3D U-Net Analysis of Oligodendrocytes in Human Brain Organoids: Exploring Myelin Disorders and Therapeutic Pathways

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Abstract

Myelin disorders such as Pelizaeus-Merzbacher Disease (PMD) involve oligodendrocyte dysfunction and impaired myelination, and effective therapies are hampered by the lack of human-specific models. Bioengineered neuronal organoids (BENOs) provide a promising platform for the imaging of oligodendrocytes and the study of these disorders in a human-relevant context. However, existing imaging techniques capture only partial organoid slices, failing to represent the complete three-dimensional cellular architecture. To overcome this, we propose the 3D Oligodendrocyte Morphometrics (3DOM) tool, which uses a 3D U-Net architecture to enable comprehensive whole-organoid analysis of oligodendrocytes.