Surgical Manual: Epoch Transmitters for Local Field Potentials

Implanting an Adult Mouse with the Single-Channel Epoch Transmitter for Recording Local Field Potentials (EEG & Neural Signals)

November 21, 2013
Recommended Surgical Tools

A. Hemostat (curved)
B. Fine scissors
C. 4x Aneurism clamps
D. Toothed forceps
E. Burr tool
F. Fine burr (FST #19007-09 or equivalent)
G. Accelerant (Loctite 7452 or equivalent)
H. Cyanoacrylate (Loctite 4541 or equivalent)
I. Suture (Vicryl 4-0)
J. Electrocautery unit
Trim Electrodes

- Trim electrodes to the desired length. Leave extra length for the reference electrode.
Hypodermic Tube Attachment

- Lightly glue a piece of hypodermic tubing to the side of the transmitter with a small amount of cyanoacrylate.

- Hypodermic tubing will be used to mount the transmitter in the stereotaxic micromanipulator.
Sterilize Transmitter

**Ethylene Oxide**
- Place transmitter in Tyvek pouch
- Gas for a complete Kill cycle
- Off-gas for at least 24 hours

**Isopropyl Alcohol**
- Soak in 95% ethanol for 1 minute and allow to air-dry
Anesthesia

- Anesthetize animal (4% isofluorane) and maintain anesthesia (1-2% isofluorane) according to IACUC-approved protocol.
Fix Position in Stereotaxic frame

- Each ear bar tip must be properly positioned in auditory meatus
- Do not excessively tighten ear bars
- Make sure head is centered and anesthesia nose cone is secure
- A heated water blanket or heating pad is used under the animal to keep it warm during surgery
- Periodically check depth of anesthesia with corneal reflex, limb pinch, or pulse oximetry.
Apply subcutaneous anesthetic

- Inject 0.5% Marcaine in a few locations under the scalp
Trim Scalp

- Remove excess fur from the scalp
- Scissors or a small electric trimmer can be used to remove fur
Protect the Animal’s Eyes

• Apply lubricant eye ointment to each eye

• A mixture of mineral oil (20%) and white petrolatum (80%)
Sterilize Incision Site

- Swab the scalp with alternating applications of 70% ethanol and betadine.

- Start in the center of the scalp and make increasingly wider concentric circles.
Scalp Incision

- Incision is made slightly behind the eyes along the midline, approximately \( \frac{3}{4} \)".
Exposing the Scalp

- Use aneurism clamps to grasp scalp.
- Gently pull scalp away from midline at four corners.
- Look for anatomical landmarks in the skull such as Bregma and Lambda.
Clean and Dry the Skull

- Remove periosteum from the exposed surface of the skull.
- A 0.3% hydrogen peroxide-soaked swab can be used to remove periosteum.
- Skull must be completely dry.
Identify desired location of burr holes using stereotactic coordinates

- A hypodermic needle can be used to identify the location of bregma.

- An electrocautery unit or marking pen can be used to mark location for burr holes.
Drill two holes in the skull over desired electrode locations

- Recommend using Dremel-type tool with a burr-type drill bit
- Practice drilling burr holes in a block of wood before attempting in a rat.
- Holes should be bigger than 300 μm in diameter.
- Burr sizes of 0.9 mm produce clean holes.
Check Spacing

- LFP is subtractive (electrode 1 – electrode 2).

- Holes can be within a hemisphere or between hemispheres.
Load transmitter in micromanipulator

- Attach the transmitter to the micromanipulator with the hypodermic tubing.

- Position the transmitter electrode (LFP electrode) over the burr hole.
Position LFP electrode

- Using stereotaxic coordinates, position the LFP electrode in the Anterior-Posterior and Medial-Lateral directions.

- Dorsal-ventral positioning of the electrode is measured relative to the brain surface.
Drive LFP electrode to desired depth

- Using the stereotaxic micromanipulator, carefully position the LFP electrode at the desired depth.

- Once in place, take care not to bump the micromanipulator or stereotaxic frame.
Apply Cyanoacrylate

- Liberally apply cyanoacrylate under the base of the transmitter and around the outside edge.

- Make sure to avoid coating the reference electrode or the burr hole for the reference electrode.
Apply Accelerant

- Apply accelerant around the cyanoacrylate at the base of the implanted transmitter using a syringe.

- Use accelerant sparingly, taking care not to apply to adjacent tissue.

- Cyanoacrylate accelerant is useful to speed curing of adhesive.
Trim reference electrode to length

- Trim reference electrode to a length that is manageable for inserting through the reference burr hole.
Locate reference electrode in the second burr hole

- With forceps, gently place the reference electrode in the reference burr hole.

- Reference electrode should be placed such that the tip of the electrode is just touching the brain and not penetrating.
Apply cyanoacrylate to reference

- Completely cover the reference electrode with cyanoacrylate.
- Apply accelerant to the cyanoacrylate as before.
Suture Skin

- Suture the skin around the base of the transmitter, but do not cover the transmitter.

- Top of transmitter must be above skin to efficiently transmit neural signals.

- Skin should be reasonably tight around the transmitter.
Remove Animal

- Remove animal from stereotaxic frame and place on heated blanket for recovery.

- Carefully snap off the hypodermic tubing used to hold the transmitter with the micromanipulator.

- Animals should be warm and mobile before returning to their home cage.

- Once animal is active, moving around, and grooming, it can be returned to its home cage.
Care and Housing

- Recordings may commence directly after animal has recovered from surgery.

- Sutures may need to be removed from the scalp after one week.

- Check for signs of necrosis around the transmitter and treat where needed.