Purpose: To investigate and determine the optimal b-values for Diffusion Weighted Imaging (DWI) for Apparent Diffusion Coefficient (ADC) maps in differentiating normal, benign and malignant breast tissue.

Methods: Twenty-five patients underwent diffusion-weighted magnetic resonance imaging (DWI-MRI) and conventional breast MRI with suspicious breast findings (BIRADS >4). Breast lesions were defined by pathology. The DWI was acquired with different b-values ranging from 0, 500, 600, 750 and 1000s/mm². Apparent Diffusion Coefficient (ADC) maps of breast tissue were constructed using different b-values, e.g., using either 2 b-values (0-1000) or combinations of 3 or more (0, 500, 1000 or 0, 600, 750, 1000). Quantitative analyses of the ADC maps of glandular, fatty and lesion tissue were obtained. Ratios of lesion to glandular tissue (L/GT) and signal to noise (SNR) were assessed. Paired t-tests were performed for statistical significance.

Results: Eighteen patients had invasive ductal carcinoma and 7 had benign breast lesions. The mean ADC value for malignant lesions using all b-values was 1.17±0.16x10⁻³mm²/s with a lesion to glandular (L/GT) ratio = 0.65. The benign lesions, ADC map value was 1.86±0.03x10⁻³mm²/s with L/GT = 0.98. There was a significant difference (P<0.05) between benign and malignant lesions ADC map value. The lowest SNR (12±6) was with single b-values. There was a significant difference (P<0.05) in SNR with multiple b-values (34±6) compared to single b-values. The highest SNR was given by using two b values greater than 500. Finally, the background noise for all combinations was surprisingly stable and ranged between 60±20%.

Conclusions: This is the first study to investigate the effect of changing different b-values in DWI breast imaging. There were significant differences in the SNR between single and multiple b-values. Our data show suggest that the recommended b-values for DWI in breast are 0, and two that are 500 or greater. Therefore use of at least 3 b-values in DWI/ADC mapping of breast lesions are needed for better characterization of benign and malignant breast tissue.

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