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### ABSTRACT SUBMISSION

**Title:** Sensitive detection of axonal injury using double pulsed field gradient MRI

**Abstract No.** 0037

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#### Abstract

**Introduction:** Sensitive measurements of changes in tissue microstructure in the nervous system can improve the detection and diagnosis of pathology. Following mechanical, chemical, or metabolic insults<sup>1</sup> axons exhibit a beaded morphology, but Diffusion Weighted MRI (DWI) methods like DTI are not sensitive or specific enough to characterize the underlying pathology. Methods like Double Pulsed Field Gradient (d-PFG) MR<sup>2,3</sup>, which provide microstructural information, such as average cell size, cell shape, and microscopic anisotropy, may be able to detect these microscopic changes. In these studies d-PFG MRI was used to characterize beading in a nerve injury model.

**Material & Methods:** Fixed samples of rat sciatic nerve subjected to axial tension sufficient to induce beading were used as a model of acute axonal injury. A 7T vertical bore scanner with a micro-2.5 gradient set (Bruker Biospin) was used. D-PFG filtered MRI sequences were applied. Bead diameters and length size distribution were obtained by fitting the data to a mathematical model, with beads characterized as combinations of spheres and infinite cylinders<sup>4</sup>.

**Results & Discussion:** The beaded sciatic nerves displayed a clear difference in the d-PFG measurements compared to control nerves. In control nerves, fitting yielded a distribution of axonal diameters measured perpendicular to the nerves and low restriction parallel to the nerves in agreement with straight, parallel nerve morphology. In the injured nerves, on the other hand, fitting yielded two unique distributions for the diameter perpendicular to the nerves and high restriction parallel to the nerves, reflecting the beaded morphology. Preliminary histological data agree with those findings.

**Conclusion:** d-PFG MRI shows promise for characterizing tissue microstructural features in acute axonal injury such as stroke, traumatic brain or spinal cord injury. Methods like d-PFG MRI have the potential to more accurately characterize tissue microstructure and enable *in situ* and *in vivo* detection of specific pathologies.

**References:** 1. M.D. Budde, J.A. Frank, *Proc. Natl. Acad. Sci.*, 107, 14472-14477, (2010), 2. P.P. Mitra, *Phys. Rev. B*, 51, 15074-15078, (1995), 3. M.E. Komlosch et al., *J. Magn. Reson.* 208, 1168-1177, (2011), 4. D. Benjamini et al., *J. Magn. Reson.* 230, 198-204, (2013)

**Approval** Confirm

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