

Apparent Diffusion Coefficient Measurement for Evaluation of Vertebral Normal Variations in the lumbar spine

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Introduction

MRI is highly useful for detecting bone marrow infiltration. MRI of bone marrow infiltration shows low signal intensity on T1-WIs and high signal intensity on T2-WIs. It is sometimes difficult to diagnose bone marrow infiltration with intertrabecular spread, because of poor contrast of vertebral signal intensity of trabecular bone¹⁾. On apparent diffusion coefficient (ADC) value of diffusion weighted image MRI has been proven to be an effective and non invasive method for evaluating the in vivo histological feature^{2,3)}. However ADC value is little evaluated in the spinal vertebra⁴⁾.

The purpose of this study is to measure ADC value based on diffusion weighted MRI in the vertebrae of lumbar spine and evaluate location dependent.

Subjects and Method

Forty-two consecutive patients (26 males and 16 females, 34-82 years old [mean 54.8]) were entered the study. All patients were studied with 1.5 T MRI units (Magnetom Quantum and Sonata, Siemens, Germany) with a phased array spine coil. In addition to the routine sequences such as T1-weighted images and fast STIR images at sagittal image, DWIs were obtained with spine echo sequences with GRAPPA (accel. factor=2) and the following parameter : TR=1000, TE=38, FOV=280x280mm, thickness=5mm ,and three b factors=0,300 and 800 (Fig.1). The reconstructed voxel size is 2.2x2.2x5.0mm. The apparent diffusion coefficient (ADC) was measured from regression using three b-values in each vertebra with software of MRI system. Measurement of the region of interest was done at mid-sagittal excluding cortex. Mean and SDs were calculated for ADCs of the each vertebra. The mean values of ADC were compared the Tucky-Kramer test using commercially available software (JMP; SAS Institute Inc.). Significance was defined at p less than 0.01.

Results

The mean ADC for vertebrae were L1:L2:L3:L4:L5=34.8+/-22.3:26.3+/-18.1:32.1+/-16.3:37.3+/-15.7: 45.3+/-23.1 x 10⁻⁵ mm²/sec (mean +/- SD), respectively. The mean ADC for L5 was significantly higher than that of L1, L2, L3 and L4 (p<0.01) (Fig. 2).

Discussion and conclusion

Our results revealed that ADCs of L5 yielded high values and ADCs of L2 and L3 yielded low values. Tissue ADC is thought to be composed of extracellular and intracellular tissue compartments. Concerning the contribution of extracellular compartment, lower ADCs have been reported with narrowed extracellular space⁵⁾. L5 and L4 vertebrae are usually decreased height with age, so the space of trabecular network may be slightly decreased. Mean ADCs of L4 and L5 could show high values. No MRI analysis of location dependent within lumbar vertebra has been reported.

In conclusion in this work we showed regional quantification of bone marrow ADC in the vertebra. The location dependent variation of ADC were shown. These data obtained for the normal variation may prove useful for evaluating disease that bone marrow effect.

Reference

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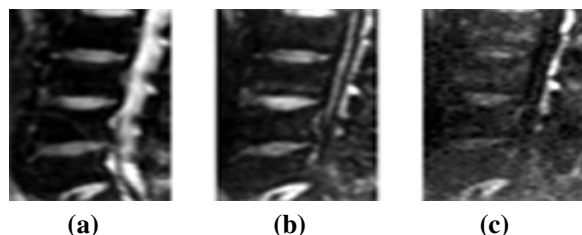


Fig. 1 A 73-yearold female:
(a) DWI (b factor=0) (b) DWI (b factor=300) (c) DWI (b factor=800)

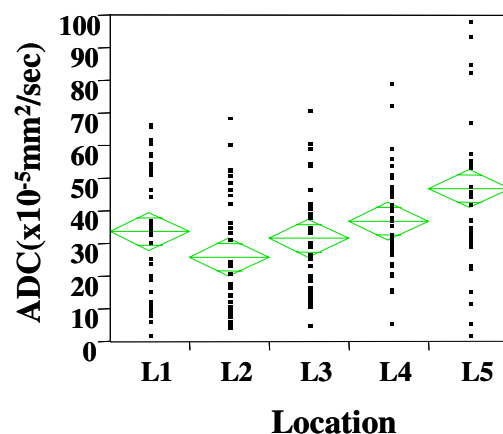


Fig. 2 ADC of Lumbar spine