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Large 3D Printed Skull Window for Neuroscience Research

3D printed skeletal prostheses

This technology is a method for creating a large, optically clear window in the skull that facilitates basic neuroscience research over a larger section of the brain. The technology has two components:

- **Robotic drill.** A computer numerical controlled (CNC) neurosurgery robotic drill precisely excises sub-millimeter thick, digitally defined sections of skull or bone. The robot drills in 10 µm increments, allowing the surgeon to stop drilling once the bone is sufficiently loose enough to be pried with forceps. This prevents damage to underlying dura and brain tissue.
- **Clear skull prosthetics** are digitally designed, 3D printed and optically clear. The morphologically realistic polymer prosthestic replaces excised sections of skull. It allows long-term (>200 days) optical access to 45 mm2 of the dorsal cerebral cortex.

This technology greatly expands the arsenal of neuroscience tools and therapies that can be used for basic research and pharmaceutical applications that require optical access to the brain.

Minimally invasive, reduced tissue damage and increased field of view

Light-based neurotherapies are difficult to use in vivo. The currently accepted method of obtaining optical access to the brain is to excise a section of skull, implant a planar glass coverslip, and shine light through the cranial window. This method offers good resolution but a small field of view. It can also deform the brain and damage the underlying tissue, disrupting therapies and experiments. Other technologies (e.g., skull thinning, light emitting probes/optical probe insertion, and wavefront shaping) suffer from poor resolution, a small field of view, or both. This new technology is minimally invasive, has low surgical variability, reduces tissue damage and dramatically increases field of view. The three dimensional geometry of the implants allow excision of much larger sections of the skull allowing for access to a much wider region of the brain.

Phase of Development

- Prototype built. Tested in vivo in mice models.

Benefits

- Dramatically increases field of view
- Reduces damage to underlying dura and brain tissue
- Increased reproducibility; low surgical variability

Features

Technology ID

20170158

Category

Life Sciences/Medical Devices
Life Sciences/Neuroscience
Life Sciences/Research Tools

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- Computer numerical controlled (CNC) neurosurgery robotic drill
- Creates large, optically clear window in skull
- 3D printed skull prosthetic
- Allows simultaneous use of light-activated therapies and other research tools over a larger section of the brain
- Minimally invasive

Applications

- Neuroscience research
- Neurosurgery
- Neuroprosthetics, neurotherapeutics
- Cochlear implants

Researchers

Suhasa Kodandaramaiah, PhD

Assistant Professor, Mechanical Engineering

External Link (www.me.umn.edu)

Timothy Ebner, MD, PhD

Professor and Department Head, Neuroscience

External Link (www.med.umn.edu)

Russell Eugene Carter

Researcher, Neuroscience

Publications

Cortex-wide Neural Interfacing via Transparent Polymer Skulls

Nature Communications, 10, Article number: 1500 (2019)

Interested in Licensing?

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