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Surgery for Electrophysiological Recording in Behaving Non-Human Primates: Craniotomy

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Jack Kettering¹, Moya Carrier¹, Machiko Ohbayashi¹

¹Department of Neurobiology, University of Pittsburgh



Machiko Ohbayashi

University of Pittsburgh

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We use this protocol and it's working

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Abstract

The procedure below details the steps for performing a craniotomy within a recording chamber affixed to a cranial implant. The procedure may be conducted either during the initial implantation surgery or in a subsequent session after the animal has fully recovered from implantation and has acclimated to head fixation using the implanted head posts. Performing the craniotomy after recovery simplifies long-term chamber maintenance.

Materials

	Item	Specifications	Vendor	Note
	Electric drill			
	Drill bit	40 gauge	McMaster-Carr	
	Bone rongeur	Jaw width: 1.3 mm Length: 5.5"	Roboz	http://shopping.roboz.com/micro-scissors-micro-forceps-groups/Rongeurs/Micro-Friedman-Rongeur-5-5-Very-Delicate-Curved
	Kerrison Bone Punches	Jaw width: 4 mm Jaw position: 90 degrees	Aesculap	https://www.aesculapusa.com/en/healthcare-professionals/or-solutions/or-solutions-neurosurgical-instruments/kairison-pneumatic-bone-punch.html
	Excavator Spoon	#1 and #153-154	Nordent Instruments	https://nordent.com/product/excavator-1-2/ https://nordent.com/product/excavator-english-pattern-153-154-2/

Before start

This protocol requires prior approval from the users' Institutional Animal Care and Use Committee (IACUC) or an equivalent ethics committee.

Preparation on the days leading up to the surgery

- 1 Submit an NPO (nothing by mouth) form for the animal scheduled to receive the craniotomy.
- 2 Bring all necessary sterile tools to the surgical suite and set up the surgical suite.

Preparation on the day of the surgery in the prep room

- 3 Sedate the animal that is receiving the craniotomy.
- 4 Start the gas anesthesia.
- 5 Have a skilled veterinary anesthesiologist intubate the animal.
- 6 Using a cart, transfer the animal from the prep room to the surgical suite.

Surgical procedure in the surgical suite

- 7 Secure the head of the animal onto the stereotaxic frame.
- 8 Unscrew the chamber cap and remove it, exposing the inside of the recording chamber.
- 9 Using alcohol and then betadine, thoroughly clean the chamber, head fixation posts and dental acrylic.
- 10 Scrub in for the surgery using proper sterile technique and don a sterile surgical gown and two pairs of sterile surgical gloves.
- 11 Cover the animal's body with a sterile drape.

- 12 Insert a sterile drill bit into the sterile drill handle, and expose the bit approximately 2.8-4 mm from the drill.
- 13 Carefully drill through the dental acrylic within the recording chamber until the drill reaches the skull surface. Once the skull is exposed, extend the opening along the inner wall of the chamber and remove the dental acrylic covering the skull inside the chamber. Throughout drilling, continuously irrigate the area and drill bit with sterile saline to prevent overheating.
- 14 Adjust the exposed length of the drill bit to the approximate skull thickness (typically 2.8-4 mm, depending on the species, age and size of the animal).
- 15 Carefully drill through the skull within the recording chamber until the bone is sufficiently thinned to be breakable with gentle pressure from forceps, but not penetrated through to the dura. Proper adjustment of the exposed drill bit length should prevent inadvertent perforation of the skull. Throughout drilling, continuously irrigate the skull and drill bit with sterile saline to prevent overheating.
- 16 Continue drilling multiple holes, along the inner edge of the implanted recording chamber to outline the opening.
- 17 Using the bone rongeur, carefully remove the bone segments between the drilled holes to expose the underlying dura. An excavator spoon may also be used to remove bone in narrow areas.
- 18 Enlarge the opening to match the chamber diameter using a bone punch or a drill. When the hole is too small to accommodate the lower jaw of the bone punch, gradually expand it by shaving the edges with an excavator spoon. Exercise extreme caution when inserting the lower jaw of the bone punch between the dura and skull, and ensure that no sharp bone fragments remain.
- 19 Once all of the bone between the drilled holes has been removed, a circular bone segment will remain in the center of the recording chamber. Using an elevator or forceps, carefully lift and remove this segment, taking care not to damage the underlying dura.
- 20 If further enlargement is required, expand the opening with bone punches.
- 21 Smoothen the edge of the hole you created using the excavator spoon or a drill so as to not increase the risk of a dura puncture and csf leak.
- 22 Thoroughly rinse the recording chamber with saline to remove any small bone fragments left behind.



- 23 Take measurements of the distance between the top edge of the recording chamber and the surface of the dura at various key locations (most medial, lateral, anterior, posterior corners and center of the chamber).
- 24 Cover the recording chamber with a chamber cap and screw it on.
- 25 Stop the gas anesthesia, extubate the animal once it starts reflexively coughing due to the breathing tube, and wait for the animal's recovery.