Abstract- Engineering 3D human dopaminergic implants

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Parkinson's disease, a common neurodegenerative disorder, is caused by the degeneration of dopaminergic neurons in the substantia nigra part of the midbrain, resulting in motor and cognitive symptoms. There have been several approaches proposed for replacing damaged dopaminergic neurons in patients with Parkinson's disease, including implanting stem cells-derived dopaminergic neurons into the substantia nigra. By using defined protocols, stem cells, including induced pluripotent stem cells, can be differentiated into dopaminergic neurons, and the dopaminergic-like phenotype of these neurons can be determined. However, there are several drawbacks to this method, among them the possibility of provoking an immune response and the short survival of the injected neurons.

In the research, we aim to overcome these limitations by creating 3-dimensional patient-specific neuronal implants capable of dopamine secretion. We created ECM-based hydrogel that provides a supportive environment for cell culture and acts as a biocompatible scaffold for dopaminergic neuron culture. Our preliminary results show the co-expression of dopaminergic neuron markers, as well as a significant increase in dopamine secretion between days 0 and 30 of differentiation. Future experiments will first focus on examining the biological interaction between dopaminergic implants and brain slices ex vivo. Following, we will explore the potential of the dopaminergic implants to interact with the diseased brain, secrete dopamine, and their ability to restore function in the Parkinsonian brain.