In this research project, we aimed to elucidate artificial intelligence and brain function by developing a tissue called "connectoid" that mimics neural circuits by connecting neural organoids made from human iPS cells and functionalizing them. To achieve this, we modeled the complexity of brain activity beyond ordinary neural organoids by imitating the "connections" between regions in the brain, assigning different roles to each organoid. We aimed to construct a circuit that performs motor processing by stimulating an organoid expressing channelrhodopsin with a specific shape (spatial pattern) of light to provide a sensory input role and making the activity of the connected organoid a motor output. To accomplish this, we applied multiple patterns of light stimulation to the sensory organoid and obtained neural activity patterns on the motor output side using a multielectrode array. We amplified and digitized the obtained signals and examined the relationship between the given signal patterns and the output activity patterns. Upon repeated analyses using deep learning, we observed a trend of increasing input-output relationship strength with each test. This is thought to be due to the primitive circuit enhancement and learning-like changes caused by the strengthened circuit and increased pattern discrimination ability through repeated stimulation. Furthermore, we developed a schizophrenia model and analyzed changes in neural activity and gene expression. We are also developing a technique to cut neural organoids gently and quickly. While the low efficiency of recording neural organoid activity on multielectrode arrays is recognized as an issue, we have been developing a simple method to improve the recording efficiency of neural organoid activity. The future possibilities of this research project are expected to contribute significantly to various fields, not only the advancement of artificial intelligence research but also applications to brain-machine interfaces, the creation of bio-AI, and the development of therapeutic drugs for mental disorders. We will continue to develop and pursue the elucidation of the network functions of neural organoids.

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