EVALUATION OF MYELIN CHANGES DURING CHRONIC NERVE COMPRESSION

K Rowshan, T Chao, T Mozaffar, O Steward, R Gupta, Depart of Orthopaedics; UC-Irvine, Irvine, CA.

INTRODUCTION. Studies have shown that the chronic nerve compression (CNC) induces changes in the structure and microvasculature of peripheral nerves. In a previous study, we demonstrated that CNC of rat sciatic nerve, a model of compressive neuropathies, triggered dramatic Schwann cell proliferation and concurrent apoptosis. This Schwann cell response occurred before signs of overt axonal pathology, raising the question of whether there are alterations in axonal myelination in the areas of the nerve in which Schwann cell apoptosis and proliferation occur. Here, we sought to use rigorous techniques of stereology and nerve teasing to provide data about myelination and nerve injury. METHODS. Previously described model of CNC was applied to Sprague rats. Nerves were harvested at 1 and 8-months. Design-based, unbiased stereologic counting techniques were used to quantify changes in myelin thickness and axonal diameter. Also, single myelinated axons were manually teased apart from the nerve using ultrafine forceps to evaluate internodal length (IL), axonal diameter (AD), and myelin changes. RESULTS. There were no significant electrophysiological changes at 1-month. By 8-months, NCV consistently decreased to 65% of normal. CNC induces significant alterations in IL and myelin structure. Normal fibers exhibited thick healthy myelin without areas of demyelination with IL and AD of 1231ìm ± 107 and 5.45ìm ± 0.87, respectively. At 1-month, the mean IL was reduced to 335ìm ± 96 with an AD of 5.26ìm ± 1.12. Each teased fiber exhibited segments of demyelination with remyelination and areas of normal myelin. Demyelination began at the paranode and regressed into the internode. At 8-months, a reduction of IL to 397ìm ± 152 was noted in all segments of each fiber with an AD of 4.89ìm ± 1.03. Myelin thickness was noted to be 49% and 62% of normal nerves at 1 and 8 months, respectively. Measures of myelin thickness revealed a > 6-fold increase in axons with very thin (<5ìm thickness) myelin sheaths, also a proportional decrease in axons with the thick myelin sheaths characteristic of normal nerve. CONCLUSION. This study confirms the hypothesis that CNC induces segmental demyelination. CNC induces regions of segmental demyelination that were evident as early as 1-month without signs of axonal death. As the naked healthy axon is exposed to the surrounding milieu, Schwann cells adhere and produce new, thinner myelin. These results confirm that an early consequence of chronic nerve compression is local demyelination and re-myelination, which may be the primary cause of alterations in nerve function during the early period post-compression.