

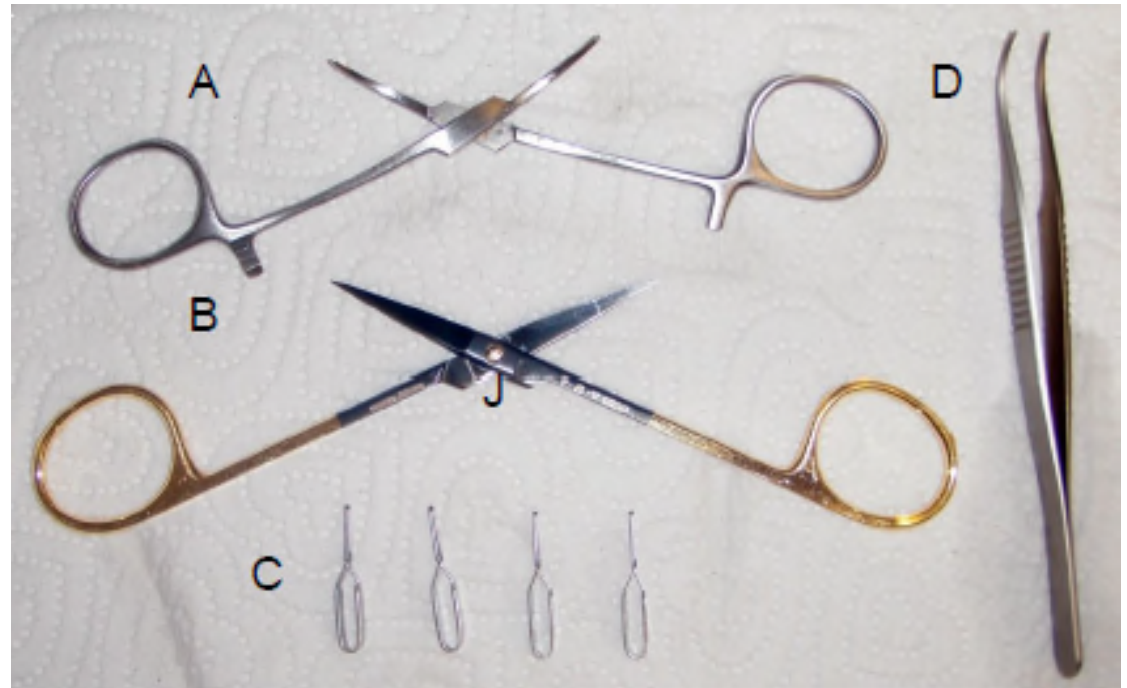
Surgical Manual: Epoch Transmitters for Local Field Potentials

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



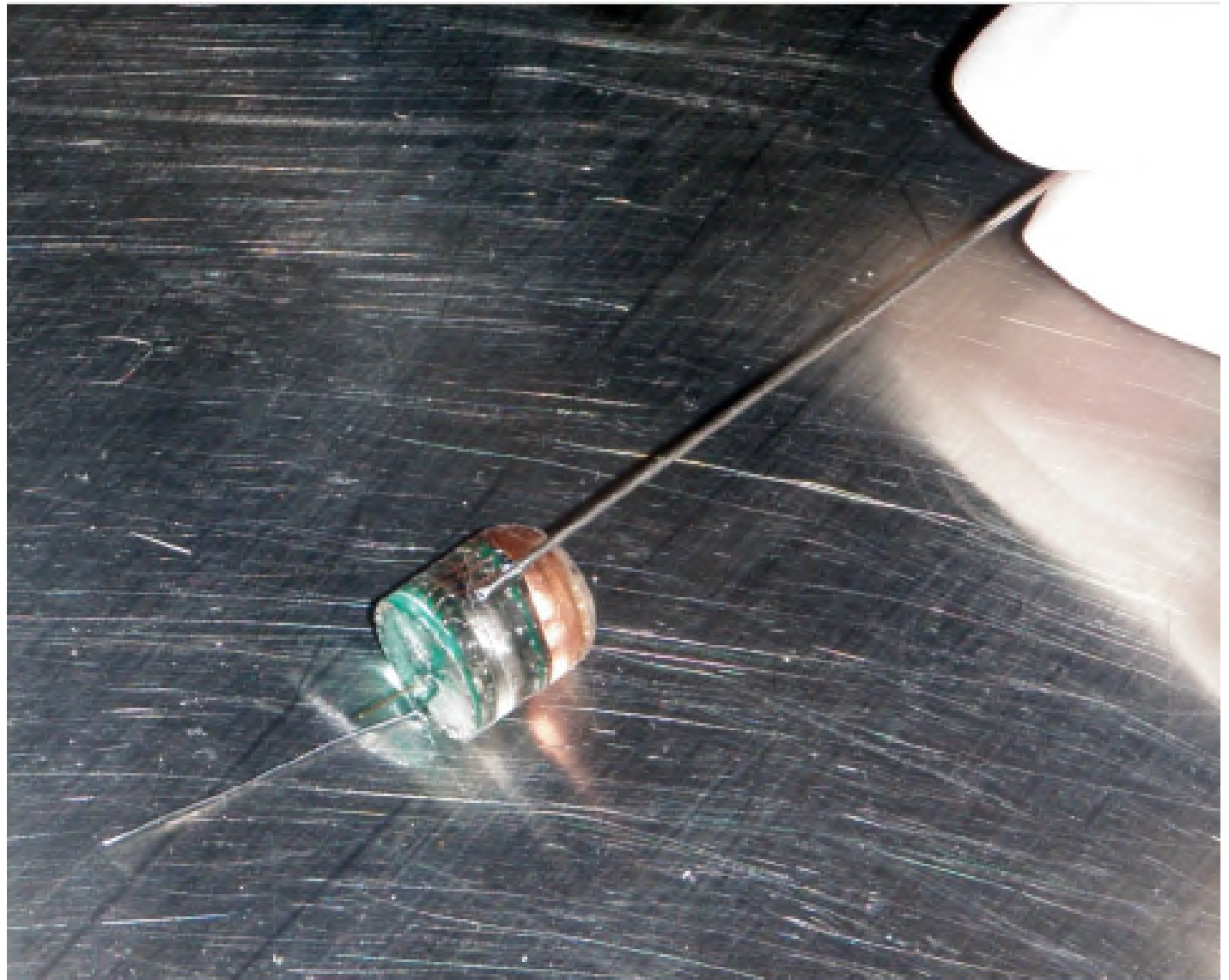
Trim Electrodes

- 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

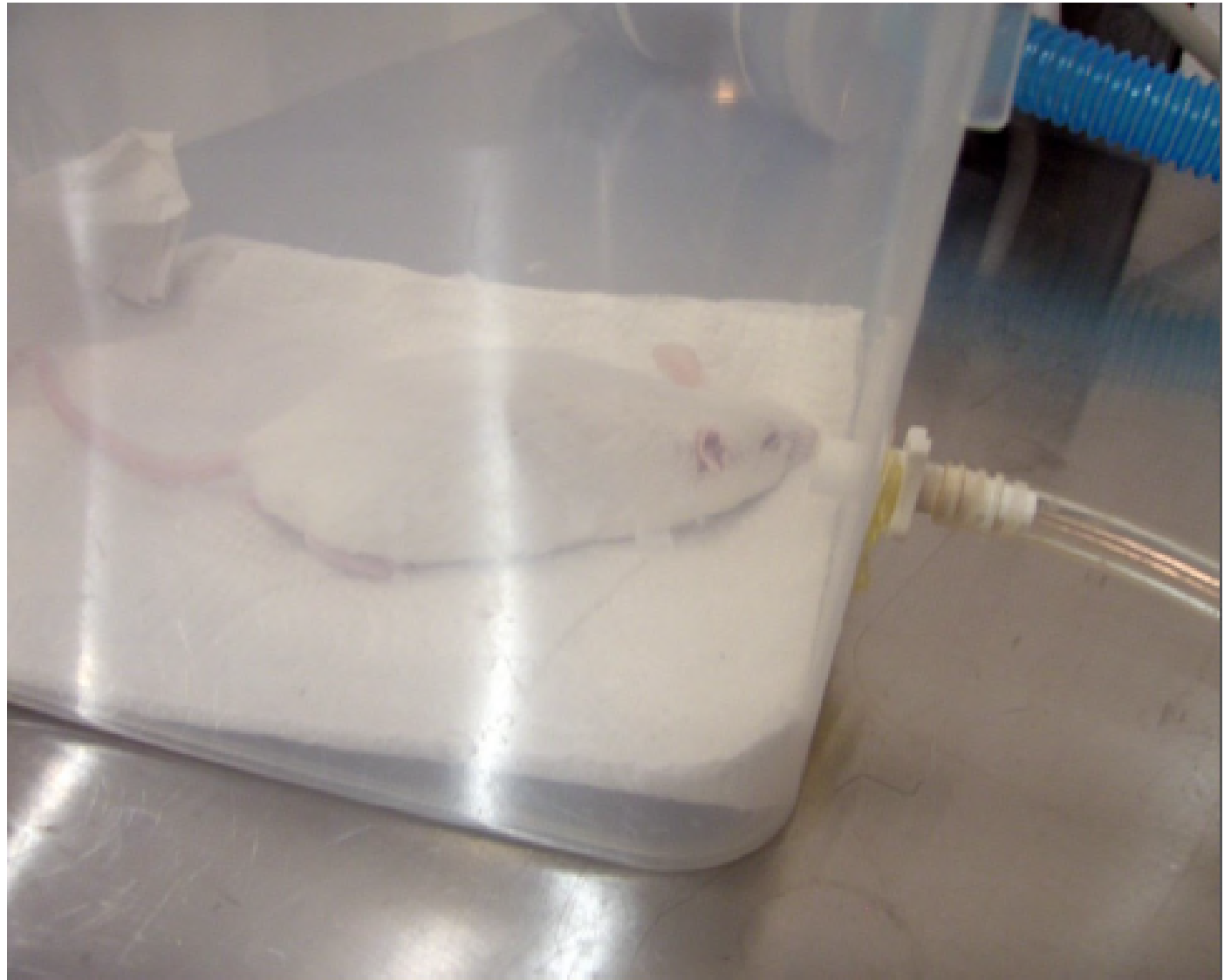
- Place transmitter in Tyvek pouch
- Gas for a complete Kill cycle
- Off-gas for at least 24 hours

Isopropyl Alcohol

- Soak in 95% ethanol for 1 minute and allow to air-dry

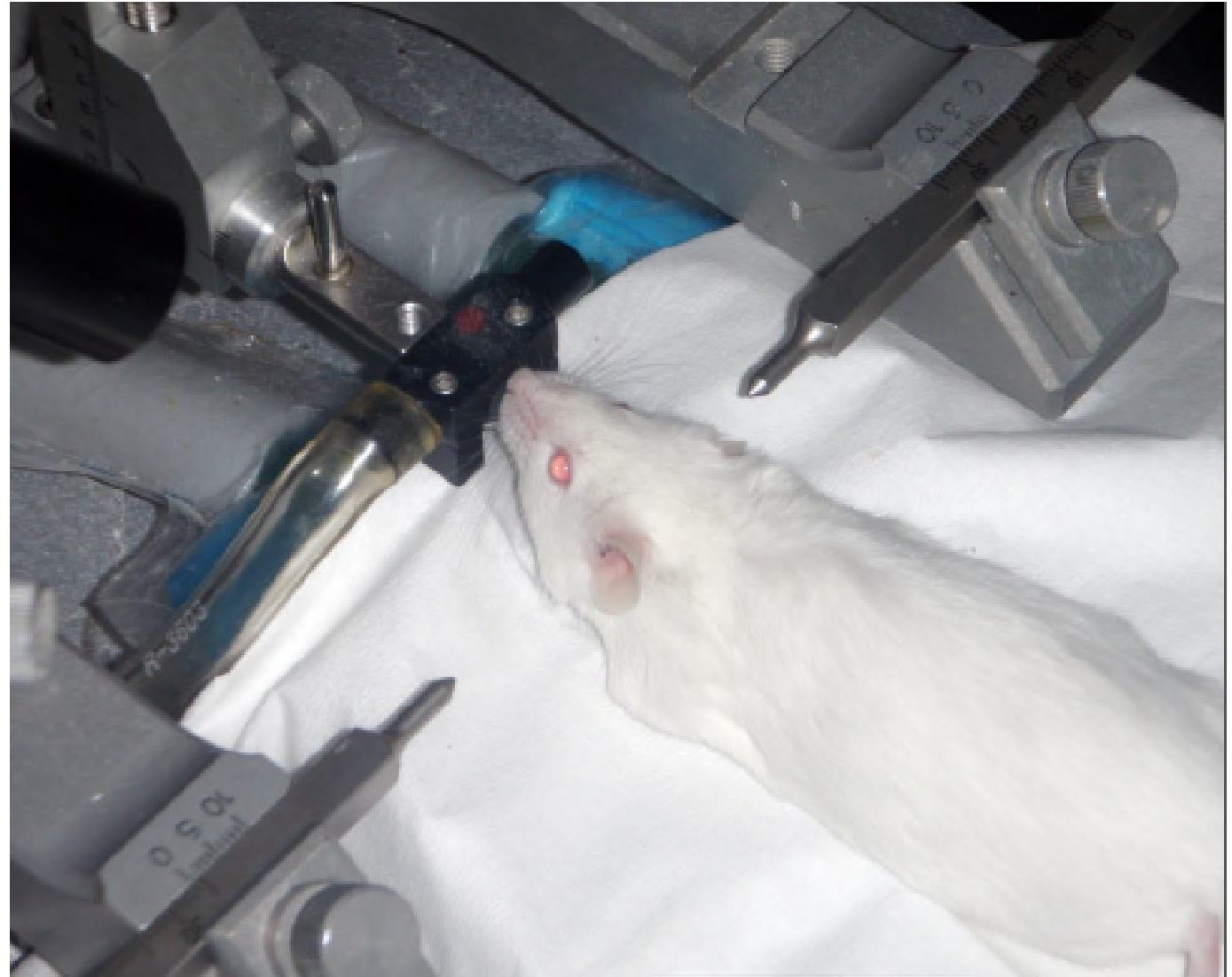
Anesthesia

- Anesthetize animal (4% isoflurane) and maintain anesthesia (1-2% isoflurane) according to IACUC-approved protocol



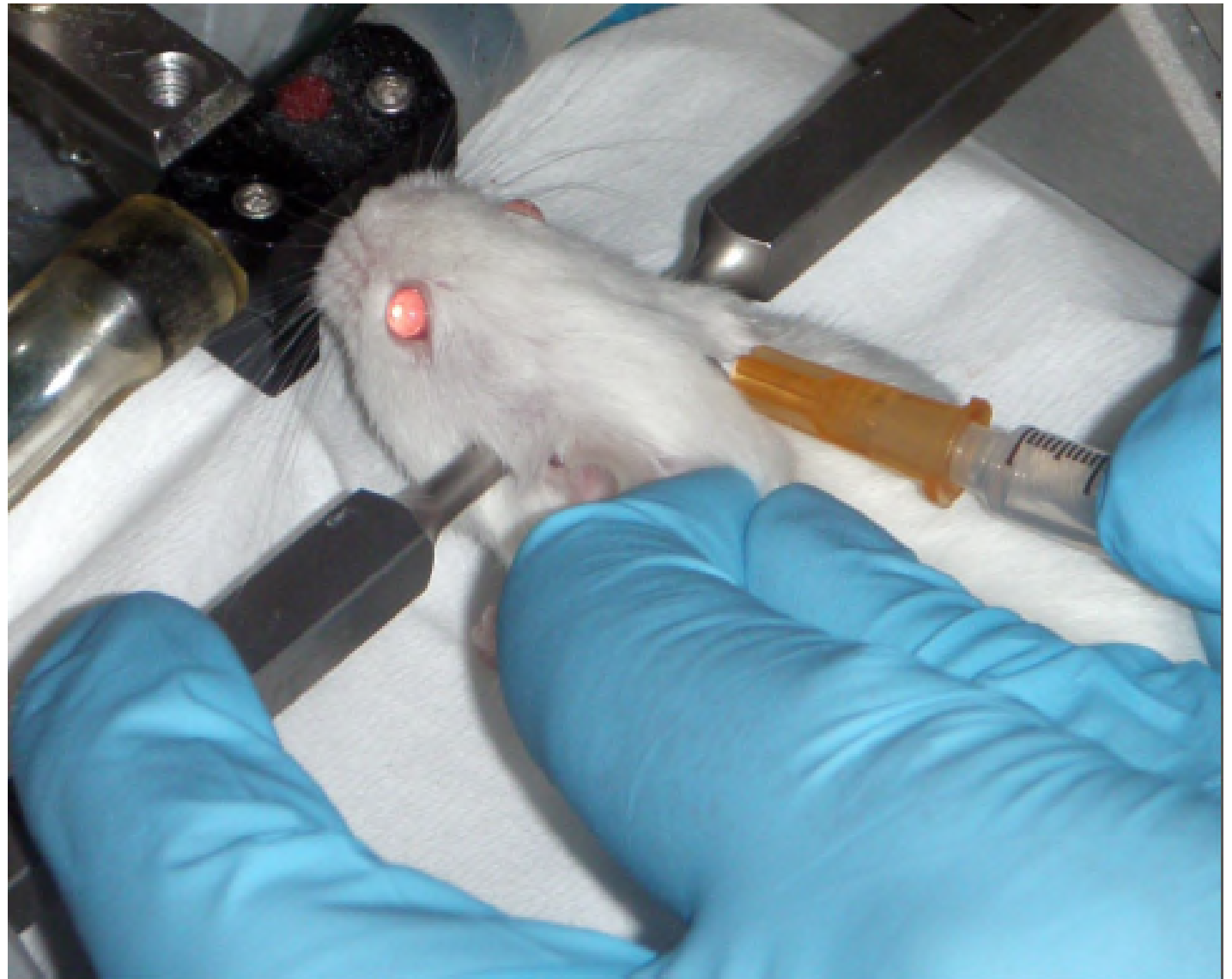
Fix Position in Stereotaxic frame

- 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.



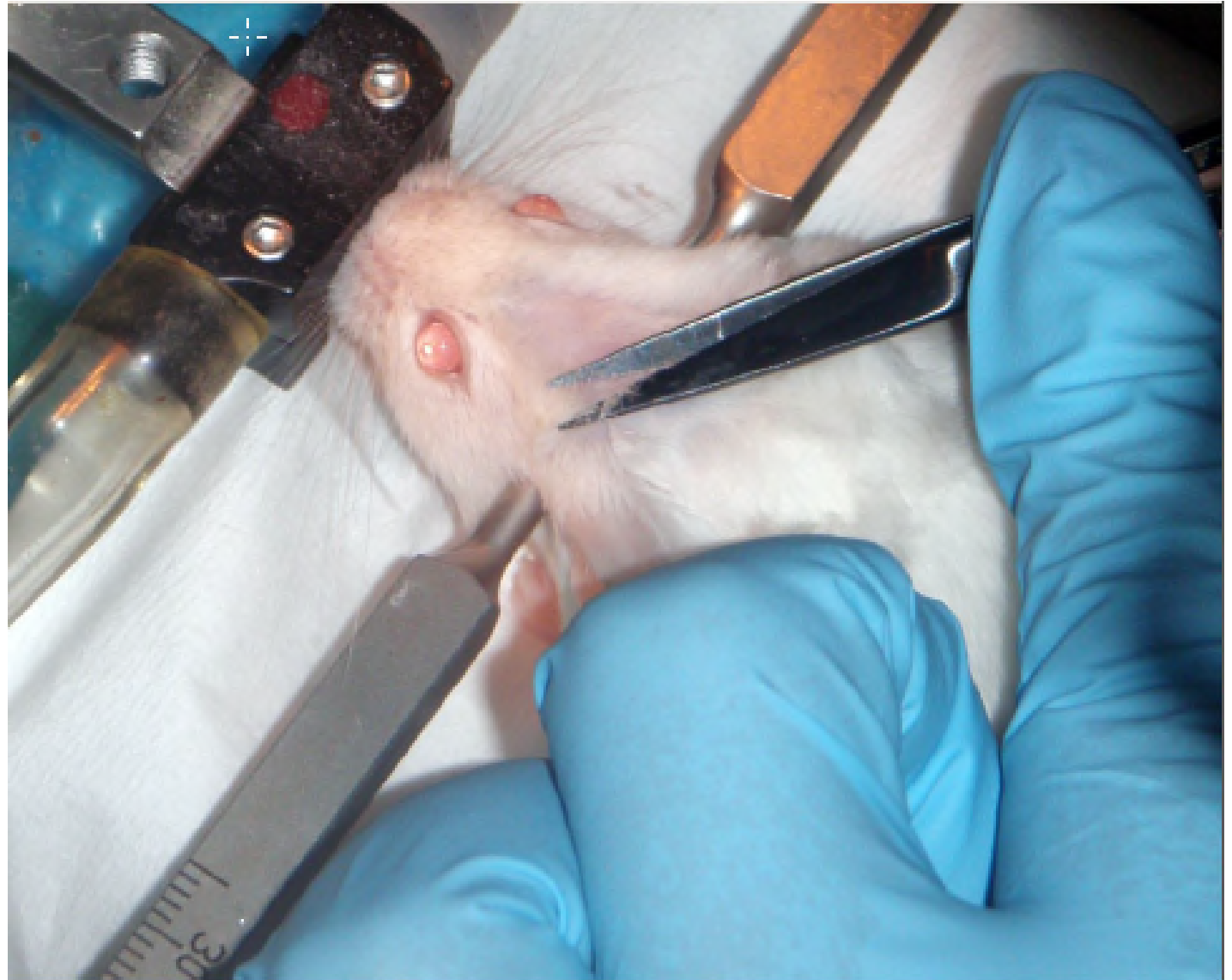
Apply subcutaneous anesthetic

- 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%)



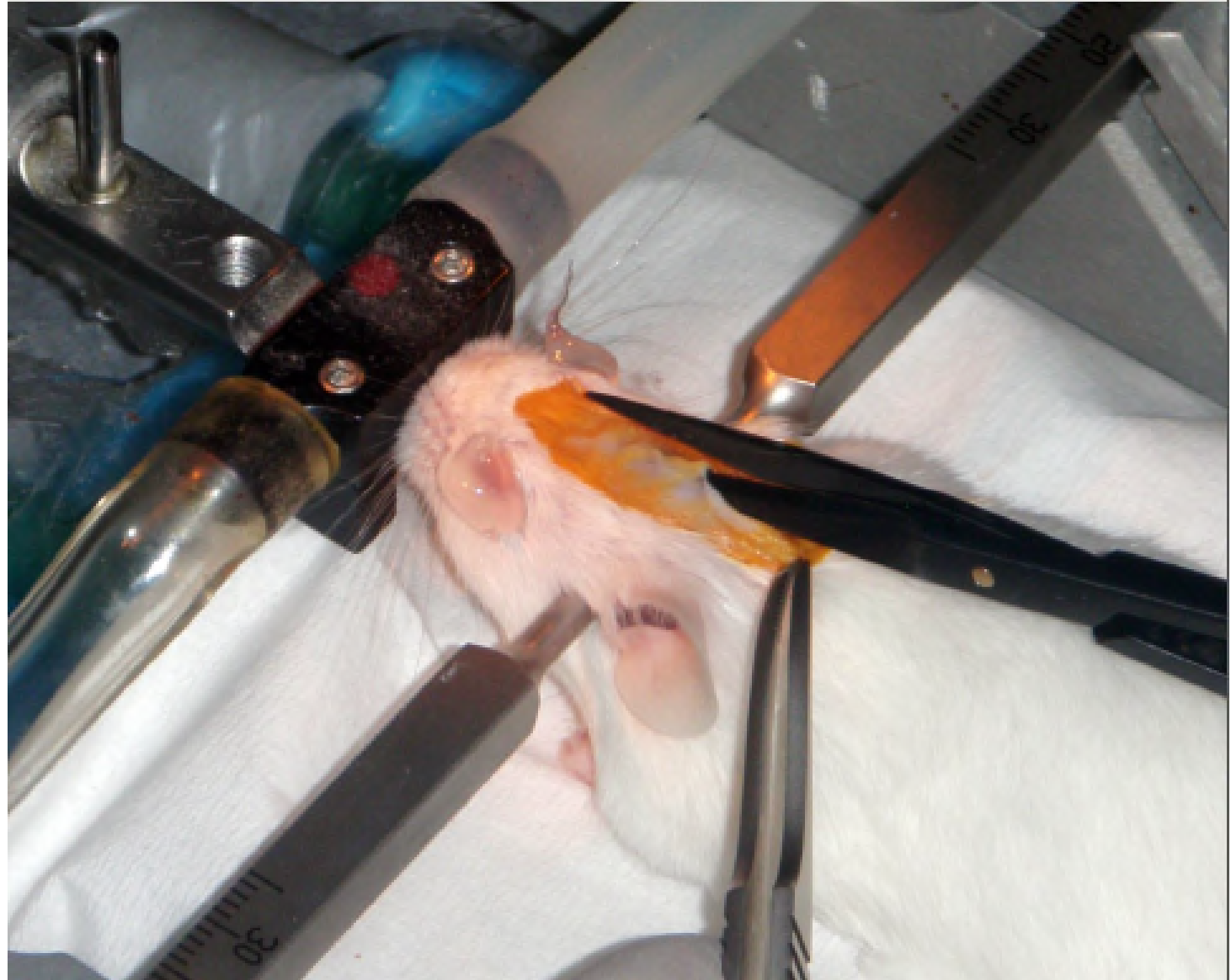
Sterilize Incision Site

- Swab the scalp with alternating applications of 70% ethanol and betadine.
- Start in the center of the scalp and make increasingly wider concentric circles.



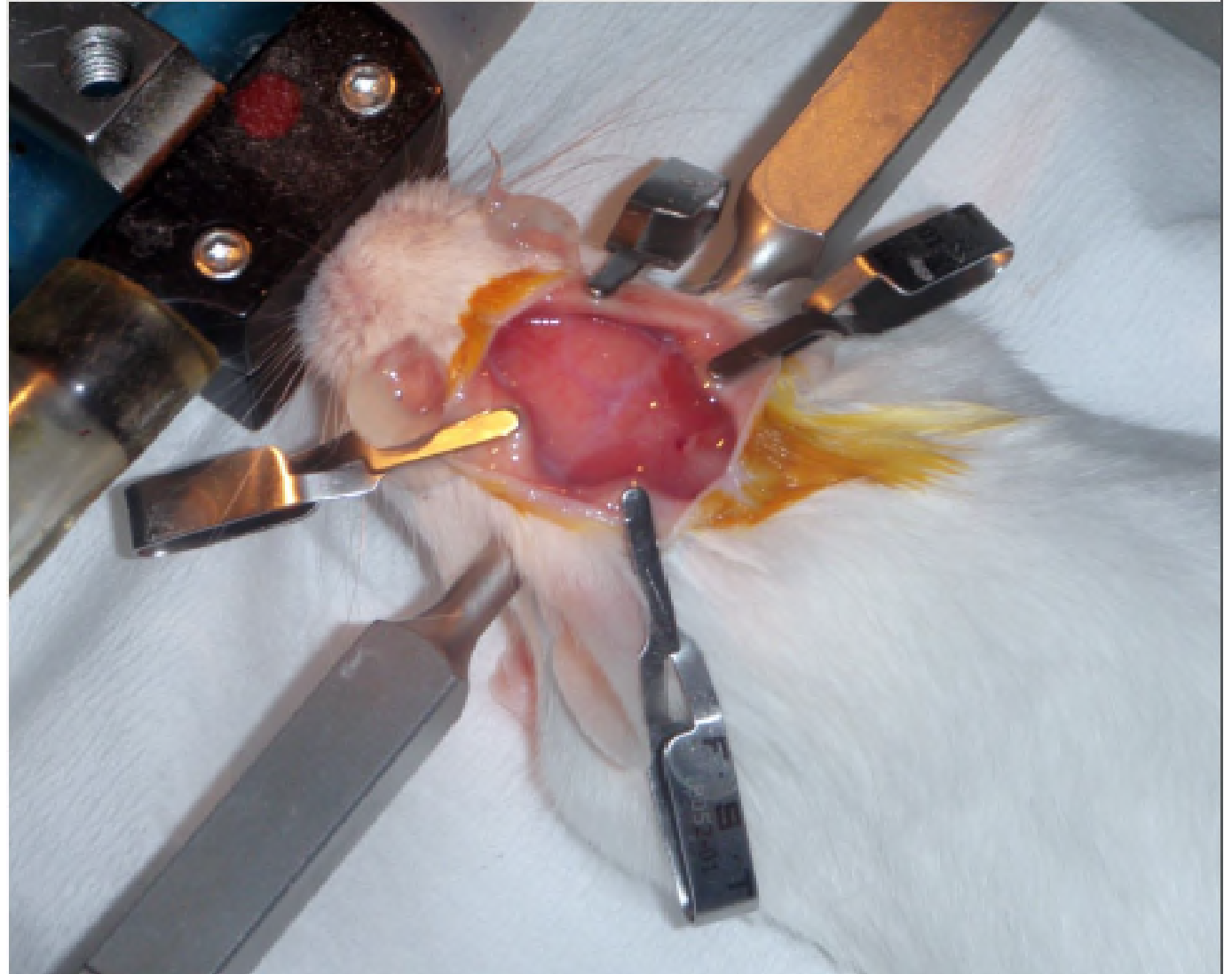
Scalp Incision

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



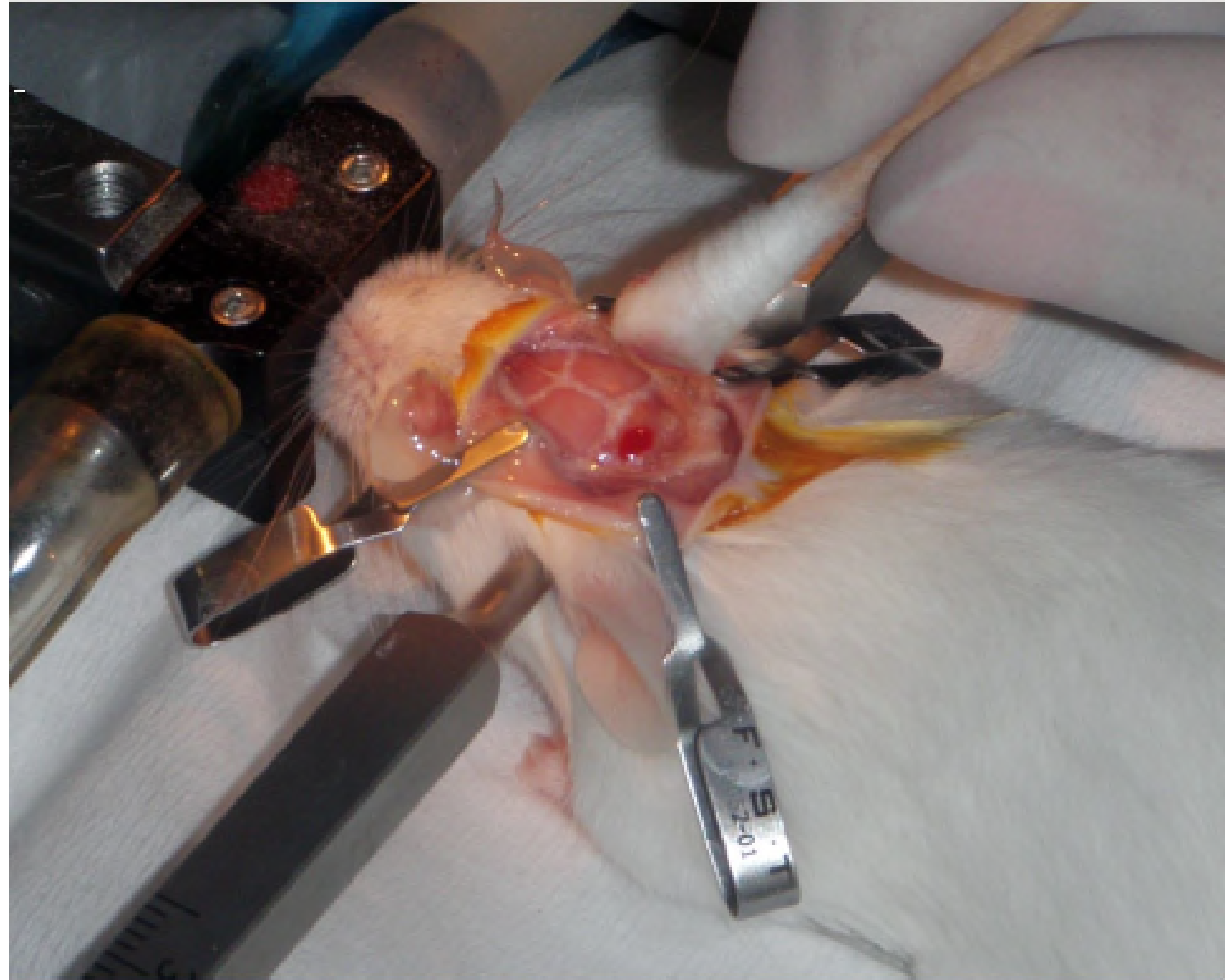
Exposing the Scalp

- 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.



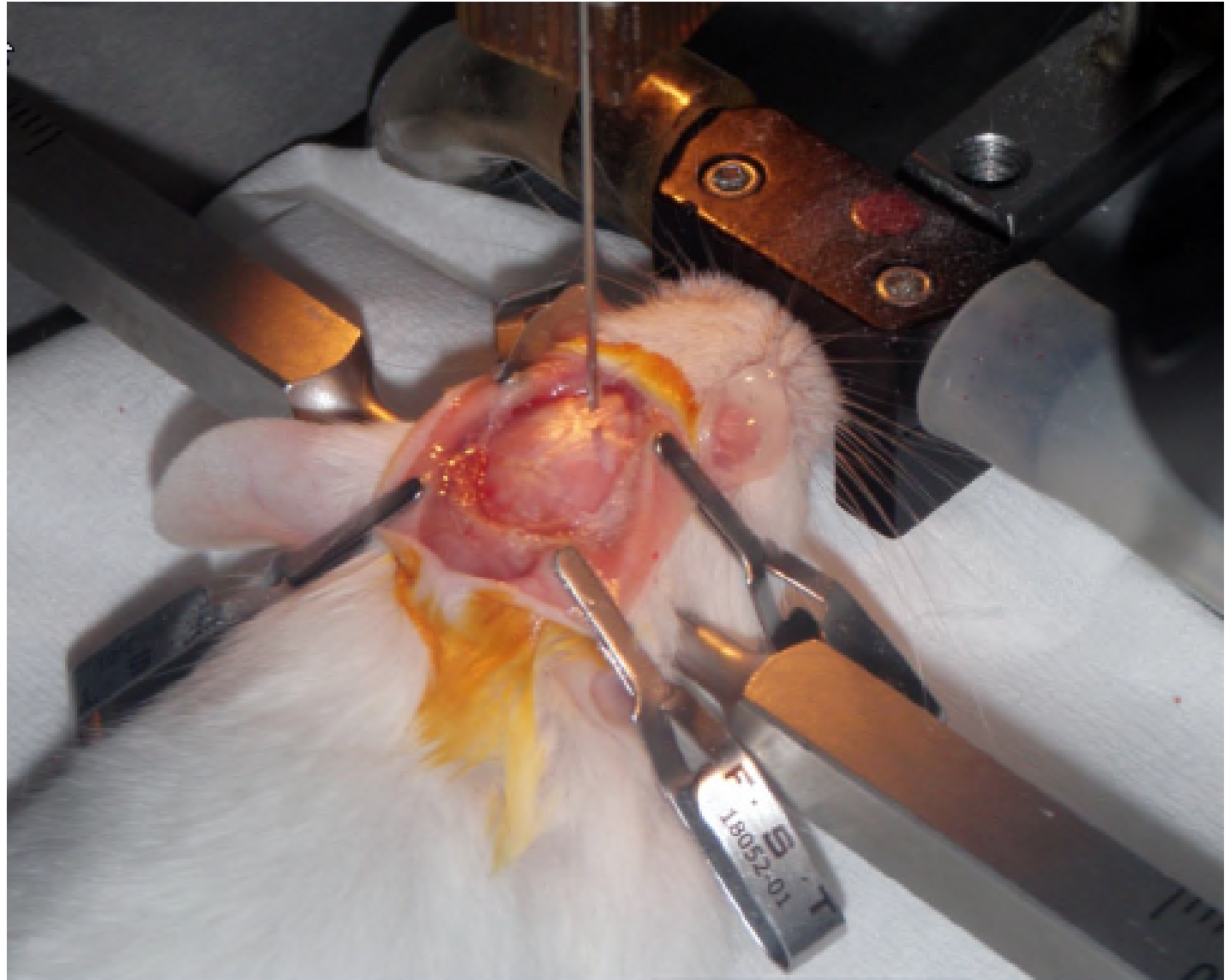
Clean and Dry the Skull

- 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.



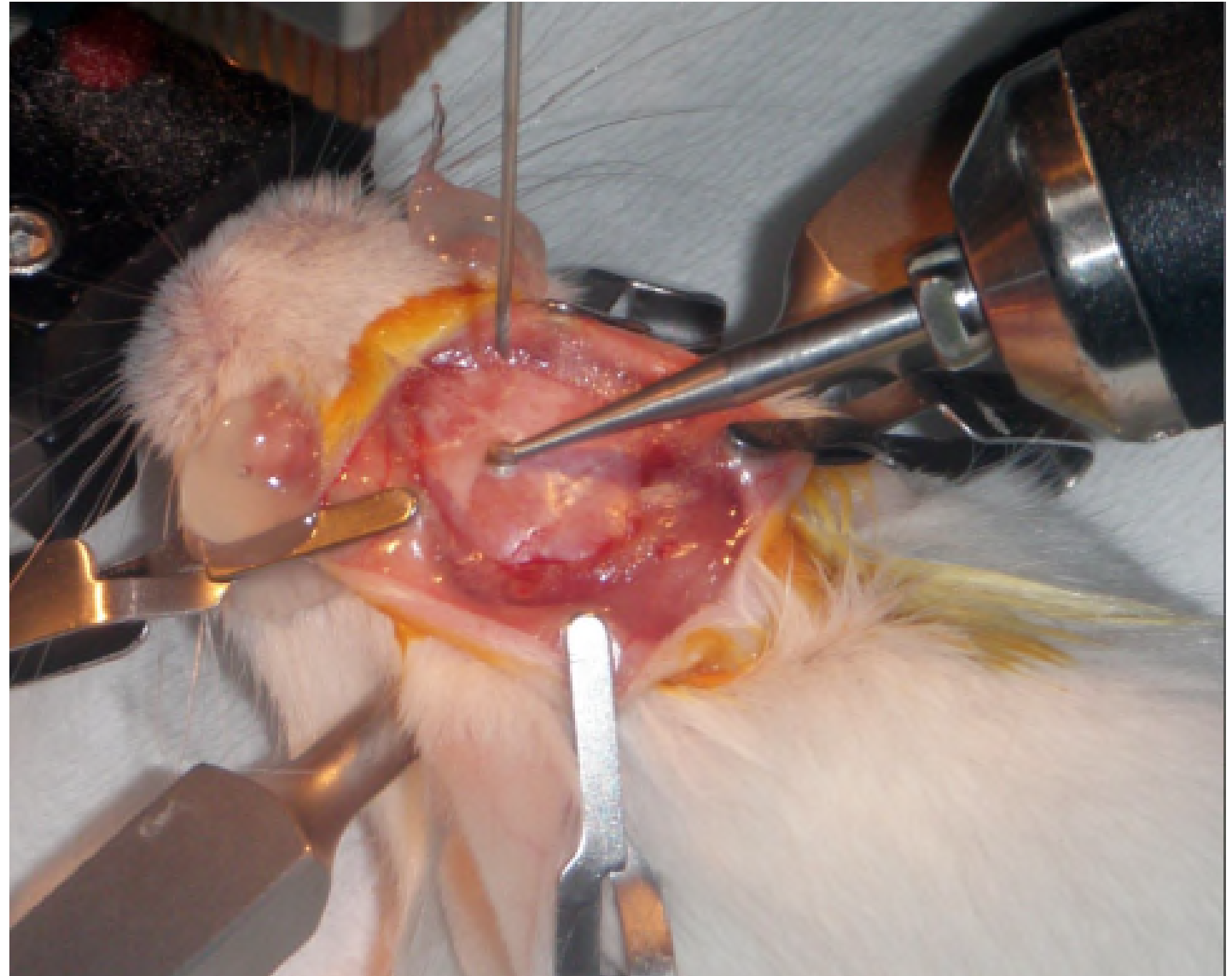
Identify desired location of burr holes using stereotactic coordinates

- 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.



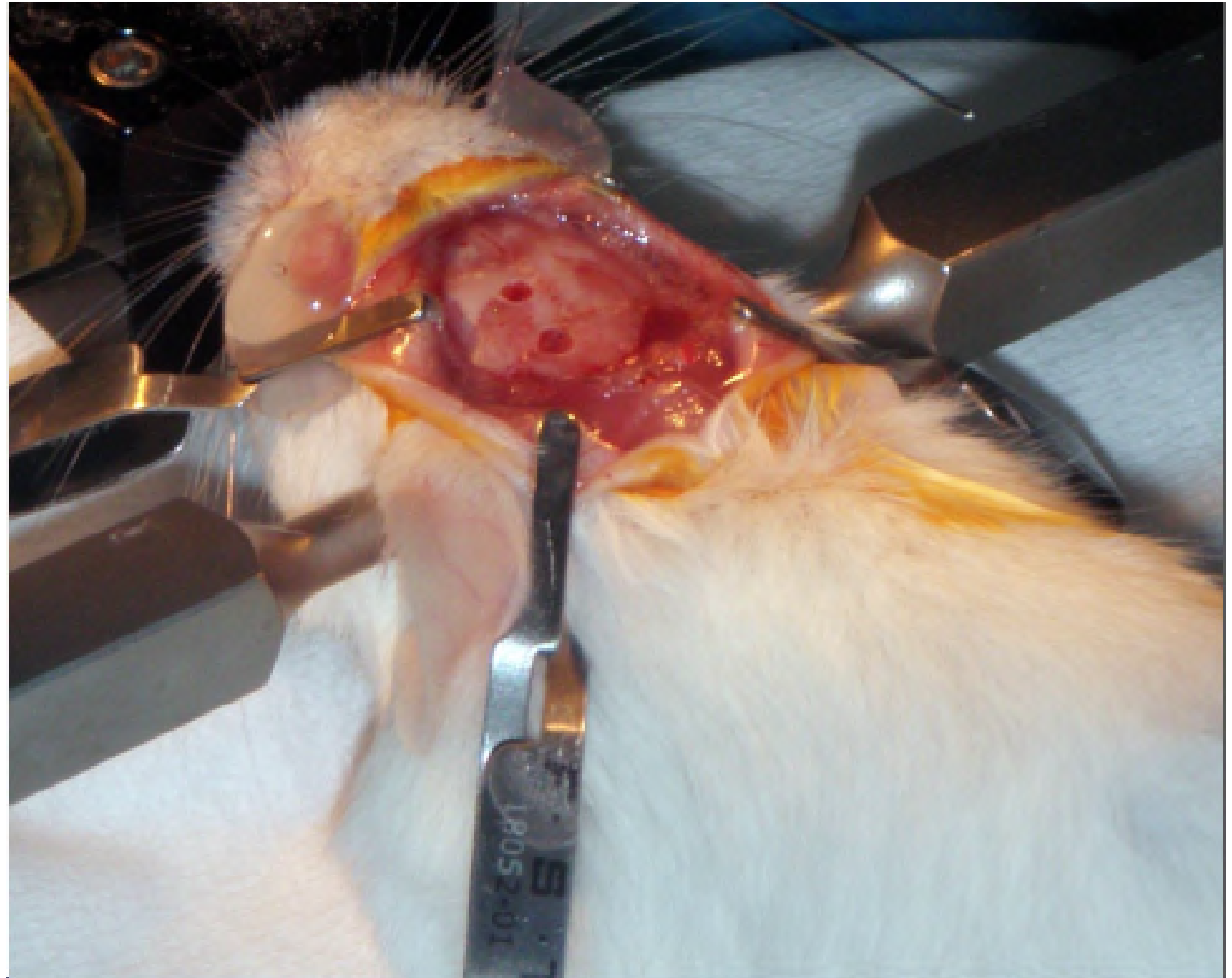
Drill two holes in the skull over desired electrode locations

- 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.



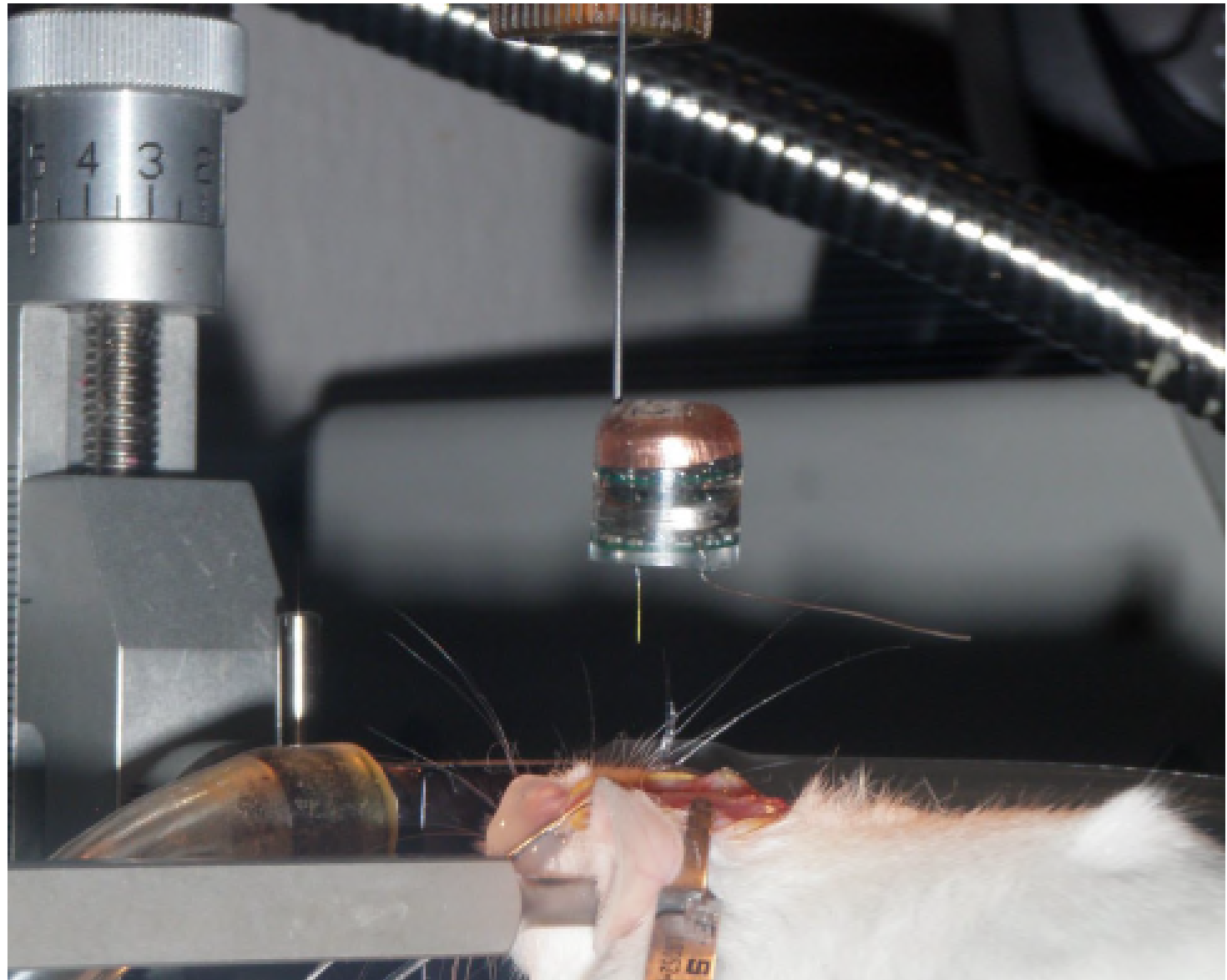
Check Spacing

- LFP is subtractive (electrode 1 – electrode 2).
- Holes can be within a hemisphere or between hemispheres.



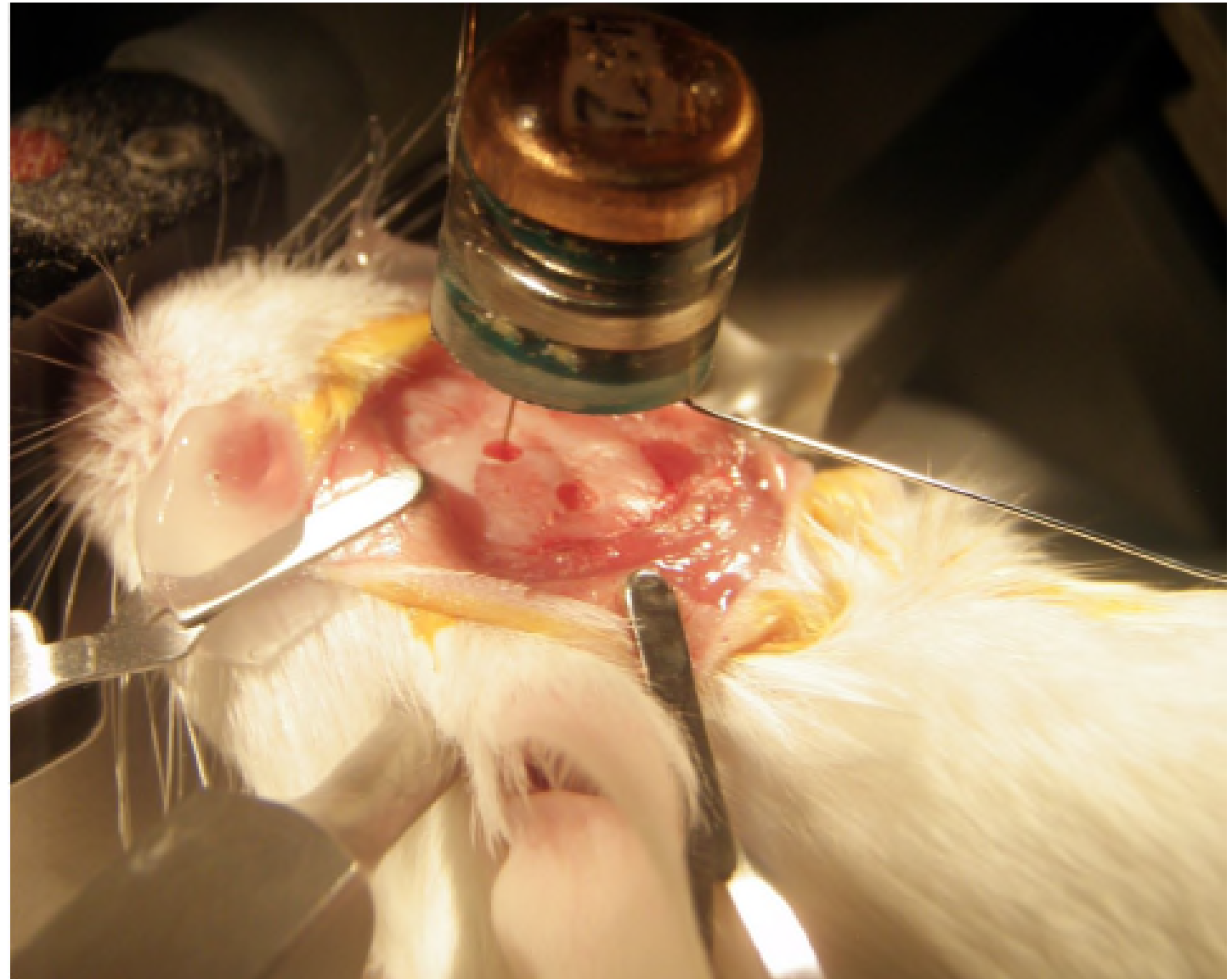
Load transmitter in micromanipulator

- 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.



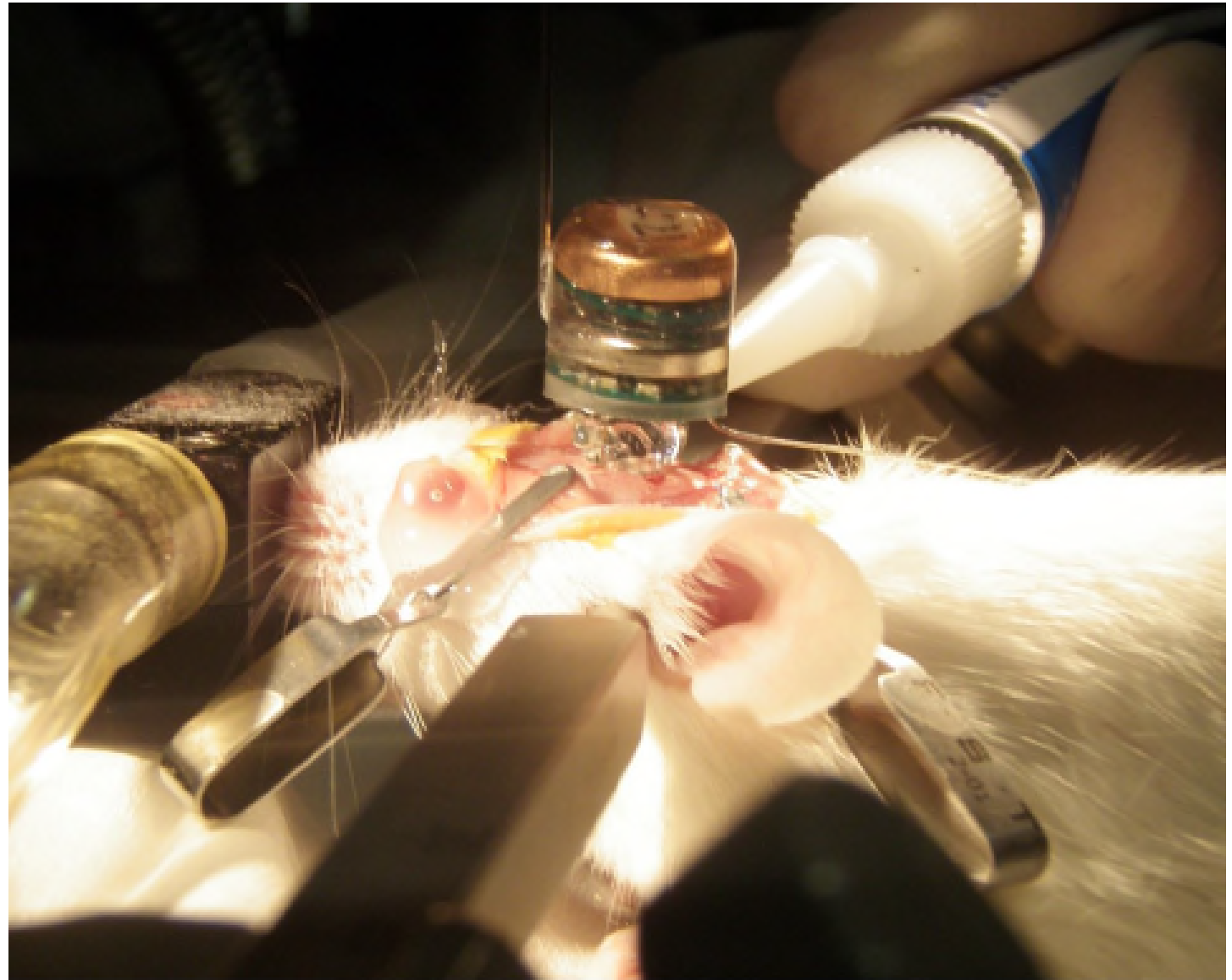
Drive LFP electrode to desired depth

- 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.



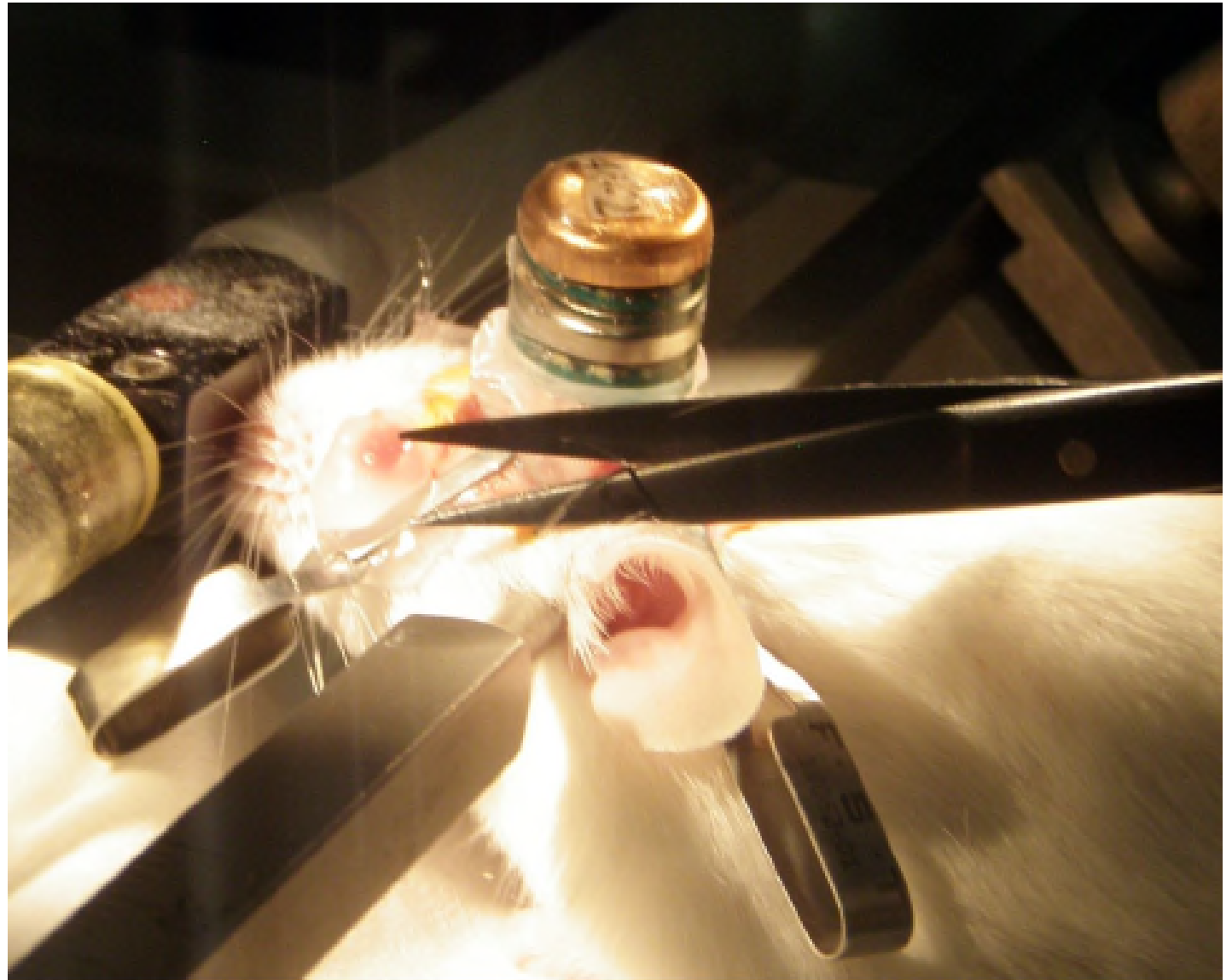
Apply Accelerant

- 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.



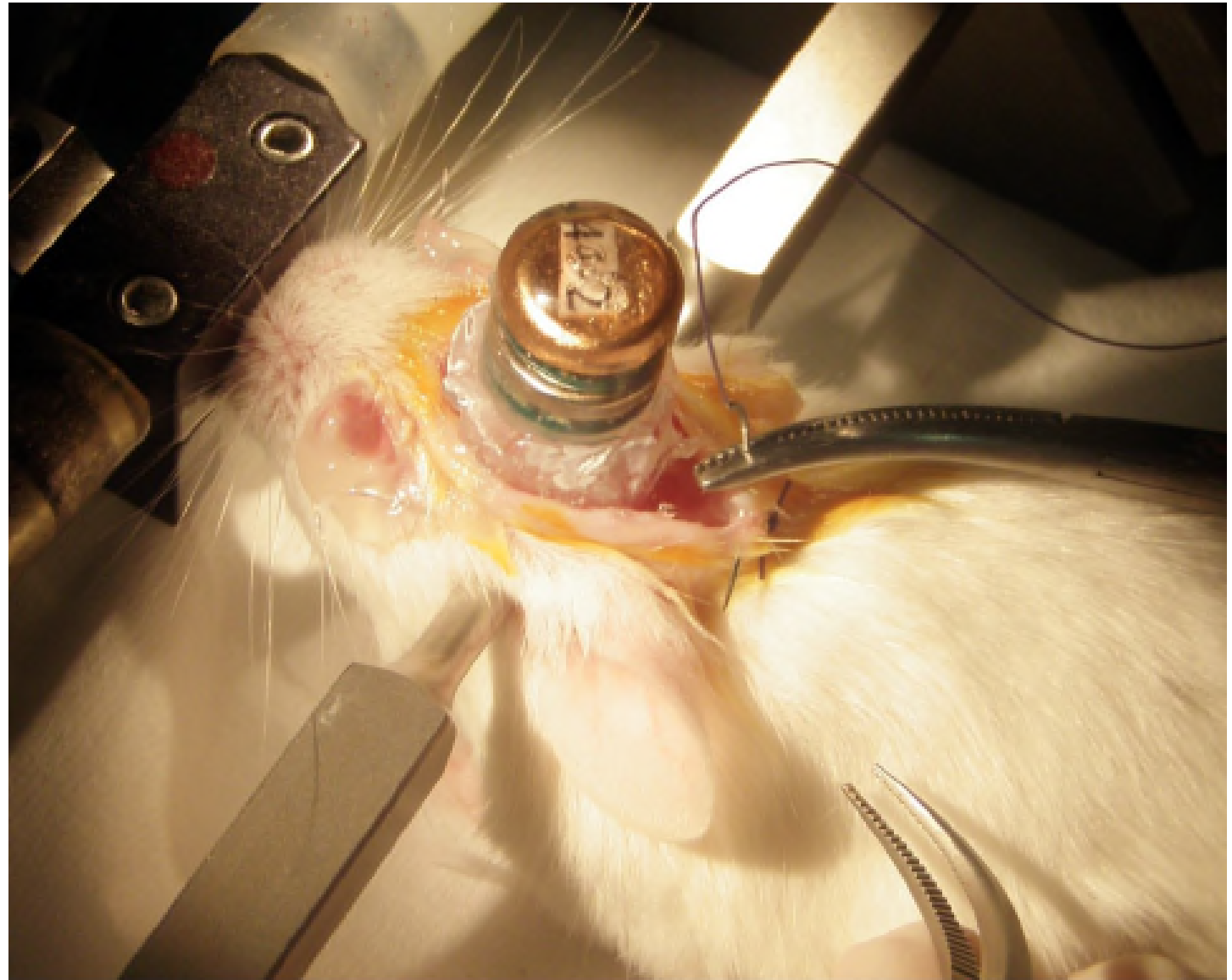
Apply cyanoacrylate to reference

- 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.

