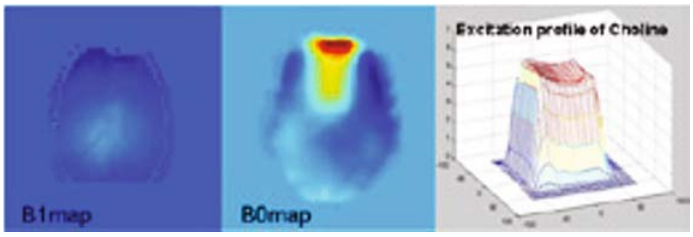

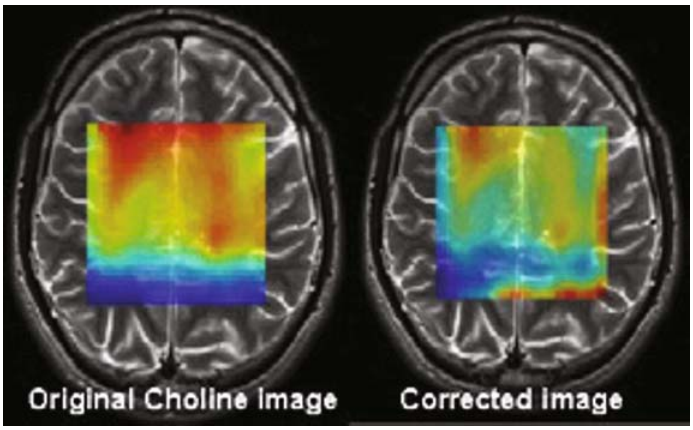

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Vertebral marrow fat content and diffusion indexes in postmenopausal women with varying bone density: MR evaluation

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Purpose/Introduction: To prospectively investigate the relationship among vertebral marrow fat content,marrow apparent diffusion coefficient(ADC),and bone mineral densities(BMD) documented with dual x-ray absorptiometry (DXA) in postmenopausal women.

Subjects and Methods: Institutional study approval and informed consent were obtained. Sixty postmenopausal women (mean, 61.7±4.9 years;range, 55-76 years) were divided into normal bone density group(T>-1.0,20 cases), osteopenic group(T=-1.0~-2.5,20 cases), and osteoporotic group(T<-2.5,20 cases) based on T score after DXA examination. Proton magnetic resonance spectroscopy (^{1}H MRS) and diffusion-weighted MR imaging of the L3 vertebral body were performed with a 1.5-T whole-body MR imaging system. Marrow fat content and apparent diffusion coefficient (ADC) were compared among three bone density groups. The correlation between BMD and marrow fat content or ADC were analysed.

Results: Vertebral marrow fat content was significantly increased in osteoporotic group(59.1%±8.8,P=0.003)or osteopenic group(54% ±7.6,P=0.039) when compared with that of the normal bone density group(49% ± 9.1). The difference of that was also significant(P=0.045) between osteoporotic and osteopenic group. The ADC of vertebral marrow did not change with bone density. A mild significant negative correlation was observed between marrow fat content and T score(γ=-0.46, P<0.001). A negative correlation between vertebral marrow fat content and ADC was significant in the osteoporotic group (γ=-0.72,P=0.008),though it was slight in all postmenopausal women(γ=-0.25,P=0.03). No signifcant correlation was present between bone density and marrow ADC (γ=0.315,P=0.16).

Discussion/Conclusion:
The subjects with osteoporosis in postmenopausal women experienced a corresponding increase in vertebral marrow fat content as bone density decreased. MRS can be a compensative way for BMD determination. The bone marrow fat content may acts as a significant diagnostic indicator of bone weakening. MRS and DWI can *noninvasively assess the physiological and pathological process of bone marrow in* postmenopausal women with osteoporosis. DWI could not reflect the BMD change alone.

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Comparison of glutamate and glutamine quantitation in rat brain by 1H-[13C] NMR Spectroscopy at 9.4 T and 14.1 T

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Introduction: ^{1}H-[^{13}C] NMR spectroscopy in conjunction with ^{13}C label administration is routinely used for studying brain metabolism. It can offer higher sensitivity than ^{13}C NMR spectroscopy, but suffers from lower spectral resolution, such as the incomplete separation of labeling in C3 position of glutamate (Glu) and glutamine (Gln) [1]. With increasing magnetic field strength, spectral resolution and signal-to-noise ratio can be substantially improved. The aim of the present study was to demonstrate the improvement of quantitation of Glu and Gln labeling under [2-^{13}C] acetate infusion using ^{1}H-[^{13}C] NMR spectroscopy at 14.1T relative to 9.4T.

Subjects and Methods: All *in vivo* experiments were carried out on a 14.1T/26cm and a 9.4T/31cm actively-shielded magnet (Varian/Magnex). Sprague-Dawley rats were infused with 99% enriched [2-^{13}C] acetate. ^{1}H-[^{13}C] NMR spectra were acquired with the recently proposed 'SPECIAL-BISEP' sequence [2] from a volume of 60µl at 14.1T and 75µl at 14.1T, shimmed with FASTMAP. Individual edited spectra were acquired with 64 averages (TE=2.8ms, TR=4 s). Metabolite concentrations and their Cramer-Rao lower bounds (CRLB) were calculated using LCModel [3]. ^{1}H spectra of Glu and Gln at 9.4T and 14T were simulated based on the density matrix formalism.

Results and Discussion: In the simulated spectra of Glu and Gln at 14.1T, Glu at 2.04ppm and 2.12ppm ($^3CH_2$) showed as a better separated doublet than that at 9.4T (Fig. 1), which indicated potentially improved spectral resolution at 14.1T.

During *in vivo* experiment with infusion of [2-^{13}C] acetate, the labelings of AceC2, GluC2,C3,C4, GlnC2,C3,C4, NAAC6, AspC2,C3 and GABA were observed at both 14.1T and 9.4T. A more separated spectral region of Glu, Gln and NAA resonances from 1.9 - 2.2 ppm (Fig. 2), was noted at 14.1T, as well as better resolved GlnC4 and GluC4 resonances. In the individual fits,

GluC3 appeared as a better separated doublet at 14.1T, which was consistent with simulated spectra (Fig. 1). The CRLBs of concentrations of GluC4, GlnC4, GluC3 and GlnC3 were ~50% lower at 14.1T compared to those obtained at 9.4T (Fig. 3), which demonstrated substantially improved measurement accuracy of ^{13}C labeled metabolites at 14.1T.

We conclude that the improved sensitivity and spectral dispersion at 14.1T substantially increased the accuracy of the measurement of ^{13}C labeled metabolites, which should greatly enhance the ability to study neuron-glial metabolism using ^{1}H-[^{13}C] NMR spectroscopy.

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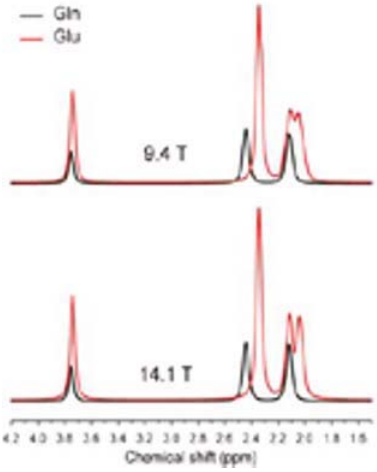

Figure 1. Simulated spectra of glutamate and glutamine at 9.4 T and 14.1 T with linewidths of 10Hz and 18Hz, respectively.

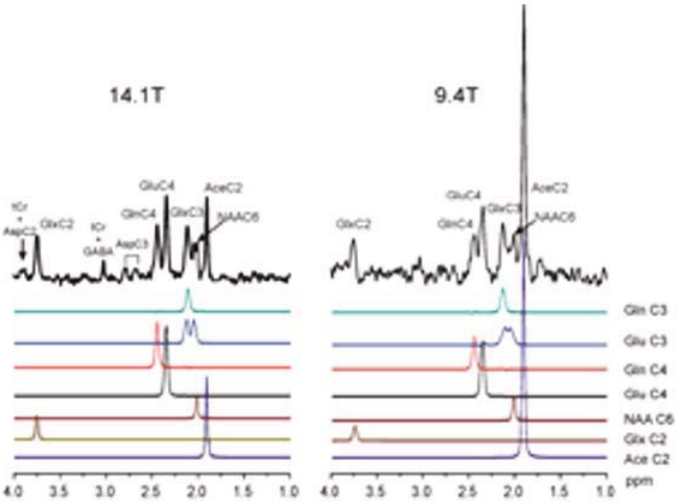

Figure 2. ^{1}H-[^{13}C] NMR spectra at 9.4T and 14.1T (nt = 512, 90min after starting infusion of [2-^{13}C] Acetate) and individual fits of the labeled metabolites.

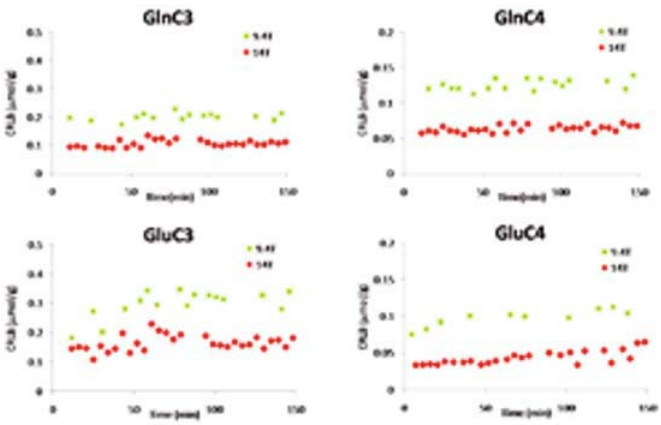

Figure 3. CRLBs of concentrations of GluC4, GlnC4, GluC3 and GlnC3 at 9.4T and 14.1T during infusion of 2-[^{13}C] labeled acetate.