

# Development and Stability Testing of an MRI Compatible Isolated Tissue System

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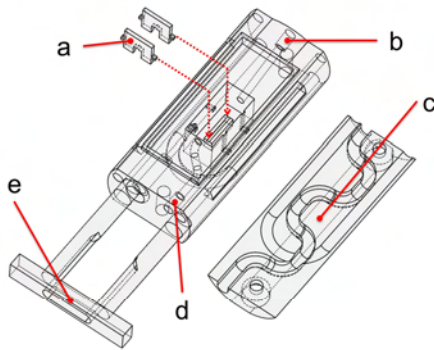


Figure 1: MRI compatible incubation chamber (exploded), produced in nylon using 3D selective laser sintering. Circular diameter of the main chamber = 26mm. a) inserts for grease-gap electrophysiology which sit over the central bench to support the optic nerve, b) medium inflow, c) preheating system in lower section of chamber, d) medium outflow and e) tubing support and isocentre positioning bar.

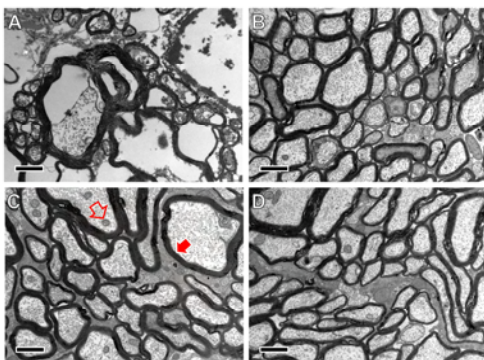


Figure2: Transmission electron microscope images at 20k of four treated optic nerves. a) oxygen and glucose deprived for 2 h. b) immediately fixed nerve. c) aCSF for 5 h within the chamber, d) aCSF for 10 h within the chamber. Open arrow shows a healthy mitochondria, the solid arrow shows compact myelin layers surrounding an axon. Scale bars =1μm.

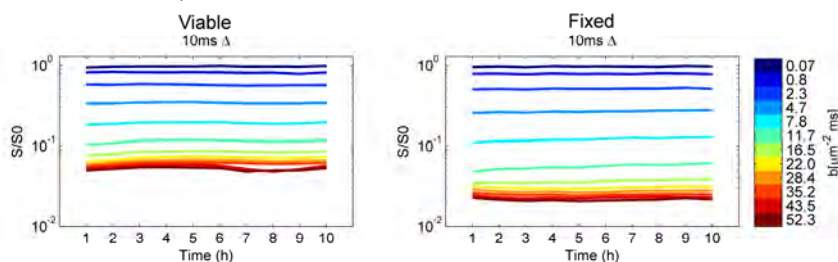


Figure3: 10ms  $\Delta$  example: Representative semi-log diffusion-weighted signal at various  $b$ -values from diffusion MR experiments on a viable (left) and a fixed (right) optic nerve. Both nerves were scanned with range of diffusion weightings once per hour  $\Delta = 10\text{ms}$  for 10 h.

**Discussion:** In this work we demonstrate the structural, functional and MR stability of rat optic nerve within this MRI compatible tissue maintenance chamber over time. We hope that this well validated system may become a standard model for examination of viable isolated tissue: finding uses for validation of quantitative MRI (for example, contrast agent uptake, axon diameter measurements and tractography) and will be of particular use in testing of diffusion MRI white matter models (reviewed in [6]). In contrast to other recent viable excised tissue models, this system: 1) Operates and maintains the tissue temperature at  $36.5 \pm 0.5^\circ\text{C}$ , 2) Is validated for 10 h with electron microscopy, electrophysiology and diffusion MRI, 3) Is a reliable, reproducible high field MRI compatible piece of equipment which could be used in various MRI scanners.

**Selected references:** [1] Perrin, M. *et al.* *PHILOS T R SOC B*, **360**, 881-891 (2005). [2] Shepherd, T.M. *et al.* *MAGN RESON MED*, **62**, 26-34 (2009). [3] Alexander, D.C. *et al.* *NEUROIMAGE*, **52**, 1374-1389 (2010). [4] De Juan, J. *et al.* *ACTA ANAT*, **102**, 294-299 (1978). [5] Garthwaite, G. *et al.* - *EUR J NEUROSCI*, **11**, 4367-4372 (1999). [6] Panagiotaki, E. *et al.* *NEUROIMAGE*, *In press* (2011), doi:10.1016/j.neuroimage.2011.09.081. **Acknowledgements:** Peter Johnson, Dr Giti Garthwaite, Professor John Garthwaite. Funding: MRC Capacity Building Studentship.