# Correlation of Fractional Anisotropy in Rhesus Monkeys with Age and Motor Function

**P. A. Hardy[1], D. K. Powell[2], and Z. Zhang[3]**

[1]Biomedical Engineering, University of Kentucky, Lexington, Kentucky, United States, [2]MRISC, University of Kentucky, Lexington, Kentucky, United States, [3]Anatomy and Neurobiology, University of Kentucky, Lexington, Kentucky, United States

INTRODUCTION: A common observation across multiple species is the gradual motor slowing with advancing age. Understanding the biological changes which accompany or explain motor slowing is a major goal of research into aging. Rhesus monkeys are frequently used as a facsimile of human aging as their brain organization is very similar albeit smaller than that of a human. In this diffusion tensor study we used cohorts of young and old rhesus monkeys who were well characterized behaviorally and correlated their activity level with white matter fractional anisotropy determined from high resolution diffusion tensor images.

METHODS: We studied a group of twelve research naïve rhesus monkeys between the ages of 6 and 25 using diffusion tensor imaging. Rhesus age at approximately three times the rate of humans hence these animals correspond to young adults and aged individuals. The animals were anesthetized with pentobarbital and imaged on a 3.0T Siemens Trio imager. A custom-built, single channel, receive-only coil was built on a fiberglass frame and used to enhance the received signal. Imaging consisted of double echo, diffusion-weighted, echo planar images with a spatial resolution of 1.25 X 1.25 X 2.0 $mm^3$. Forty eight diffusion directions with six b values from 500 to 3000 $s/mm^2$ were acquired in an acquisition which lasted approximately 30 minutes. The images were analyzed using FSL. Specifically the images were corrected for susceptibility and eddy current distortions and normalized using a non-linear registration algorithm to a common space. The motor function of the animals was characterized using *Actical* monitors which recorded the animal's movement (in arbitrary units) continuously over period of approximately 30 days. The activity level of the animals was divided into average values during the twelve hours of daylight and twelve hours of night time. The FA images for the twelve animals were analyzed using a general linear model which regressed FA against Age and Activity level during the twelve hours of day time. This analysis was carried out in RANDOMISE.

RESULTS: The average ages of the two groups of animals were young (n=6) 6.8+/-0.6 yr and old 23.5 +/- 1.7 yr. The activity levels of the animals varied greatly: low activity (n=6) average 86+/-27 (au) vs high activity (n=6) average 271+/-129 (au) but were uncorrelated with the age of the animals. Thus chronological age was a poor predictor of motor activity. The correlation of the FA data with activity with age as a confound revealed several white matter tracts with significant correlation. Specifically, regions within the cortical-spinal tract, the external capsule and the corpus callosum were identified with a significance level of $p<0.025$.

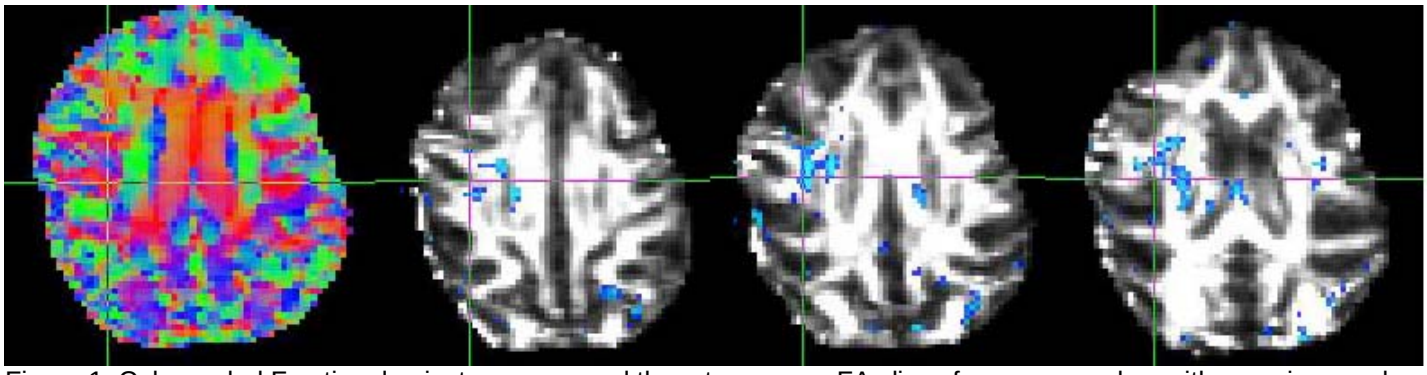

Figure 1. Color-coded Fractional anisotropy map and three transverse FA slices from one monkey with superimposed regions of correlation with activity. Regions were significant at $p<0.025$. Slices are separated by 2 mm.

DISCUSSION: These results are supportive of the contention that diffusion tensor imaging measures an important physical property of white matter. Higher FA may indicate more heavily myelinated white matter or tracts with a denser distribution of axons. These regions of higher FA correlate highly with increased activity of the animal and thus may be an objective method of assessing the effects of aging on motoric decline.

REFERENCES:

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