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I completed my Bachelor of Science with honours in Neuroscience and Human Biology at the University of Toronto in 2018 and began my Ph.D. in Neuroscience with Dr. Jason Plemel at the University of Alberta in 2019.

Throughout my Ph.D., I worked to uncover central processes during white matter repair by probing the immune basis of repair in multiple sclerosis (MS). I identified novel immune states present in brains of people with MS that can be targeted to regenerate brain lesions.

Microglia, the immune cells of the central nervous system, are essential for efficient myelin regeneration, or remyelination—a process that occurs naturally in people with MS but is often inadequate and declines with age. Prior to my study, it was known that microglia form environment-specific states; however, the states present throughout remyelination and their differences in young and aged environments were unknown.

Here, I used mouse models of remyelination and single-cell RNA sequencing to identify novel microglial states specific to the key stages of remyelination, each with a distinct functional signature. I showed that microglia first adopted states that engaged in pro-repair pathways and then transitioned into states that resolved these pathways and were akin to homeostatic microglia. I also found that aging disrupted either the emergence or resolution of these states, identifying states associated with successful repair in young environments that were dysregulated with age. One of the remyelination-specific states I identified was also enriched in human MS autopsy tissue, demonstrating strong translational relevance.

Overall, this work provides the first blueprint of microglial states that underlie effective remyelination. These states, along with their active gene regulatory networks, secreted ligands, and expressed receptors, now serve as actionable therapeutic targets. Mapping these states also opens the possibility of developing biomarkers to measure successful remyelination in people with MS.