A NOVEL MAGNETIC RESONANCE DIFFUSION TENSOR IMAGING SEGMENTATION AND VISUALISATION TECHNIQUE FOR BRAIN TUMOUR DIAGNOSIS

More people under the age of 40 die from a brain tumour in the UK than any other form of cancer. In terms of the average years of life lost per patient, brain tumours represent one of the most lethal cancers with over 20 years of life lost

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FELLOWSHIP/SPONSOR
Joint RCS/Freemasons Fellowship

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SITE OF WORK
St George's University of London

PRESENTATIONS
1. International Society of Magnetic Resonance in Medicine ISMRM. Melbourne Australia, 2012.
2. Congress of Neurological Surgeons Meeting, San Francisco, USA, 2010.

PRIZES
1. British Neurosurgical Research Group Annual Meeting, Best presentation prize 2010.
2. International Society of Magnetic Resonance in Medicine Travelling Fellowship 2012-2013.

FURTHER FUNDING
Cancer Research UK for three years

The term 'brain tumour' refers to a heterogeneous group of lesions with variable degrees of malignancy and associated morbidity and mortality. A total of 4,700 cases of primary brain tumour are diagnosed annually in the UK and are the fifth most common cause of death from cancer under the age of 65 with a 5-year survival of only 18%. Treatment decision making relies on preoperative magnetic resonance imaging (MRI) to identify likely tumour type and thus guide surgical resection. It has been proposed that conventional scans may underestimate the extent of tumour and their diagnostic accuracy is not yet good enough to preclude the requirement for lesion biopsy with its associated risks.

The research fellowship allowed me to acquire advanced MRI scans (diffusion tensor images, DTI) from patients with a range of brain tumour subtypes and develop a novel technique to display tumour specific characteristics and investigate its role in clinical practice.

DTI scans were obtained from 96 patients with newly diagnosed brain tumours prior to surgical treatment and definitive diagnosis from tissue biopsy. I devised a technique of defining a boundary on the DTI-MRI scan between tumour tissue and normal brain using an image segmentation method. This incorporated an automated method of labelling tumours according to their constituent patterns of water diffusion. These patterns were different between tumour regions and normal brain as well as between different tumour types. We tested the diagnostic role of the technique using a statistical model and have shown that it compares favourably with the diagnostic accuracy of conventional MRI in practice.

Our method has the advantage of being non-invasive, not requiring intravenous contrast injection, fully automated and may potentially be performed using scanners present within most hospitals. Ultimately, it may be employed to reduce the requirement for tumour biopsy which is associated with morbidity and in some cases mortality. The ability of this technique to identify a boundary between tumour and normal appearing brain may have other uses such as guiding the margins of tumour resection, monitoring response to chemo/radiotherapy or evaluating subtle changes in lesion size over time in the case of inoperable or partially resected tumours.

Top: Acquisition of MRI scans using 3 Tesla system

Bottom left: Right frontal mini-craniotomy performed using guidance system to expose brain surface prior to tumour resection

Bottom right: The segmentation technique