

# Diffusion Tensor Imaging Reveals White Matter Damage in the Optic Nerves of Alzheimer's Patients

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**Introduction** In addition to cognitive decline, Alzheimer's disease (AD) patients commonly display visual deficits<sup>1</sup>. Because the visual cortex was shown relatively unaffected in AD<sup>2</sup>, the visual deficits in AD may be the result of damage within the visual pathway. Recent data from optical coherence tomography (OCT) studies have showed reductions in retinal layer thickness in AD, compared to controls, suggesting potential loss of retinal ganglion cells (RGCs) in AD<sup>3</sup>. RGC axons make up the optic nerve. Optic nerve damage in AD may be an important indicator of neurodegeneration in AD, though the optic nerve integrity has not been studied in living patients. In this study, DTI scans from the ADNI database were analyzed to measure optic nerve changes between AD and Controls.

**Materials and Methods** DTI scans from thirty AD patients, along with twenty age-similar cognitively normal controls were selected from the ADNI database. Average age was similar between the two subject pools (77 years for AD vs. 75 years for controls) diffusion-weighted scans were first aligned to a matching T1 reference scan using 3D Slicer (Fig 1). After alignment, the scan was processed to create maps for all parameters measured (Fractional anisotropy (FA), Trace Diffusion (TR), Parallel ( $\lambda_{||}$ ) and Radial ( $\lambda_{\perp}$ ) Diffusivity). The optic nerve was identified using the T1 scan and the region of interest applied to all the parameter maps.

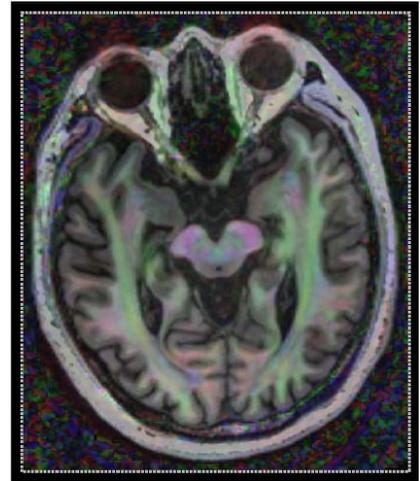


Figure 1. Alignment of structural T1 scan with diffusion-weighted image

**Results** AD patients show increases in TR and  $\lambda_{\perp}$  as well as decreases in FA within the optic nerves, compared to controls (Fig 2.) Differences in TR and  $\lambda_{\perp}$  between AD and control patients were more pronounced at advanced patient age.

**Discussion** To our knowledge, this is the first study showing DTI changes in AD optic nerve. Our findings are consistent with OCT studies showing degeneration in RGCs<sup>3</sup>. Currently, MRI is used to examine brain atrophy which usually occurs at late stage of AD. DTI has the advantage over traditional MRI of being sensitive to microstructural changes, such as demyelination and axonal degeneration. In vivo DTI to detect optic nerve degeneration may provide a tool for the diagnosis of AD.

## References

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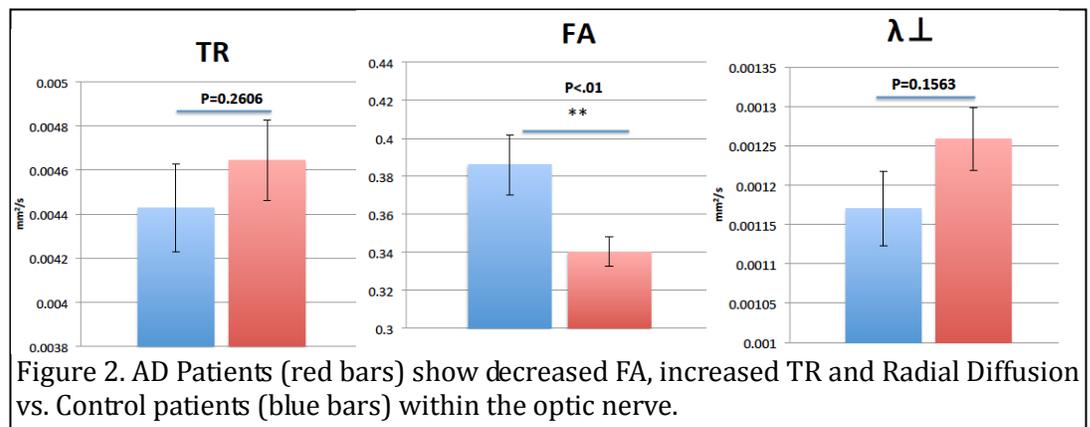


Figure 2. AD Patients (red bars) show decreased FA, increased TR and Radial Diffusion vs. Control patients (blue bars) within the optic nerve.

## Acknowledgement

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