MR Microscopy of the Isolated Retina Using Microcoils

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Introduction

The retina is a thin multilayered structure at the back of the eyeball that converts light into electrical signals for the brain to construct our vision of the world. Understanding its structure and function and how it changes is vital for the diagnosis and treatment of a variety of ocular diseases. MRI has improved to be an important tool for eye studies *in vivo* and *ex vivo*; however the thin nature of the retina and its position in the eye limit the spatial resolutions possible. We have previously achieved around 40 microns in plane at 17.6T on the ex vivo eye (1). In this report we describe our first attempts at MR microscopy of the isolated retina using MR microcoils, achieving the highest resolution retina images to date.

Experimental

MR microscopy was performed on isolated fixed mouse eye retina imaged on a 600MHz narrow bore Bruker instrument. Data were acquired in a *q*-space acquisition format. Image resolution was 10x10x10 microns. The apparent diffusion coefficient (ADC) was calculated from six-direction diffusion tensor data.

Results and Discussion

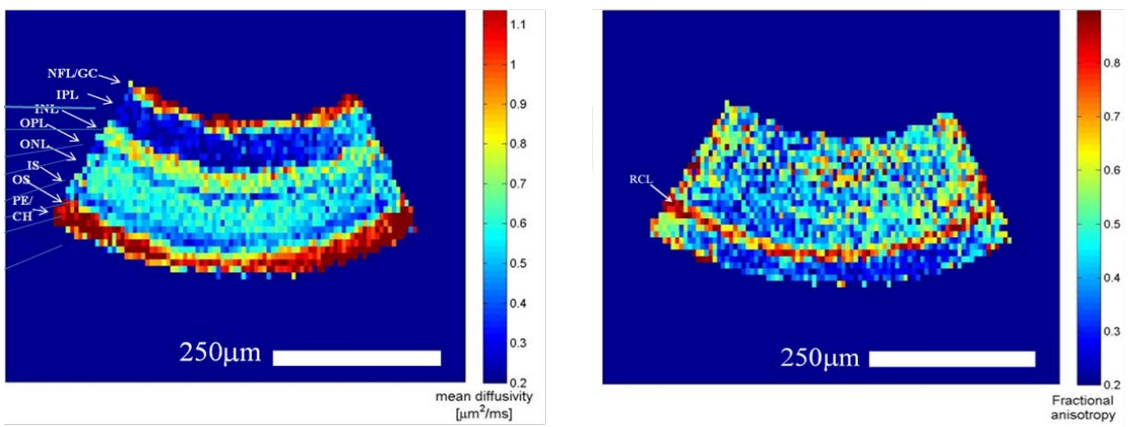

Figure 1. (left) and mean diffusivity map; (right) fractional anisotropy map of the mouse retina.

In **Figure 1**, all layers of the retina are distinguishable in the diffusivity map: NFL/GC nerve fiber /glial cell layer, IPL inner plexiform layer INL inner nuclear layer OPL, outer plexiform layer ONL, outer nuclear layer, IS inner segment [rods & cones], OS outer segment [rods & cones], PE/CH pigmented epithelium/choroid.

In the MR image (bottom left) all laminae are visible but only the layer corresponding to the inner rod and cone segment possesses anisotropy sufficient to generate contrast with adjacent layers.

Conclusions

These data represent the highest resolution images of the retina to date. The data can be used to interpret the necessarily lower resolution images on *ex vivo* isolated eyes or *in vivo* MRI. Future studies will involve improved resolutions and studies of a variety of ocular diseases.

Acknowledgements

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References

1. Calzi *et al*., Microvascular Research 78(1); 132-139 (2009).