Enhancing the magic of MRI

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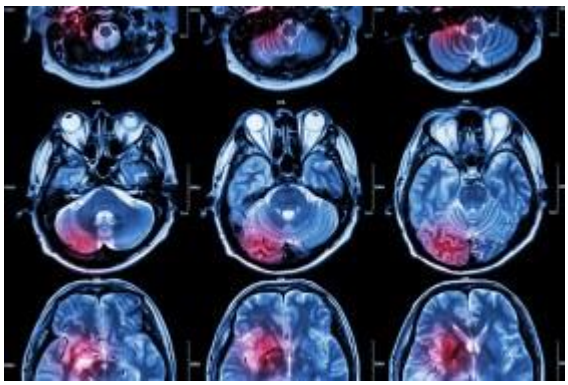

MRI or magnetic resonance imaging is an amazing technical marvel, the ability to see into the human body in a non-invasive way is nothing short of magic. The famous science fiction writer Arthur C Clarke once said 'Any sufficiently advanced technology is indistinguishable from magic' he could easily have been referring to MRIs. But like any magic, there is an awful amount of work required behind the scenes to produce the perfect illusion.

Magnetic resonance images are a type of illusion because an MRI machine detects changes in the magnetic field of atoms in the human body and then calculates an image from the pattern of these magnetic fields. The powerful magnets of an MRI machine cause the atoms in the body to change their magnetic fields, these changes are temporary, and the atoms revert, or 'relax' back, to their natural state or resting state at different times, allowing the detection of different molecules in the body, and this allows a picture of the brain to be generated.

Radiologists utilise differences in molecules' relaxation time, and differences in magnetic field direction to capture different types of images. These different images are called T1 and T2, but they are by no means the only two types of images available to radiologists. The T1 and T2 techniques create different images of the brain, with the white matter of the brain appearing bright and intense in T1 images and fluids appearing darkly, whereas in T2 images, the brain white matter appears grey and fluids appear bright.

In MS, the challenge is to use these different MRI techniques to detect the intricate events that are occurring in the brain. Typically, MS can be readily picked up by a MRI with dark patches appearing in T1 images and bright patches in T2 images, and these patches are referred to as lesions. It is thought in MS that T1 lesions or dark spots represent loss of cells, whereas lesions seen when a contrasting agent is injected (such as gadolinium) are thought to represent areas of active inflammation. T2 images are used to see the total number of MS lesions, and are a rough indication of the extent of a person's MS.

A group of Australian scientists based at Universities of Sydney and Macquarie, and led by Professor Stuart Graham and Associate Professor Alexander Klistorner, have just recently published a study furthering our understanding of what the various patterns observed in MS might reflect. They recruited 75 people with relapsing-remitting MS and took multiple MRIs using various techniques including T1 and T2 with and without injecting contrasting agents. They then combined and compared the different images to see how much overlap and what similarity there was between the different images and whether there was any additional information that could be gathered by then combining the images.

They show that while the lesions on both T1 and T2 overlap, the T2 lesions tend to bigger and extend past the borders of the T1 lesions, and that this presumably reflects distinct changes occurring in the brain in these areas. They then concentrated on the way that the MRIs revealed the movement of

water molecules in and out of these different regions. They conclude that the central parts of T1 lesions do represent nerve fibre loss and that the areas where T1 and T2 lesions don't overlap probably are regions where de/remyelination are occurring. This rim of de- and re-myelinating tissue is an important detail to detect as it may provide a tool for testing the ability of new medications to stop myelin damage and enhance myelin repair.

Identifying and separating those patterns also has important implication for the diagnosis of MS, giving more precise information on lesion activities. It may allow us to follow disease progression before it physically manifests itself, giving early warning of disease activity and through this, also provide a tool for more accurately tracking the effects of new medications in clinical trials.

This study increases the clarity in which we see into the brain and may provide enhance the power and utility of MRIs in clinical use and clinical trials to diagnose and monitor disease.