MP2RAGE for deep gray matter measurement of the brain: A comparative study with MPRAGE

Gosuke Okubo[1], Tomohisa Okada[1], Akira Yamamoto[1], Mitunori Kanagaki[1], Yasutaka Fushimi[1], Tsutomu Okada[1], and Kaori Togashi[1]

[1]*Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan*

Introduction Recently, magnetization-prepared with 2 rapid gradient echoes (MP2RAGE) sequence has become available[1]. In MP2RAGE two gradient echo images are acquired at different inversion times, which yields a T1-weighted image volume that are free from inhomogeneity of B1+ and B1-. The improved image quality may improve segmentation of the deep GM.

Purpose To evaluate MP2RAGE imaging for deep gray matter segmentation compared with conventional MPRAGE imaging and reproducibility of T1 maps.

Methods 19 healthy volunteers were enrolled. MP2RAGE and MPRAGE imaging was conducted twice for each volunteer. Images were normalized and segmented using SPM8. To evaluate reproducibility, coefficient of variation (COV) of deep gray matter (GM) probability maps between first scan and second scan was computed, and a paired t-test was conducted to compare difference between MP2RAGE and MPRAGE with a deep gray matter mask (Fig A). Difference in deep GM probability was also investigated between them with contrast ratio (CR) using region-of-interest analysis. In addition, COV of T1 maps generated from MP2RAGE was evaluated.

Results COV of deep GM probability map was significantly higher at some small areas of the bilateral basal ganglia in MPRAGE than MP2RAGE ($P<0.005$, uncorrected, Fig B), but MP2RAGE was inferior at no area without a small focus on left caudate head. Comparison of GM probability map found that putamen and caudate nucleus were segmented significantly larger in MP2RAGE than in MPRAGE, but GM probability map was larger at lateral thalamus in MPRAGE ($P<0.05$, family-wise error, Fig C, D). CRs of every structure including thalamus were better in MP2RAGE (Fig E). COV of T1 map was around 0.5%, which is much smaller than a previous study[2].

Conclusion This study revealed that MP2RAGE has better reproducibility and tissue contrast than MPRAGE as for deep gray matter. Additionally, MP2RAGE can generate a reliable T1 map. Although SPM8 may assign lateral thalamus to WM incorrectly in MP2RAGE, MP2RAGE is more useful than MPRAGE for analysis of deep gray matter structures.

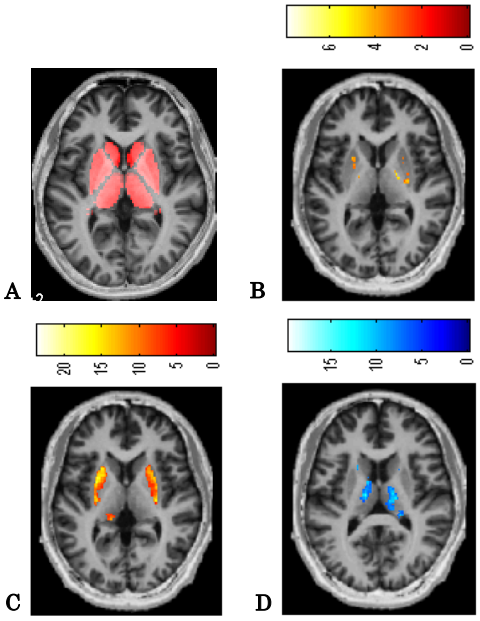

Fig. A. shows the deep gray matter mask image which was applied following SPM analyses. **Fig. B** is a two sample t-test result comparing COV of GM probability between MP2RAGE and MPRAGE. The area with significantly higher COV in MPRAGE is superimposed on an individual image. **Fig. C and D** are Two sample t-test results comparing GM probability between MP2RAGE and MPRAGE. Fig. C shows higher GM probability in MP2RAGE, Fig. D shows higher in MPRAGE.

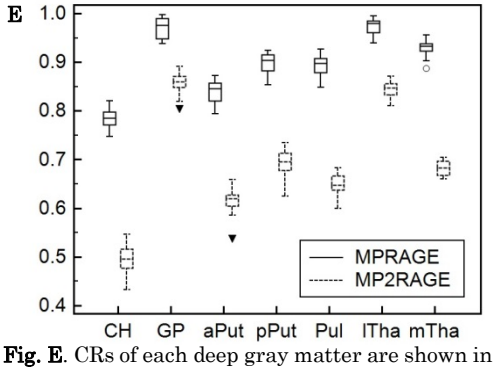

Fig. E. CRs of each deep gray matter are shown in a box and whisker plot. Each signal intensity was compared with corpus callosum. MP2RAGE shows smaller CR which means better contrast. Caudate head (CH), globus pallidus (GP), anterior putamen (aPut), posterior putamen (pPut), pulvinar (Pul), lateral thalamus (lTha), medial thalamus (mTha)

References 1. Marques JP, Kober T, Krueger G, et al. MP2RAGE, a self bias-field corrected sequence for improved segmentation and T1-mapping at high field. NeuroImage. 2010;49(2):1271-1281.

2. van Walderveen MA, van Schijndel RA, Pouwels PJ, et al. Multislice T1 relaxation time measurements in the brain using IR-EPI: reproducibility, normal values, and histogram analysis in patients with multiple sclerosis. JMRI. 2003;18(6):656-664.