Diffusion MRI in the Assessment of Stroke
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Abstract: Brain tissue microstructure is complex and the maintenance of this complexity is necessary for proper brain function. Water diffusing in the brain encounters many microstructural barriers, such as cell membranes and axons that have profound effects on diffusing water by inhibiting its motion. Diffusion-weighted imaging (DWI), an imaging technique that utilizes Magnetic resonance imaging (MRI), is a powerful tool that can be used to investigate brain tissue microstructure. With DWI, we can measure the average distance a water molecule moves during a certain time period and we can also estimate which direction the water is moving. As an example, water diffusing inside an axon would move along the length of the axon faster than across the axon. This is because the water does not encounter barriers to diffusion along the axon but has difficulty diffusing across the myelin coated sheath of the axon. In stroke patients, water diffusion is reduced by approximately 50%. Hence, DWI is widely used clinically as a tool for assessing the extent of ischemia. However, it has long been appreciated that DWI is capable, in principle, of yielding considerably more information about tissue microstructure. Our laboratory has invented a new approach to DWI called diffusional kurtosis imaging (DKI). This technique is of interest since it has the potential to be a more specific indicator of tissue microstructure than DWI alone. Here, we will present the first results of DKI in human stroke. Our results may lead to a better understanding of tissue viability following stroke.