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Brain-spanning Tissue Capture and Sequencing from Living Humans: Methods for Collection, Processing and Analysis of Tissue Residue on Intracranial Electrodes

Stanford scientists have developed innovative methods for safely collecting, preserving, imaging, and molecularly profiling human brain tissue that remains on explanted intracranial electrodes used in neurosurgical procedures. This technology addresses a significant missed opportunity in clinical practice: after intracranial electrodes used in surgeries for conditions such as epilepsy and Parkinson's disease are removed from the brain, the thin residue of attached tissue is thrown away, missing out on critical molecular information about human brain health, disease, and individual patient biology.

This invention establishes reliable protocols for the recovery and analysis of these live tissues, enabling high-quality single-cell and bulk RNA sequencing from fresh, patient-specific brain samples. Because we recover live tissue, cells could be cultured to generate disease- and patient-specific human cell lines, setting a new standard for basic science and preclinical research. Notably, the method does not require modifications to any clinical processes.

The method fills a significant gap. To our knowledge, no method can collect tissue samples from both superficial and deep parts of the human brain from living people. Biopsies of the brain are too dangerous, and tissue is rarely resected from deep or multiple parts of the brain (safer, noninvasive options like LITT or ultrasound are now standard of care). What we know about the molecular make-up of the human brain comes from deceased persons—meaning the insights all come from tissue that has been dying and changing for hours before it is preserved. This is a persistent and fundamental problem for science and medicine and motivated the development of this technology. With our novel approach, researchers and clinicians can access living, single-cell neuronal and non-neuronal cell populations from across the human brain, and finally link molecular profiling (RNA-seq) to electrical recordings (such as EEG) with a single person.

In summary, the ability to access molecular data from brain tissue across the human Brain represents a significant advancement in basic and clinical neuroscience, offering a new dataset that could revolutionize how clinicians plan interventional strategies for disease cures. We see a clear trajectory to transforming patient care in neuropsychiatric and neurological disorders.

Stage of Development
Proof of concept

Applications

- Precision medicine for patients
- Research reagents/tissue samples and single-cell gene expression datasets for pharmaceutical and biotech companies.
- Generation of patient- and disease-specific human brain cell lines for research.
- Mail-in clinical and research service for tissue processing and analysis.

Advantages

- First-in-field access to living human brain tissue across multiple brain regions
- Rich, scalable, and patient-specific
- Enables novel drug discovery

Innovators

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