

ENGINEERING

Discovery of Undescribed Brain Tissue Changes Around Implanted Microelectrode Arrays

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Brain-implantable microelectrode arrays are devices designed to record or electrically stimulate the activity of neurons in the brain. These devices hold the potential to help treat epilepsy, paralysis, blindness, and deafness, and also provide researchers with insights into a variety of neural processes, such as memory formation.

While these devices have a very promising future, researchers are discovering that their long-term functionality is greatly limited by the brain's natural immune response to foreign objects. To improve the functional lifetime of these devices, one solution lies in fully characterizing and understanding this tissue response.

Roles for microglia and astrocytes in this biological response have been characterized. However, changes to oligodendrocytes, cells that myelinate axons, remain poorly understood. These cells provide insulation to the axons, which is required for proper neural functioning. Here we report on the changes that occur

with oligodendrocyte processes in tissue around microelectrode implants in the brain.

Six rats were surgically implanted with microelectrode arrays and allowed to recover for 1, 2, or 4 weeks. Subjects were then sacrificed and the brain tissue was processed using our recently developed method, Device-Capture Histology. Immunohistochemistry and confocal microscopy was employed to assess the response around the device. Results indicated a decrease in oligodendrocyte density and a loss in typical directional orientation of oligodendrocyte processes in tissue near the device. These results suggest alterations in the underlying neuronal networks around these devices, which may greatly impact the current functional utility of these promising devices.

Faculty advisor Dr. Kevin J. Otto writes, "The importance of this study is its contribution to understanding the basic cell types reacting to the device insertion and their dynamics. In the future, this work will assist researchers in understanding how devices or insertion parameters might be varied so as to completely mitigate the reactive tissue response, enabling reliable lifetime neural interfaces for neuroprostheses."