Activity Dependent Myelination and Remyelination

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Oligodendrocytes are cells within the central nervous system (CNS) that produce myelin, a multilamellar structures insulating axons and allowing the rapid conduction of action potentials. These cells are derived from oligodendrocyte progenitor cells (OPCs), a class of progenitors highly abundant during development but also persistent in the adult brain, where they contribute to myelin remodeling and regeneration. Compelling evidence indicates that OPCs are dynamic and sense neuronal activity. Indeed, these cells preferentially myelinate electrically active axons and neurotransmitter vesicular release along axons is a key modulator of the myelination process. Interestingly, OPCs are synaptically innervated by glutamatergic and GABAergic neuronal fibers throughout the CNS. These synaptic communications between axons and OPCs may constitute a possible mechanism to control oligodendrocyte development, and likely (re)-myelination in an activity-dependent manner. In line with this hypothesis, we recently investigated changes of the synaptic transmission in OPCs during remyelination of the mouse brain and showed alterations of OPC synaptic connectivity in response to demyelinating insults both in experimental models and in multiple sclerosis (MS) lesions. To decipher the functional role of axon-OPC synapses in myelination, we also developed zebrafish lines for live imaging of synaptic connectivity on oligodendroglial cells. We showed that synaptic glutamate vesicular release plays a critical in myelination *in vivo*. Furthermore, we demonstrated that axon-oligodendroglial synapses are kept in oligodendrocytes during myelin internode growth, suggesting new functions these axo-glial communications in myelin plasticity and remodeling, which could have a broad implication in neurodegenerative and neuropsychiatric diseases.