive female patients with suspected breast lesions on mammography and ultrasound were prospectively evaluated. Dynamic contrast-enhanced MRI and diffusion imaging of the breasts were performed at 3T (Magnetom Tim Trio, Siemens Medical Solutions, Germany) using a four-channel phased array coil. EPI diffusion-weighted images were acquired in the axial plane with b values of 0 and 1000 s/mm<sup>2</sup> and with parallel imaging. The acquisition time was 1.5 minute. CE-MRI was performed using a dynamic 3D sequence with parallel imaging. The temporal resolution was 1 minute per 3D slab of 96 slices with 0.7 mm x 1.1 mm in-plane resolution. A contrast enhancement curve was generated for each suspected lesion. We compared qualitative DWI, quantitative ADC, and CE-MRI with histology. The sensitivities, specificities, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracies of CE-MRI, qualitative DWI and quantitative ADC were determined.

## RESULTS

20 (64.5%) of the lesions found were malignant tumors. Histology showed 10 invasive ductal carcinoma (32.2%), 8 DCIS (25.8%), 1 tubular carcinoma (3.2%) and 1 invasive medullary carcinoma (3.2%). 11 lesions were benign (35.5%) They included 7 cases of fibrocystic change (22.6%), 2 fibroadenomas (6.4%), 1 fat necrosis (3.2%) and 1 case of inflammatory change (3.2%). The mean ADC values of benign and malignant lesions were 1.47 +/- 0.30 x 10<sup>-3</sup> mm<sup>2</sup>/s and 1.01 +/- 0.25 x 10<sup>-3</sup> mm<sup>2</sup>/s respectively. The difference between them was statistically significant (P = 0.0002). The sensitivities, specificities, PPV, NPV and diagnostic accuracies of dynamic CE-MRI, qualitative DWI and quantitative ADC are shown in table 1.



**Fig. 1** a) CE-MRI at this slice level of a 69 yr old patient showed lesions with rapid contrast enhancement and washout. b) The lesions were bright on DWI. ADC value was 0.94 x 10<sup>-3</sup> mm<sup>2</sup>/s. c) Whole volume MIP projection of CE-MRI showed a third lesion at another slice position. Histology showed multifocal invasive ductal carcinoma.

**Table 1** The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of qualitative DWI and quantitative ADC.

	Sensitivity	Specificity	PPV	NPV	Accuracy
CE-MRI	95%	91%	95%	91%	93.5%
DWI	95%	63.6%	82.6%	87.5%	83.9%
ADC	90%	91%	95%	83%	90%

Table 1

## CONCLUSION

This is the first comparison of qualitative DWI, quantitative ADC and CE-MRI at 3T. DWI is highly sensitive in the detection of breast lesions. Quantitative ADC increases the specificity of qualitative diffusion to over 90%. The technique is rapid (scan time = 1.5 min), non-invasive, and does not involve ionizing radiation. Furthermore, it does not require injection of a contrast injection. While DWI is not recommended as a stand-alone diagnostic tool at this time, there may be a future role for a study without injection, particularly with concern about using contrast agent in certain patients.

## REFERENCES

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