Diffusion-Weighted Imaging of the Parotid Gland: Influence of the Choice of b-Values on the Apparent Diffusion Coefficient (ADC) Value.

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Introduction:
Considerable discrepancies in the ADC values of the salivary glands in healthy volunteers are found amongst published reports. We postulate that these differences in ADC values could be due to the choice of different b-values applied, based on the fact that the signal attenuation by increasing b-values is not a single exponential function and, therefore, analysis of one part of the curve by a single exponential or by a logarithmic analysis necessarily leads to a different result than an analysis of another part. Reasons for the non-single-exponential character of the diffusion curve signal = f(b) are manifold, including perfusion and the division into intra- and extracellular compartments.

The purpose of this study was to determine how the ADC value of parotid glands in healthy volunteers is influenced by the choice of b-values.

Material and Methods:
Eight healthy volunteers (five men, three women) with a median age of 24 years (range: 22-31) were examined on a 1.5T MR system using an 8-channel head coil. Axial T1-weighted spin-echo and T2-weighted turbo spin-echo sequences were acquired for morphological evaluation. Diffusion-weighted echoplanar imaging (DW – EPI) was performed with b-values (in s/mm²) of 0, 50, 100, 150, 200, 250, 300, 500, 750 and 1000. The other imaging parameters of the DW-EPI sequence consisted of: TR=3000 ms, TE=73 ms, a matrix size of 128 x128, and six averages acquired. The time of acquisition was 5:45 min. All series were performed with parallel imaging with a GRAPPA-factor of two. ADC values were calculated by two alternative methods (exponential vs. logarithmic fit) from 5 different sets of b-values: (A) all b-values; the following sets of b-values were used to calculate separate ADCs: (B) b=0, 50, 100, (C) b=0, 750, (D) b=0, 500, 1000, and (E) b=500, 750, 1000.

Results:
The mean ADC values for the different settings were (average ± standard error of the mean in 10⁻³ mm²/s, exponential fit): (A) 0.732 ± 0.019 (B) 2.074 ± 0.084, (C) 0.947 ± 0.020 (D) 0.890 ± 0.023, (E) 0.581 ± 0.021 (Fig). ADC values were significantly different (p<0.001) for all pairwise comparisons of settings (A – E) of b-values, except A vs. D (p=0.172) and C vs. D (p=0.380). ADC values from exponential vs. logarithmic fit (p=0.542) as well as left vs. right parotid gland (p=0.962) were indistinguishable (Fig).

Discussion:
ADC values calculated from low b-value settings were significantly higher then those from high b-value settings. These results suggest that not only true diffusion but also perfusion contributes to the ADC. Attention has to be paid when interpreting the ADC values in DW – EPI of the salivary glands: by a varying contribution of molecular diffusion and tissue perfusion, the ADC values are influenced by the chosen b-values. Appropriate selection of b-values may provide additional functional and morphological information, potentially helpful in the characterization of salivary gland lesions.

References: