Introduction
Radiotherapy for malignant gliomas is an important component of radical treatment, and improves survival. The dose that can be delivered safely is limited by the infiltration of tumour into surrounding normal brain. Tumour cells, however, can be demonstrated beyond CT or MR defined lesion borders such that conventional radiotherapy fields include a 2-3 cm margin of normal brain to encompass this microscopic disease. The actual radiation dose given is, therefore, limited by the sensitivity of the normal surrounding brain. There is a need to develop imaging tools that enable the identification of possible microscopic invasion. MR diffusion tensor imaging (DTI) may have the ability to detect subtle disruption of white matter tracts, which combined with the potential advantages associated with higher field MR (3 Tesla), could be a useful tool in determining microscopic invasion. We report here the initial findings of this pilot study.

Methods
We imaged 6 patients with histologically confirmed supratentorial high grade glioma (WHO Grade IV) at 3 Tesla (Bruker Medical, Ettlingen, Germany) using T2-weighted FSE sequence and single shot spin-echo echo planar DTI (TR 5070 ms, TE 106 ms, NEX = 1, slice thickness 5 mm, FOV 25, 128 x 128 matrix with an acquisition time of 5.21 minutes). For each patient an enhanced MR or CT study was available. The extent of abnormality on the conventional and tensor images were compared. Regions of interest were drawn within the tumour, normal white matter in the contralateral hemisphere and in areas of abnormality on DTI that appeared normal on T2-weighted images. The relative anisotropy index for these areas was calculated.

Results
The mean age of the patients was 57 years (range 23-70), with 4 males and 2 females. The abnormality on DTI was larger than that seen on T2-weighted images in 5 of the 6 cases. The area of abnormal enhancement was less extensive than the area of T2 change. In three cases abnormalities were seen in the contralateral white matter on the DTI that appeared normal on T2-weighted images suggesting the possibility of spread across the corpus callosum. DTI changes were demonstrated at up to 4 cm from the border of the T2 abnormalities.

In the area of the tumour the anisotropy index was markedly reduced to 0.07±0.03 compared to the normal white matter (0.36±0.04). In areas of white matter disruption with normal T2 appearance, the index was also reduced (0.16±0.07).

Discussion
Whilst the actual cause for tract disruption in these patients is not known in the absence of a further biopsy, oedema seems less likely in view of the normal T2 changes. Tumour infiltration/effect is a more likely cause of the DTI changes. The demonstration of white matter tract abnormality may prove to be a better indicator of tumour infiltration, a feature that is frequently missed on conventional enhanced MR. This may allow more selective delineation of tissue to be irradiated, hopefully leading to reduced morbidity from the side effects of radiotherapy.

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References