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EMG implants

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Protocol status: Working

We use this protocol and it's working



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Abstract

This is the standard electromyographic electrode (EMG) implant protocol for forelimb muscles (biceps, triceps, palmaris longus (PL) and extensor digitorum communis (EDC)) for Rodrigues-Vaz and Athalye et al, 2025 and based on **Nelson et al, 2021**.

Materials

- Sterile surgical tools
- Alcohol for cleaning
- Hydrogen Peroxide (for sterilizing skull).
- Sterile Saline (fill 1cc insulin syringe)
- Gauze pads & Betadine wipes
- Gel foam (to clean/stop bleeding)
- Paper towels for surgery and to elevate mouse to right height for ear bars
- Cotton tips/swabs
- KimWipes
- Ensure to have enough isoflurane (fill to max line in holder on bottom right of regulator) for the duration of the surgery.
- Razor- ensure batteries are charged for hair removal
- Metabond
- EMG electrodes
- Head bar

Safety warnings

 -Wear appropriate PPE as required by your institution.

Ethics statement

This protocol was approved by Columbia University IACUC. Please do not perform any of these procedures unless there is prior approval from the institution's animal ethics committee.



Before start

- Mouse is habituated to Elizabeth collar and gel food for 4 days prior to surgery – this guarantees that after the surgery animal is able to move and eat with less disruption.
- Fabrication of EMG electrodes ahead of time.
- Turn on oxygen (~1.5 L/min) and extraction pump for isoflurane machine.
- Turn stereotaxic heating pad on.
- Administer analgesia on day of surgery subcutaneously: carprofen (5mg/kg body weight) repeated daily to ensure 72h of pain relieve (by surgeon or approved lab personnel) or buprenorphine XR or SR (administered by animal care staff according to IACUC protocol and standard of care).

Placement of mouse in stereotaxic frame

- 1 Weigh mouse
- 2 Anesthetize mouse in isoflurane chamber (set initially to 3-5% for induction). Monitor until the mouse is under the anesthesia.
- 3 Remove the mouse from chamber and shave head, back and forelimb (can use isoflurane nose tube if working to maintain anesthesia).
- 4 Administer bupivacaine (2 mg/kg body weight) intradermal post shaving before an incision is made
- 5 Place upper front teeth of mouse into stereotaxic equipment and position tongue so that the mouse won't choke.
- 6 Ensure nose is inside the anesthesia cone. Set isoflurane machine to 2% and decrease through surgery (1-2% for surgery is typical). Confirm plane of anesthesia before starting and throughout surgery with toe pinch and breathing rate monitoring (by eye).
- 7 Holding the mouse by the ears, position the side holders of the frame and tighten over temporal lobes. Note: in this surgery we will place the EMGs connector onto head or previously built cap; head does not have to be tightly aligned for this.

Surgical preparation

- 8 Add protective cream to the mouse's eyes (usually eye lubricant) using a sterile cotton swab.
- 9 Clean surgery area – head, back and forelimb - with 3 alternating rubs of alcohol and then iodine/betadine swabs to sterilize.
- 10 Prepare all sterile surgical tools and place them on one side of the stereotax.
- 11 Change gloves to sterile gloves, cover mouse with sterile surgical drape.
- 12 If cap is not present, do the following steps:

- Expose skull - hold skin taught with forceps and cut skin with small scissors.
- Clean tissue from skull (periosteum) using hydrogen peroxide. The hydrogen peroxide will digest periosteum; clean well with cotton tip.

Otherwise jump to next step.

Note: mouse was removed from stereotax for next steps and kept under anesthesia with nose cone.

Forelimb implantation

- 13 Make incisions over neck and forelimb sites using small scissor
- 14 Snake electrode assemblage through neck opening - connector was positioned near the head and individual electrodes were positioned near forelimb muscles to target.
- 15 With help of needle at the end of each electrode, the wire should be passed through target muscle until knot after exposed recording site sits inside the muscle.
- 16 The ends of the wire are then knotted by the exit point securing the recording sites within the muscle.
- 17 Each incision is closed with sutures and covered with antibiotic ointment to prevent itching.
- 18 The connector is then attached to back of the skull or existing cap using dental cement (Metabond).
- 19 If necessary, neck incision will be closed with sutures and also covered with antibiotic ointment.

Completion of surgery

- 20 When finished, switch off isoflurane and oxygen and remove the mouse from stereotax.
- 21 Elizabeth collar is placed in the mouse and kept for at least 5 days.



- 22 Place mouse in the home cage, on a heating pad and keep under observation until they recover and are ambulatory.
- 23 Cage grid is remove and gel food provided at least for 5 days post surgery

Protocol references

Nelson et al, 2021