REDUCING THE BRAIN FOREIGN BODY RESPONSE: SILICONE ELASTOMER AND PEDOT:PSS BASED ULTRA-SOFT NEURAL IMPLANTS FOR CHRONIC RECORDINGS

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ABSTRACT

Neural implants have the potential to improve the quality of life for individuals suffering from various neural-related disorders that otherwise have no recourse. Unfortunately, these systems perform poorly when subjected to long-term use. Evidence suggests that a major cause of failure in neural implants is the mismatch between the soft brain tissue (1 kPa) and the stiff implant material such as silicon (180 GPa) that exacerbates the brain foreign body response. This research aims to fabricate a novel neural implant that has a Young’s modulus similar to that of the brain using a soft silicone elastomer to form the substrate and the conductive polymer poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) to form the electrodes. The research will assess the effects that the ultra-soft neural implant has on the brain foreign body response in mouse subjects and will assess the ultra-soft neural implant’s functionality for chronic recordings. The realization of a neural implant with a similar Young’s modulus as the brain has yet to be accomplished, and should this research be successful it will help overcome obstacles currently preventing neural implants from being viable treatment options for neural disorders requiring chronic neural implants.

A NEUROIMAGING STUDY OF THE EFFECTS OF EARLY VS. LATE ANTI-INFLAMMATORY TREATMENT IN THE TGF344-AD RODENT MODEL OF ALZHEIMER’S DISEASE

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ABSTRACT

Alzheimer’s disease (AD) is a progressive neurodegenerative disorder with no effective treatments or known biomarkers for definitive diagnosis, substantiating the need for early detection and early intervention. One treatment option is chronic administration of non-steroidal anti-inflammatory drugs (NSAIDs). Since the effect of NSAIDs appears to differ at various stages of AD, finding a biomarker to determine when NSAID administration will be effective is crucial. Pre-clinical development of biomarkers and testing of treatment options in animal models of AD represents an important step towards clinical trials, since progression of AD pathology in the brain can be followed longitudinally and non-invasively in a controlled setting. To this end, this project employs Magnetic Resonance Spectroscopy (MRS) in a new rodent model of AD. MRS is an in vivo technique that has been used to quantify neurochemicals known to change over the course of AD, and may therefore also provide insight into treatment efficacy. The aim of this study is to assess longitudinal changes in neurochemistry and behaviour in a rat model of AD under treatment conditions consisting of early and late administration of Naproxen, a common NSAID. I hypothesize that i) disease-dependent changes in neurotransmitter levels in the rat model will parallel those reported in humans, ii) neurochemical changes will relate to progressive cognitive impairment, and iii) early but not late treatment with Naproxen will protect against disease-related neurochemical and behavioural changes. Together, the neuroimaging paradigm and NSAID intervention represent a promising step towards better understanding AD progression and development of new prevention and treatment strategies.

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