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## SPARC - Chronic implantation of gastrointestinal and vagus nerve electrodes in the ferret [↗](#)

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1

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[dx.doi.org/10.17504/protocols.io.6crhav6](https://doi.org/10.17504/protocols.io.6crhav6)



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### ABSTRACT

This protocol is used to surgically implant gastrointestinal planar electrodes and vagus nerve cuff electrodes for chronic electrophysiological recording and stimulation in the ferret. Electrode lead wiring is tunneled subcutaneously to a connector embedded in a headcap affixed to the cranium.

Funding: This protocol was developed with funding from the NIH Common Fund's Stimulating Peripheral Activity to Relieve Conditions (SPARC) program (Award U18TR002205). To learn more about the SPARC program, visit <https://sparc.science>.

### EXTERNAL LINK

<https://www.biorxiv.org/content/10.1101/607242v2>

### THIS PROTOCOL ACCOMPANIES THE FOLLOWING PUBLICATION

[Machine learning prediction of emesis and gastrointestinal state in ferrets Ameya C. Nanivadekar, Derek M. Miller, Stephanie Fulton, Liane Wong, John Ogren, Girish Chitnis, Bryan McLaughlin, Shuyan Zhai, Lee E. Fisher, Bill J. Yates, Charles C. Horn bioRxiv 607242; doi: <https://doi.org/10.1101/607242>](#)

### GUIDELINES

- 1) procedures should be conducted under sterile conditions
- 2) animal should be monitored for stability of respiration, heart rate, blood pressure, and temperature

### MATERIALS

NAME	CATALOG #	VENDOR
Vetbond	<a href="#">View</a>	3M corporation
3-point retractor	110-3445	George Tiemann
Cefazolin	Cefazolin for injection	
bone cement	Palacos bone cement	

### Remove food

- 1 Remove food from the home cage 3 h before anesthesia 03:00:00

- 1.1 Measure body weight

#### Preparation: Before first incision

- 2 Induce anesthesia with 20mg/kg ketamine (i.m.).
- 3 Apply facemask to delivery inhalational isoflurane (1 to 2%).
- 4 Shave abdomen and dorsal neck and head.
- 5 Intubate using a 3.0 or 3.5 endotracheal tube.
- 6 Place ferret supine on table. Connect EKG leads and place rectal probe for recording body temperature (keep at 36 to 40C).
- 7 Monitor vitals with pulse oximeter, EKG, rectal temperature probe. Animal prepped following sterile procedure.
- 8 Administer analgesic: 0.05mg/kg buprenorphine (s.c.).
- 9 Sterilize skin for incision with chlorohexidine and 70% isopropyl alcohol.
- 10 Administer 20 ml of warm saline (s.c.) and repeat every two hours.

#### First incisions and Tunneling

- 11 Make incisions in skin on the abdominal midline (~4 cm) and dorsal neck (~3 cm).
- 12 Use a trocar to tunnel under skin from the dorsal neck, along the back, and to the left side to exit at the abdominal incision.
- 13 Advance electrode leads and gastric catheter through tunnel with trocar and then remove trocar leaving the leads under the skin.
- 13.1 Leave ~6 cm of the leads with head connector extended from the dorsal neck incision, wrapped in sterile gauze and taped to surrounding skin.

#### Abdominal Surgery: Placement of electrodes and gastric tube

- 14 Place the animal on its back.

- 15 Make an incision in the midline abdominal muscle to expose the organs.
- 16 Open abdominal cavity using a 3-point retractor (Balfour pediatric retractor; George Tiemann), applied to the lateral edges of the abdominal incision and sternum. This retractor is elevated using a vertical post attached to a surgical board under the animal.
- 17 Make incision (~0.5 cm) on the left lateral edge of the gastric fundus and insert gastric catheter with the tip resting in the antrum. Place a purse-string suture around the incision and tied. And, additional knot is made around the catheter and the free ends of this knot and purse-string suture are tied together. Finally surgical glue (Vetbond) is applied to the incision area.
- 18 In some experiments, a cuff electrode is placed on either the ventral or dorsal abdominal vagus nerve trunk. Suture a ground electrode lead to connective tissue on the greater curvature of the stomach.
- 18.1 This is accomplished by caudal retraction of the stomach and retraction of the liver to the right side of the animal using saline moistened gauze. In this position, the esophagus and vagi become accessible.
- 19 Place planar electrodes on surface of stomach and duodenum using 8-0 silk suture. Suture a ground electrode lead to connective tissue on the greater curvature of the stomach
- 20 Administer abdominal lavage with antibiotic (cefalexin, 1% w/v) in saline (0.9%, 100 ml).
- 21 Test electrode impedances.



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- 22 Close abdomen using absorbable suture for muscle (silk, 2-0) and monofilament (3-0) for the skin.

#### Head mount: Securing the electrode connector

- 23 Turn the animal to dorsal side up.
- 24 Fix the head in place using stereotaxic frame and earbars.
- 25 Make dorsal midline incision on the head.
- 26 Tunnel under the skin between head and neck incision. Pull electrode connectors through to the head.

- 27 Suture gastric tube to neck and close neck incision.
- 28 Clear muscle tissue from dorsal skull.
- 29 Drill 4 to 8 holes in the skull and place bone screws. Leave enough space between head of screw and skull to provide grip for bone cement.
- 30 Layer bone cement onto skull to form a base.
- 31 Use bone cement to mount connectors. Surround connectors with cement.

#### Recording

- 32 Measure electrode impedances.



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- 33 Record 10 min of baseline gastrointestinal myoelectric responses.



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#### Recovery

- 34 Extubate. Remove from isoflurane exposure.
- 35 Monitor animal for recovery from isoflurane.
- 36 Administer 10 days of oral amoxicillin and 72 hours of buprenorphine (s.c.).

## 37 Remove sutures 2 weeks after surgery.



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