Q-space Analysis of Diffusion Weighted Image of the Vertebral Bone Marrow

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PURPOSE:

We reported diffusion analysis with the apparent diffusion coefficient (ADC) enabled to obtain information of bone marrow composition [1, 2]. However, it is appropriate that the unit of water molecular displacement in the bone marrow is "μm" than "mm^2/sec" of ADC. Therefore, we evaluated water molecular displacement in the vertebral bone marrow using q-space analysis to provide the detailed information on vertebral bone marrow.

METHOD:

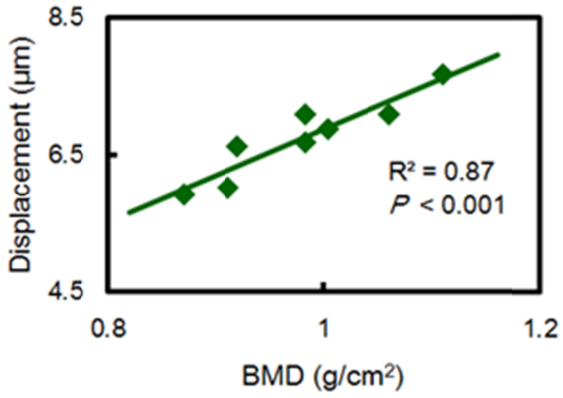
On a 1.5 T MRI, single-shot diffusion echo planar imaging was used with multi b values. Displacement of the water molecules was obtained from thedisplacement probability profile calculated by Fourier transform of the signal decay fitted with exponential curve as a function of the reciprocal spatial vector q [3]. Mean water molecular displacement was determined in the lumbar vertebral body (L2 – L4) of eight normal subjects, and then compared with the bone mineral density (BMD) obtained with dual-energy X-ray absorptiometry (DXA). Moreover, fat fraction (FF) of the bone marrow was measured with spectral adiabatic inversion recovery (SPAIR) in the same subject.

RESULTS:

A strong positive correlation was found between mean water moleculardisplacement and BMD in the vertebral bone marrow (R^2=0.87, P<0.001)(Fig. 1). Moreover, a negative correlation was noted between mean water displacement and FF (R^2=0.70, P<0.01) (Fig. 2). In addition, there was a negative correlation between BMD and FF (R^2=0.71, P<0.01) (Fig. 3), i.e., the more BMD decreases, the more cellularity decreases. Correlation of displacement vs BMD was greater than that of ADC vs BMD.

CONCLUSION:

Water molecular displacement analysis with q-space makes it noninvasively possible to obtain more detailed information of changing bone marrow composition, and metabolism.



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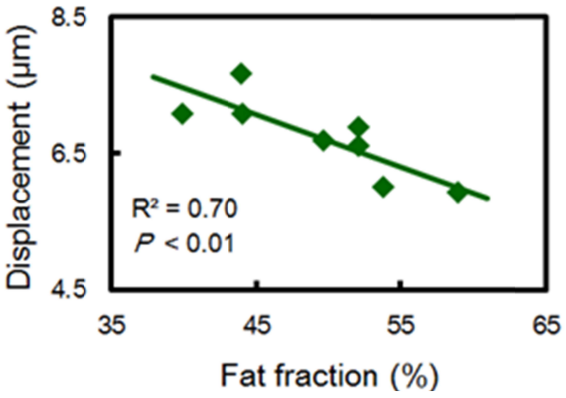

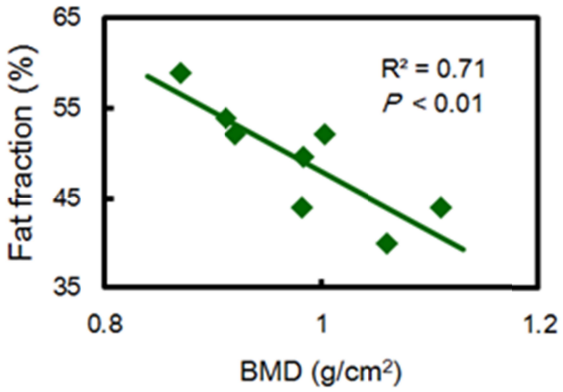

REFERENCES:

[1]. Ueda Y, et al, *J Magn Reson Imag*, 19: 222-228, 2004

[2]. Yorimitsu R, et al, *Proc ISMRM*, 19. 2011

[3]. Cory DG, et al, *Magn Reson Med*, 14: 435-444, 1990