

# Intracranial EEG Phantom for Brain Stimulation Studies

**Date:** 3/26/2026

**Client:** Dr. Raheel Ahmed

**Alternative Contact:** Dr. Arun Karumattu Manattu

**Advisor:** Dr. Paul Campagnola

**Team:**

Avery Schuda (*Team Leader*)

Lilly Mackenzie (*Communicator*)

Helene Schroeder (*BSAC*)

Orla Ryan (*BWIG*)

Corissa Hutmaker (*BPAG*)

## Problem statement

Intracranial electroencephalography (iEEG) is routinely used in surgical planning for individuals with uncontrolled seizures. Transcranial magnetic stimulation (TMS) may provide complementary information for mapping out critical brain regions that should be avoided during surgery, however, there are still safety concerns around the use of TMS in patients with iEEG. The major safety concerns are the induction of electrical currents, heating, and displacement of the implanted electrodes. The goal of this project is to develop a phantom that can be used to simulate the effect of TMS on electrode currents, temperatures, and changes in position.

## Brief status update

This week we finished fabricating the 3D printed skull and the mold for creating the hydrogel brain. We also met with Dr. Manattu and Cameron at the PNL to discuss all the variables that go into TMS test and practice on some sample gels. Our plan is still to test the final model Friday 4/10.

## Difficulties / advice requests

None for now!



<b>Meetings</b>															
Client										X					
Advisor	X	X	X	X	X	X	X	X	X	X					
<b>Website</b>															
Update	X	X	X	X	X	X	X	X	X	X					

Filled boxes = projected timeline  
X = task was worked on or completed

## Previous week's goals and accomplishments

- Avery
  - Completed CAD model of the skull
  - 3D printed 2 halves of the skull and post processed prints
  - Helped make mold of the brain
  - Fabricated hydrogels to bring to PNL
  - Attended PNL session
- Lilly
  - Made silicone mold of 3D printed brain
  - Help prepare gels for electrical testing, create electrical testing figures
  - Fabricate hydrogels for TMS testing
  - Initial TMS testing and future planning at PNL
- Helene
  - Helped fabricate gels for electrical conductivity testing
  - Processed data from electrical conductivity testing
  - Went to PNL to discuss testing
- Orla
  - Conducted round three of electrical testing
  - Went to PNL to discuss testing logistics
- Corissa
  - Helped fabricate gels for electrical testing
  - Attended PNL testing session

## Current design

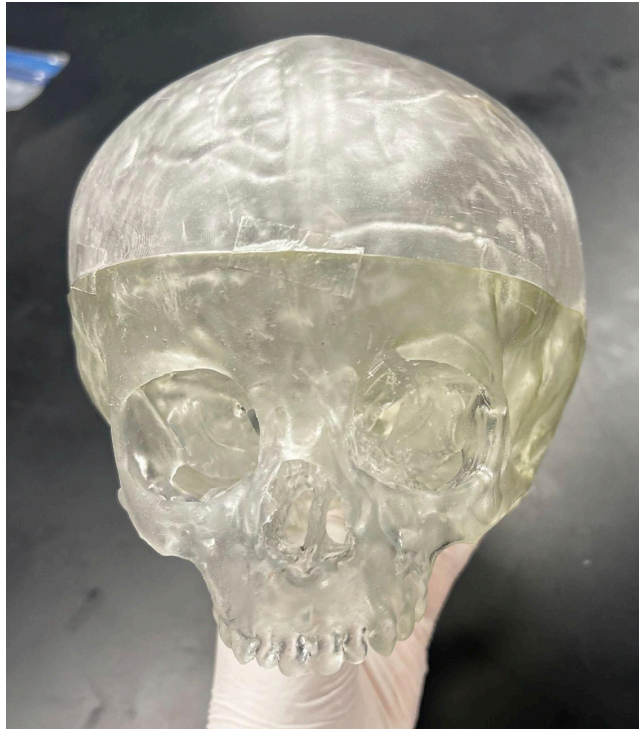


Figure 1: 3D printed skull model

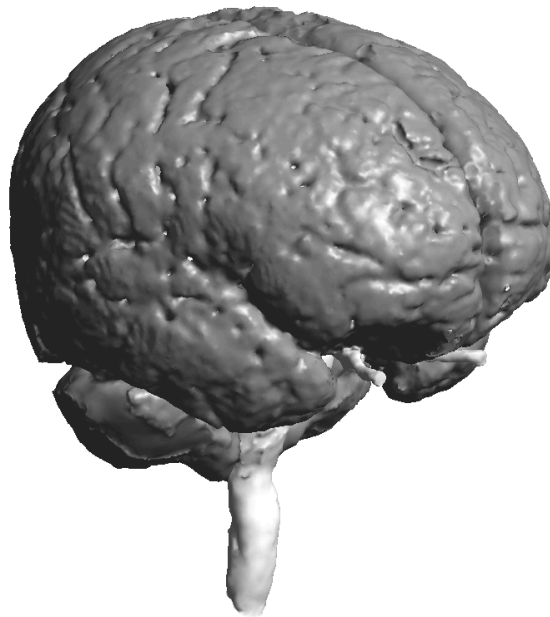


Figure 2: 3D model of brain tissues in SimNIBS GUI

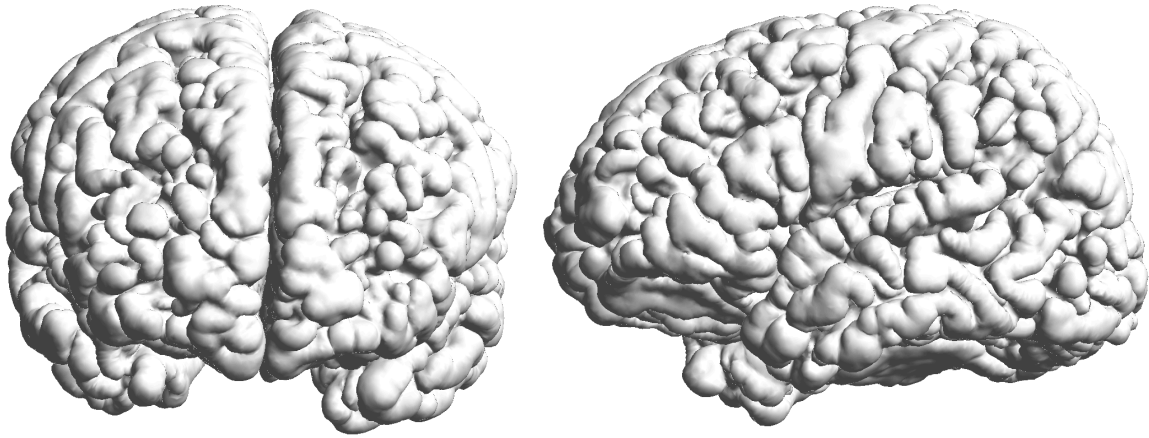


Figure 3: Model of the brain for 3D printing

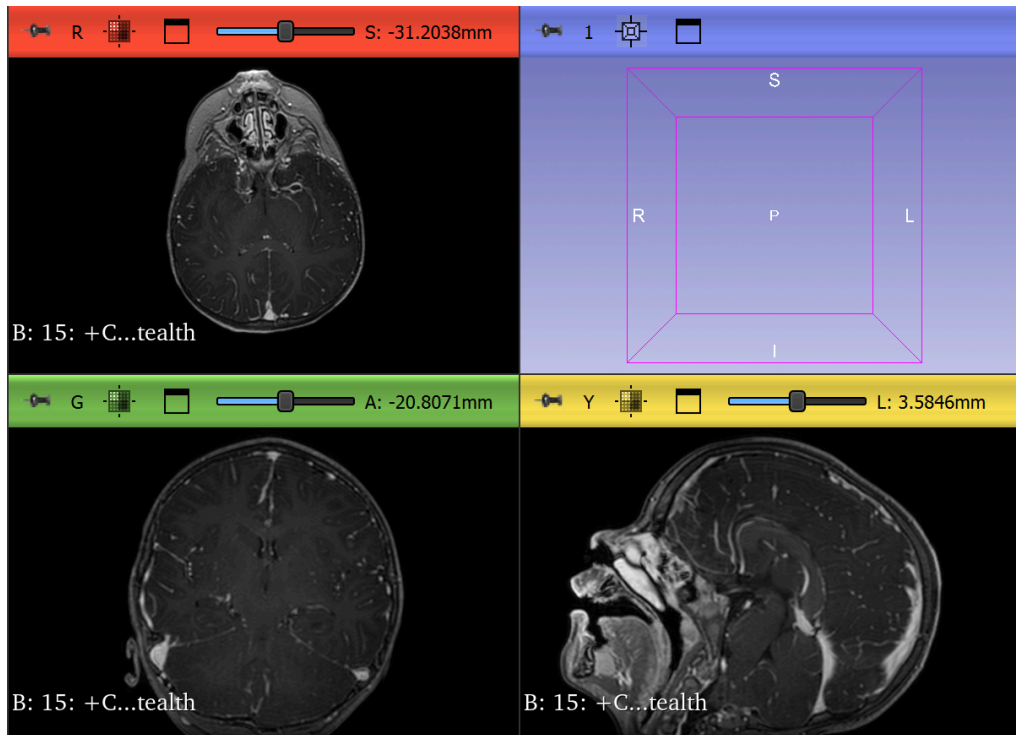


Figure 4: MRI DICOM data in 3D Slicer

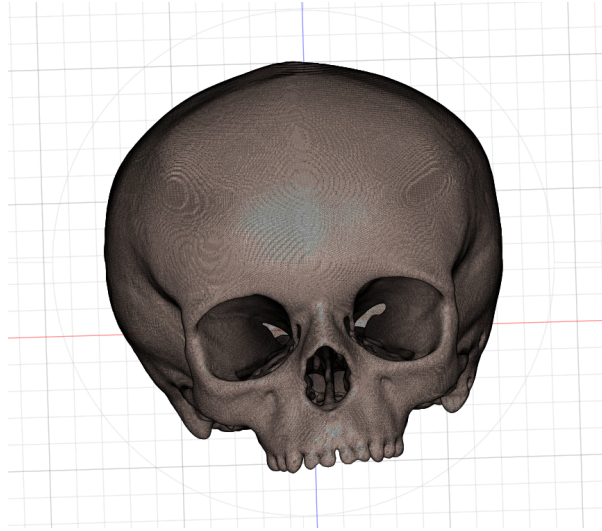


Figure 5: CAD model of pediatric skull created from CT scan

## Materials and expenses

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
<b>3D prints</b>										
Formlabs BioMed Clear Sample Swatch	Step wedge with thicknesses of 0.1, 0.2, and 0.3 inches for prelim presentation prop	UW Design and Innovation Lab	N/A	N/A	N/A	10/1	1	\$7.14	\$7.14	
Rectangular Box Phantom	Box to hold gel for potential displacement testing and poster presentation	UW Design and Innovation Lab	N/A	N/A	N/A	11/21	1	\$3.16	\$3.16	
Half Scale Skull Phantom	50% scale skull phantom for poster presentation demonstration	UW Design and Innovation	N/A	N/A	N/A	11/24	1	\$1.66	\$1.66	
Boxes for electrical testing	PLA, 100% infill boxes with hole and plug for wire	UW Design and Innovation Lab	N/A	N/A	N/A	2/27	3	\$0.85	\$2.55	
Updated	PLA, 100% infill	UW Design	N/A	N/A	N/A	3/2	4	\$0.87	\$3.49	

boxes for electrical testing	boxes with two holes and plugs for wires	and Innovation Lab									
Brain for hydrogel mold	ABS, 15% rectilinear infill	UW Design and Innovation Lab	N/A	N/A	N/A	3/12	1	\$8.00	\$8.00		
Box for hydrogel mold	PLA, 15% rectilinear infill	UW Design and Innovation Lab	N/A	N/A	N/A	3/12	1	\$7.11	\$7.11		
<b>Hydrogel Materials</b>											
Agar Powder, 500g	500g of agar powder for initial brain phantom fabrication	Thermo Fisher Scientific	A10752.36	Thermo Fisher Scientific	A10752.36	10/20	1	\$128.65	\$149.15		<a href="https://www.thermofisher.com/order/catalog/product/A10752.36">https://www.thermofisher.com/order/catalog/product/A10752.36</a>
Gelatin Type A, 100g	100g of Type A gelatin powder from porcine skin for brain phantom fabrication	Millipore Sigma	9000-70-8	Sigma Aldrich	G1890-100G	11/25	1	\$53.40	\$53.40		<a href="https://www.sigmaaldrich.com/US/en/product/sigma/g1890">https://www.sigmaaldrich.com/US/en/product/sigma/g1890</a>
Gelatin Type A, 500 g	500g of Type A gelatin powder from porcine skin for brain phantom fabrication	Millipore Sigma	9000-70-8	Sigma Aldrich	G1890-500G	2/23	1	\$199.0	\$199.0		<a href="https://www.sigmaaldrich.com/US/en/product/sigma/g1890">https://www.sigmaaldrich.com/US/en/product/sigma/g1890</a>
								<b>TOTAL:</b>	<b>\$434.66</b>		