Reproducibility of ADC in colorectal liver metastases at 3T: a cross-vendor evaluation

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Purpose: Diffusion-weighted imaging (DWI) represents an important tool in the evaluation of colorectal liver metastases. Measurements of diffusion parameters in this tumor type have been recently proposed to assess tumor necrosis[1] and predict[2-4] or assess treatment response[5,6]. Reproducibility studies at 1.5T yielded reproducibility in the order of 20% for the apparent diffusion coefficient (ADC), sufficient for determining parameter changes in recently treated lesions[7]. Despite the increasing number of 3T clinical systems, the reproducibility of ADC in liver tumors at 3T has only been assessed in few studies[8], and, to date, the specific cases of colorectal liver metastases and inter-vendor reproducibility have not yet been evaluated. The aim of our study was to assess the reproducibility of ADC at 3T in liver metastases of colorectal cancer in a two-center, cross-vendor configuration.

Methods: The study was carried out on two 3T MRI systems (Philips and GE). Five patients (4 men, 1 woman, bearing 19 tumors > 1cm) were recruited on the GE system, and 6 patients (5 men, 1 woman, bearing 27 tumors > 1cm) were recruited on the Philips system. Two acquisition protocols were applied and, for each protocol, acquisition was repeated to yield test-retest DWI data. Protocol A was a standard clinical DWI protocol with 4 b-values (0, 150, 400 and 800 s/mm^2), while protocol B had an extended b-space coverage (0, 10, 20, 30, 50, 75, 100, 150, 400, 800 s/mm^2). Both yielded ADC measurements with a monoexponential fit over all b values. Protocols were otherwise matched for number of signal averages (4), free breathing, acquisition resolution (1.4-1.5 mm), slice thickness (5 mm), TR (> 5000ms) and TE (< 70ms). Data were analyzed in terms of mean ADC over the whole tumor. Bias and coefficients of reproducibility (CR) were calculated from the Bland-Altman plots and compared with Levene's tests.

Results: *Protocol A*: the Philips system yielded almost no bias, with CR of 23% similar to typical literature figures at 1.5T. The GE system had a weak positive bias (3%), and reproducibility was similar (CR = 18.5%). *Protocol B*: The Philips and the GE systems had similar measurement bias (2% and -2%, respectively) and similar CR (15.5% and 13.2%, respectively). Protocol B yielded better reproducibility than protocol A (p = 0.034).

Conclusions: Reproducibility of ADC in colorectal liver metastases at 3T was similar between vendors and comparable to previously reported figures at 1.5T. The best reproducibility was obtained with the extended b space coverage acquisition protocol. The good reproducibility results of our study suggest that the assessment of ADC changes during treatment at 3T in colorectal liver metastases is feasible in a multicenter, multi vendor context.

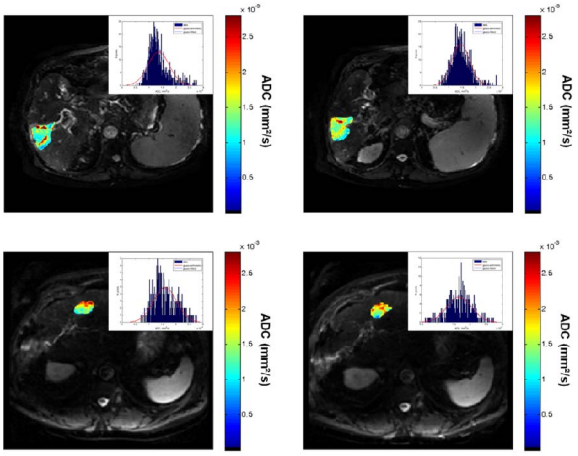

Figure 1: Representative ADC maps overlaid on anatomical images for Philips system (top) and GE system (bottom) for the initial scan (left) and the repeated scan (right). Insets: ADC histograms of the respective tumors

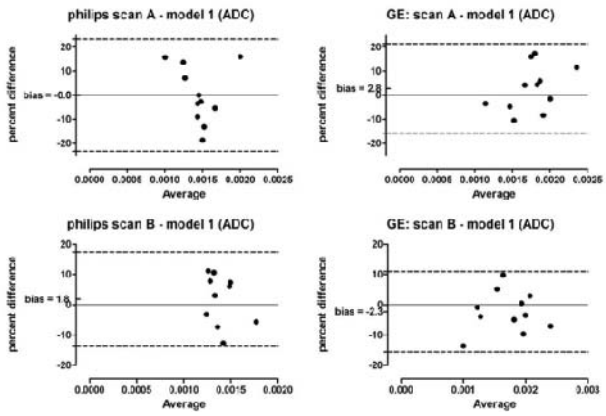

Figure 2: Bland-Altman plots of the test-retest results. Repeatability is comparable between vendors. The monoexponential model analysis of 10 b values data yields the best results.

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