Abstract
Precise imaging of glioma cell invasion into the white matter has been challenging. Exact identification of the areas with tumor cell invasion is necessary for achieving maximum tumor resection and radiation therapy planning. In order to meet these demands, use of diffusion tensor imaging (DTI) has been proposed for the detection of tumor cell invasion. It has been suggested that fractional anisotropy (FA) is reduced in areas where the tumor cells invade the white matter, disrupting the neural fiber bundles (Ref. 1). However, other reports have suggested that reduction of FA can also be influenced by vasogenic edema, and that solely relying on the reduction of FA is insufficient to accurately detect tumor cell invasion (Ref. 2).
In this report, we have been able to segment the possible area with and without tumor cell invasion in the T2-WI high intensity area in malignant glioma patients using a voxel-wise analysis of both 11C-methionine and FDG PET. The decoupling map. Two types of edema, namely edemas with (red arrow) or without (blue arrow) 11C-methionine and FDG uptake decoupling can be appreciated.

Results and Discussion
As in Fig. 3, we clearly showed that 11C-methionine and FDG uptake couples in in T2-WI high intensity areas of meningiomas, whereas they decouple in those of malignant gliomas. These results suggest that both 11C-methionine and FDG uptake decreases in vasogenic edemas, while in tumor infiltrative edema, 11C-methionine uptake is much higher than predicted by FDG uptake, possibly because tumor cells have higher 11C-methionine uptake capability by amino acid transporter overexpression on their cell membranes. As a result, it is considered that the decoupling score reflects the magnitude of tumor cell invasion into the white matter. When we reconstructed the decoupling map, two types of edemas (T2-WI high intensity areas) were observed in malignant glioma patients (Fig. 2, 4). Areas with high (2<) decoupling score in this map can be considered as tumor infiltrative edema, and low (2>) score as vasogenic edema. Segmentation of these two types of edema in malignant glioma patients was possible (Fig. 4), and the FA was plotted as a function of ADC in these two types of edema. The results, however, showed that the correlation of FA and ADC did not differ between these two types of edema (Fig. 4). Our results showed that tumor infiltrative and vasogenic edema can be discriminated by voxel-wise analysis of both 11C-methionine and FDG PET. Use of DTI for this purpose, however, should be considered limited.

References