Glial Responses To Neural Devices

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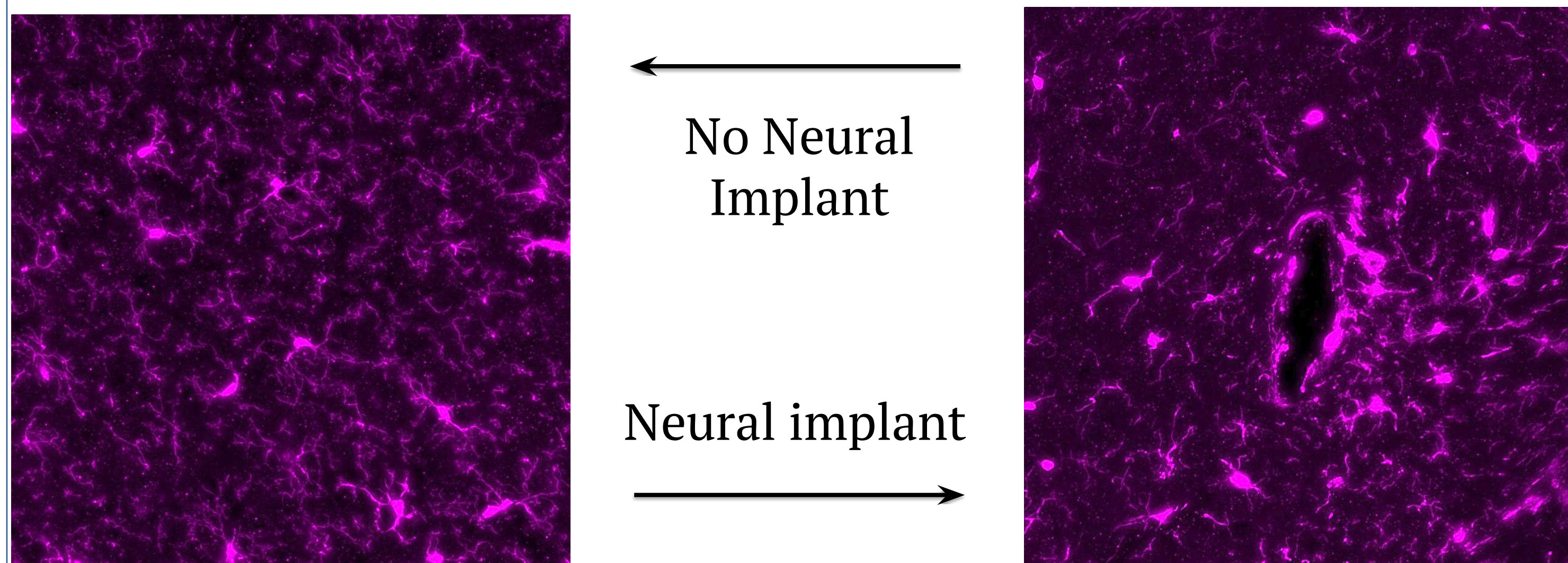
Introduction

- A critical concern arising from the interaction of neural implants with the brain's environment is the triggering of a foreign body response
- Microglia, as resident immune cells of the central nervous system (CNS), play an integral role in modulating brain function and maintaining neural health.


No Neural Implant ←

Neural implant →

- Understanding the morphological and cellular alterations in these cells is vital for advancing our comprehension of neurological disorders.
- Our research endeavors to combat user bias and excess time usage of the current methods of cell analysis by demonstrating the improved efficiency and accuracy of alteration data of our developed automated tools when compared to these methods

Methods and Materials

- Mice were grouped accordingly: either completely healthy, injured by inserting then removing probe, or having a silicon probe inserted in its brain. All implanted brains either had a 70 or 105-micron probe
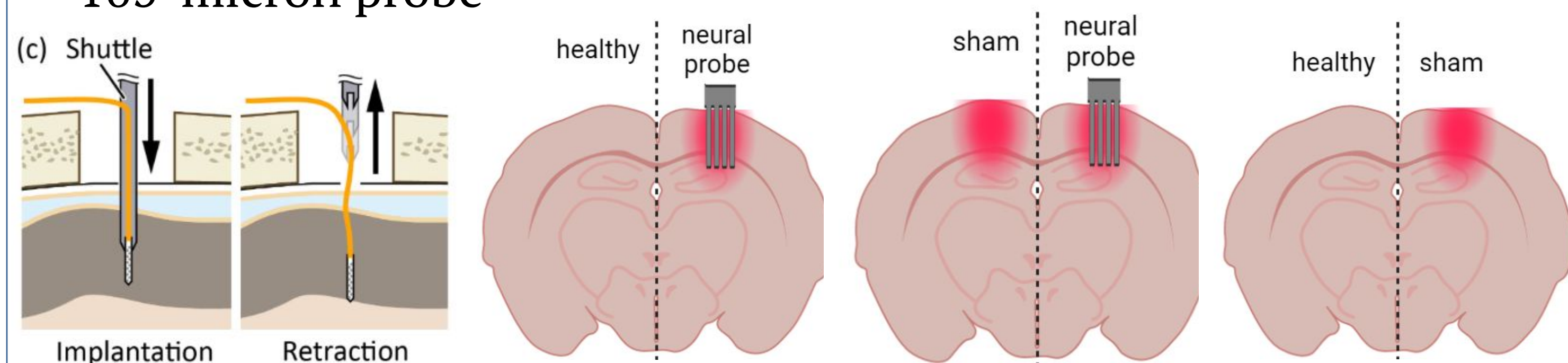
- Mice brains were collected at two separate time points, 2 weeks and 6 weeks, for image observation
- All organs were systematically embedded in Tissue Tek, cryosectioned, and then IHC staining was performed through the IBA-1 protein marker to stain for microglia
- Images were analyzed through a proprietary automated density tool and the current standard: Normalized Fluorescence Intensity (NFI). All NFI calculations were taken by calculating the ratio of Cy5 to DAPI
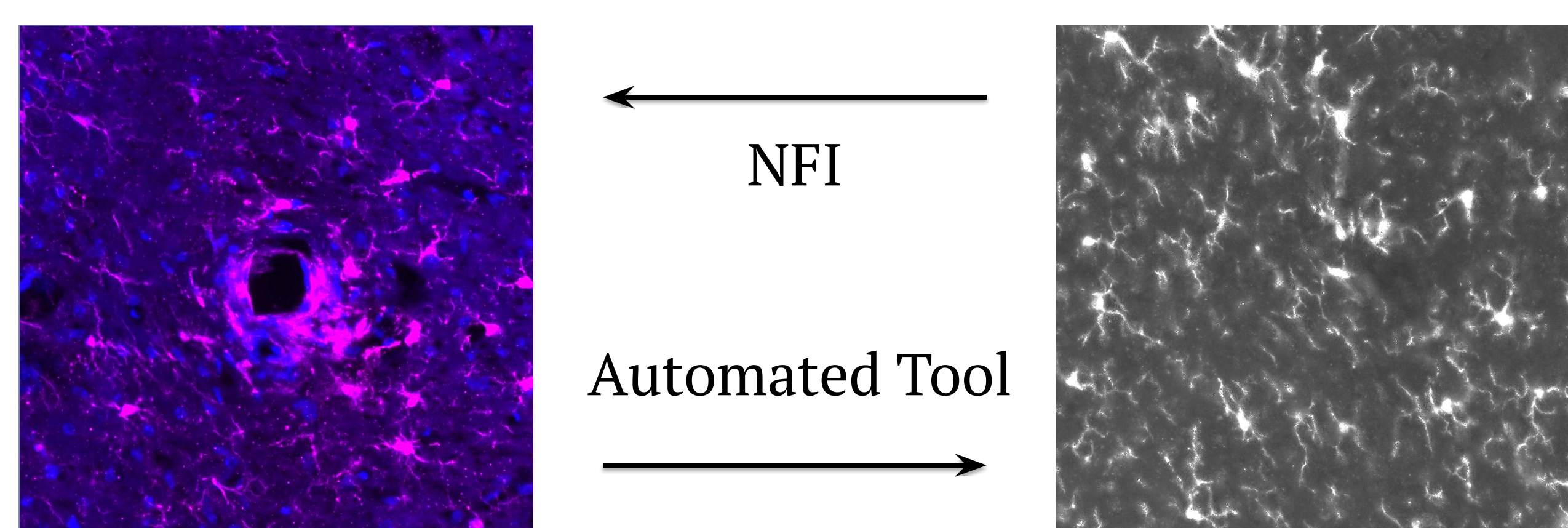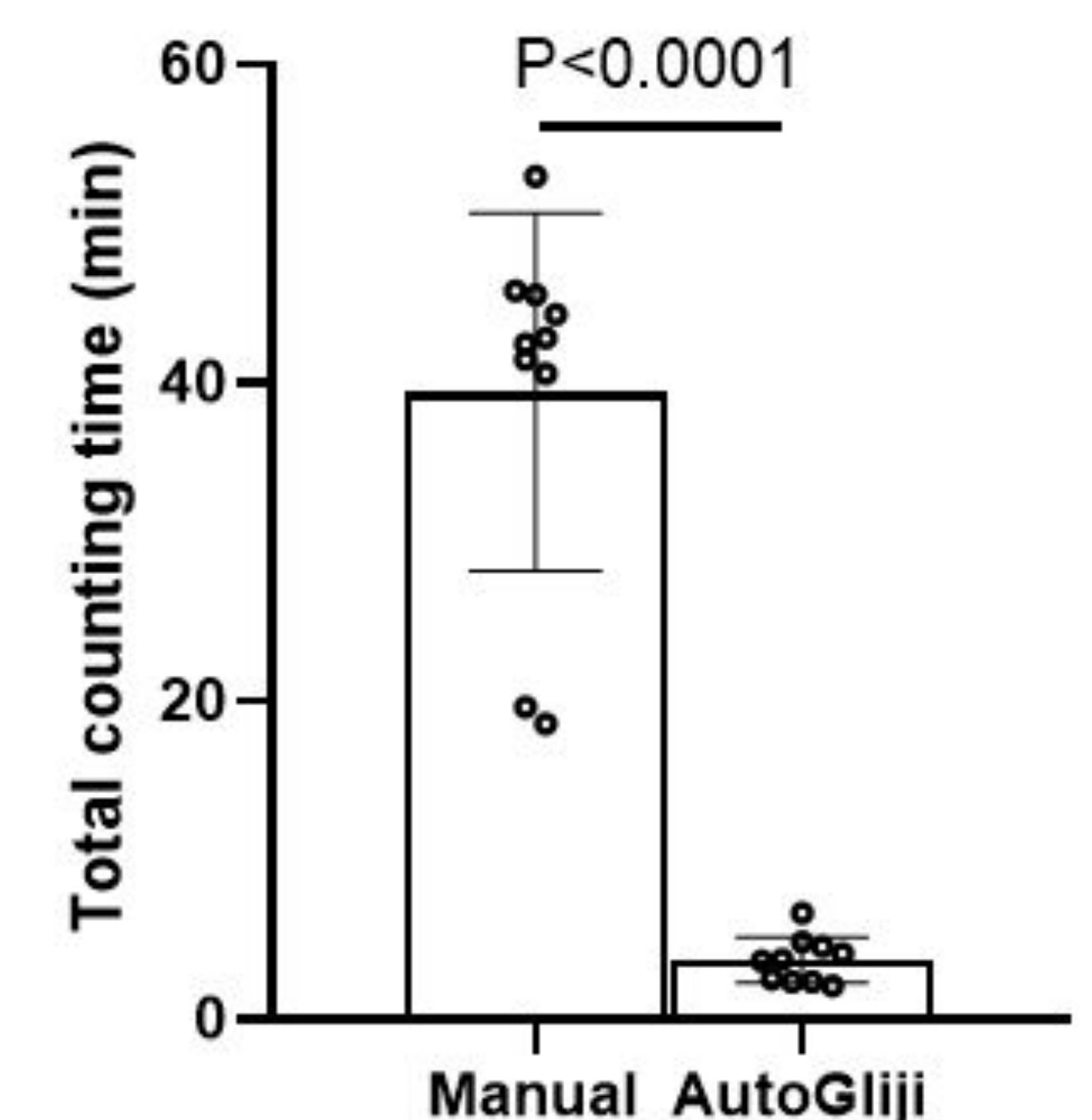

NFI ←

Automated Tool →

Results

Time:
- Using the Autogliji tool as a reference point, measuring Microglia by hand took nearly 35 minutes longer on average than the automated tool required
- This demonstrates how much more efficient automation proves to be when compared to human or manual tasks

Accuracy:
- The Automated Density was compared to NFI calculations, the standard, to determine how accurate NFI was
- The bars, especially the silicon implant, showed much more response in the density tool calculations rather than NFI
- Given how the tool was already tested to be accurate, this shows how inaccurate the standard methods researchers use are
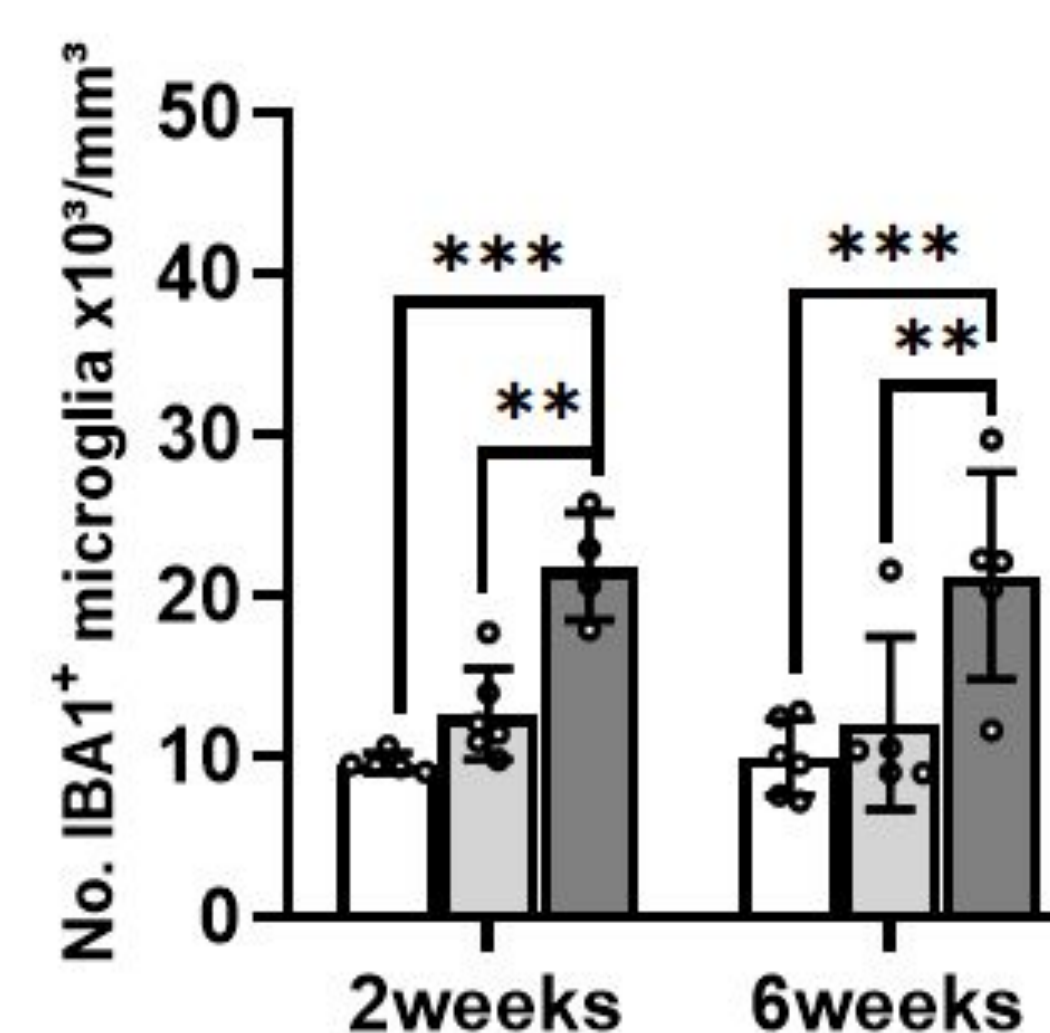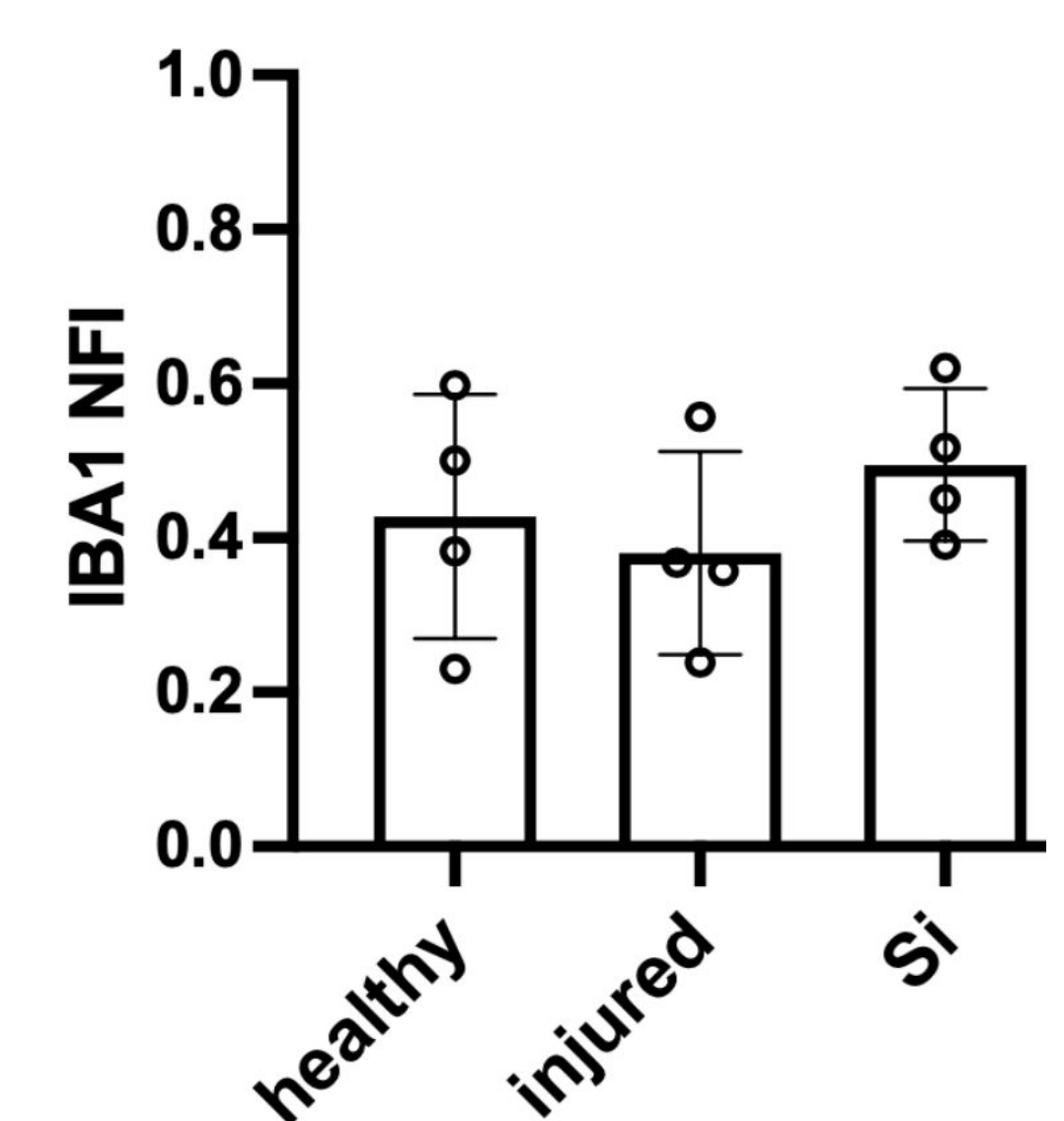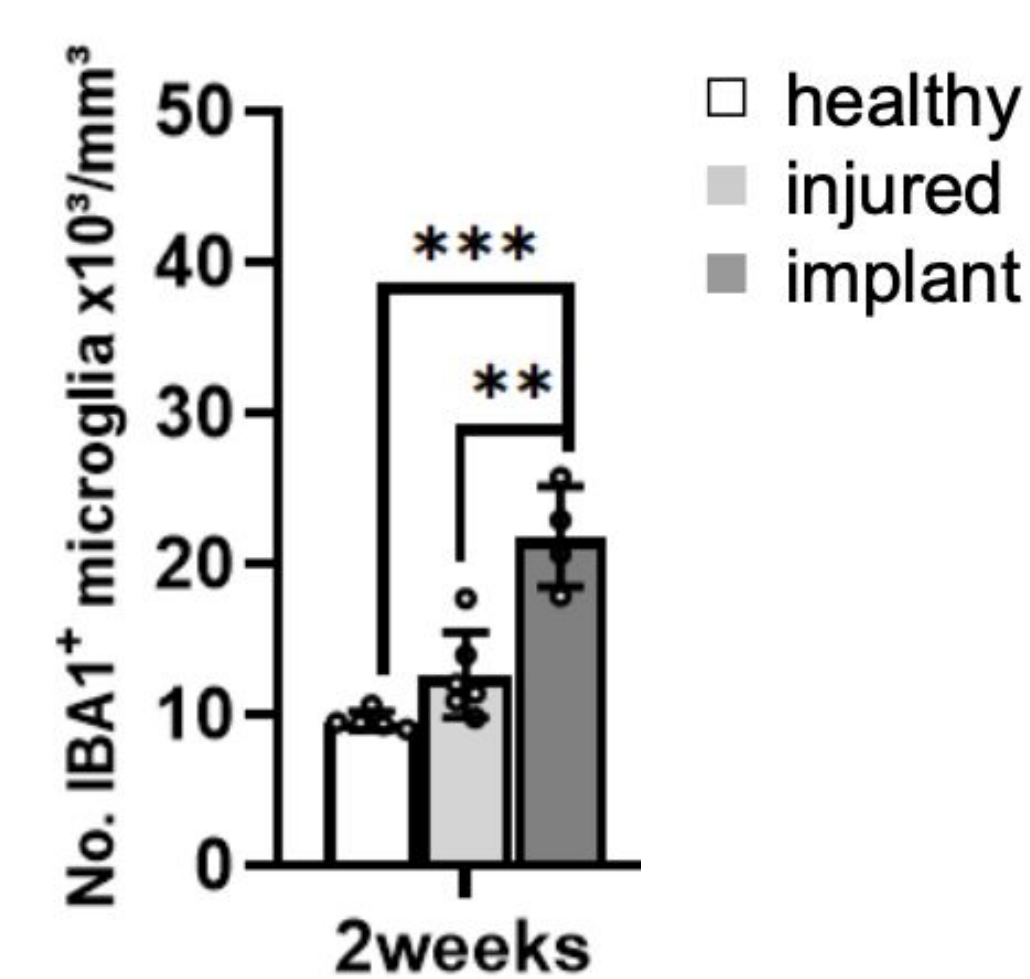
Density:
- The comparison across the different groups according to NFI calculations shows the significance in tissue response to the silicon neural probes in this experiment

Discussion

- The transition from manual to automated cell analysis marks a significant step forward in methodological advancement
- Future efforts:
  - Firstly, efforts can be directed towards establishing standardized protocols for automated cell analysis, ensuring consistency across studies and facilitating robust comparisons.
  - Secondly, while our automated tools have exhibited superior accuracy and speed in quantifying microglial parameters, future research can focus on refining the algorithms to capture more nuanced morphological features to aid in various medical disease diagnoses and treatment paths

Acknowledgements

References

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