McGill

STANDARD OPERATING PROCEDURE #209

CRANIAL SURGERY IN NON-HUMAN PRIMATES

1. PURPOSE

This Standard Operating Procedure (SOP) describes surgical principles for the cranial surgery, and refinement alternatives in non-human primates (NHP).

2. RESPONSIBILITY

Principal investigator (PI) and their research staff, veterinary care staff and all qualified personnel who perform cranial surgery on non-human primates (NHP) or assisting in the procedures.

3. MATERIALS

3.1. Analgesics

3.2. Anesthetics

3.3. Sterile ophthalmic ointment

3.4. Electric clipper

3.5. Gauze

3.6. Antiseptic (e.g., chlorhexidine 2%, povidone-iodine solution used alternatively with 70% alcohol; or ready-to-use chlorhexidine-alcohol solution; or one-step surgical prep solution)

3.7. Sterile surgical instruments

3.8. Sterile surgical drapes

3.9. Sterile suture material

3.10. Sterile gauze

3.11. Sterile isotonic saline (0.9% saline) or Lactated Ringer's Solution (LRS)

3.12. Stethoscope

3.13. Monitoring equipment: thermometer, pulse oximeter, capnograph, blood pressure monitor

3.14. Material or equipment to provide or conserve body heat (e.g. warm-water circulating pad)

3.15. Clean scrubs, appropriate Personal Protective Equipment (PPE)

3.16. Sterile gown

3.17. Sterile gloves

3.18. Xylocaine spray

3.19. Sterile lubricant (e.g. water soluble jelly)

3.20. Endotracheal tubes, cuffed, various sizes

3.21. Laryngoscope

3.22. Plain gauze rolls

4. PROCEDURES

4.1. Surgical procedures must be described in the Facility Animal Care committee (FACC) approved Animal Use Protocol (AUP).

4.2. Only trained and certified individuals can perform these procedures.

4.3. Surgical procedures are to be conducted only under the direct oversight of the veterinary care staff.

4.4. Follow SOP 203 Large Animal Surgery for general considerations: Materials, Surgical Principles, Pre-operative Care, Surgical Procedures, Monitoring and Supportive Care, Postoperative Care, and Record Keeping.

4.5. Implants must be the smallest possible within the experimental confines and as approved in the AUP, made of biocompatible material, and adapted to each animal. Use imaging and 3-D printing to design the devices when possible.

4.6. Imaging or computer-assisted technology to insert electrodes or cannulas is to be used whenever possible to increase the accuracy of placement and minimize invasiveness.

4.7. The number and invasiveness (level of penetration) of electrodes/cannulas should be minimized in line with the objectives of the study, justified to the Facility Animal Care Committee (FACC).

4.8. Multiple major surgeries:

4.8.1. Some surgeries need to be performed in sequence to allow the tissues to heal before proceeding to the next step and to reduce the duration of maintenance and care of implants. This is acceptable when it will result in less pain or distress for the animal. Sequential or repeated surgeries must be justified to and approved by the FACC.

4.8.2. Implants might become defective before the end of an experiment. It is generally acceptable to relocate them to another area, e.g., contralateral. A recovery period might be necessary between the removal and the replacement surgeries. The veterinarian will determine the best approach in collaboration with the Principal Investigator.

4.9. Post-operative Care:

4.9.1. Post-operative care should be determined by the veterinarian.

4.9.2. The required recovery period is procedure-dependent, should be determined in collaboration with the veterinarian and must be indicated in the Animal Use Protocol.

4.9.3. Cranial implants require regular cleaning and routine maintenance of the margins. Refer to SOP 210 Care of Cranial Implants and Chambers in NHPs.

4.9.4. Animals should be housed socially during the post-operative recovery period.

4.10. Humane intervention points:

4.10.1. General humane intervention points are described in SOP 410.

4.10.2. Multiple surgeries:

4.10.2.1. There is no set number of sequential surgeries. This is to be determined by the FACC during the protocol review process, based on scientific justification and expected or potential adverse effects.

4.10.2.2. In any case, after approval by the FACC and prior to performing a second surgery, the veterinarian conducts a physical exam and an Animal Welfare Assessment (see SOP 632) to establish the condition of the animal and determine the potential impact of the next surgery and if humane endpoints have been or could be reached.

4.10.2.3. The physical exam and the animal welfare assessment is to be repeated if the condition of the animal deteriorates and at least annually and reported to the FACC at the annual review of the protocol.

4.10.2.4. After each assessment, the veterinarian determines, in collaboration with the Principal Investigator, if the experiment can proceed or it needs to be suspended or ended, and if the condition of the animal requires treatment or euthanasia.

5. REFERENCES

5.1. F. Lanz, X. Lanz, A. Scherly, V. Moret, A. Gaillarda, P. Gruner, H.-M. Hoogewoude, A. Belhaj-Saif, G. Loquet, E.M. Rouiller. Refined methodology for implantation of a head fixation device and chronic recording chambers in non-human primates. *Journal of Neuroscience Methods* 219 (2013) 262–270.

5.2. Johnston J.M., Cohen Y.E. Shirley H., Tsunada J., Bennur S., Christison-Lagay K., Veeder C.L. Recent refinements to cranial implants for rhesus macaques (*Macaca mulatta*). *Lab Animal* volume 45, pages 180–186 (2016).

5.3. Overton JA, Cooke DF, Goldring AB, Lucero SA, Weatherford C, Recanzone GH. Improved methods for acrylic-free implants in nonhuman primates for neuroscience research. J Neurophysiol. 2017 Dec 1;118(6):3252-3270. doi: 10.1152/jn.00191.2017. Epub 2017 Aug 30. https://doi.org/10.1152/jn.00191.2017.

SOP REVISION HISTORY

DATE	REVISIONS
2019.01.30	5.3. Overton JA, Cooke DF, Goldring AB, Lucero SA, Weatherford C, Recanzone GH. Improved methods for acrylic-free implants in nonhuman primates for neuroscience research. J Neurophysiol. 2017 Dec 1;118(6):3252-3270. doi: 10.1152/jn.00191.2017. Epub 2017 Aug 30. https://doi.org/10.1152/jn.00191.2017
2023.02.20	3.4. Electric ~~razor~~ **clipper** 3.6. Antiseptic (e.g., chlorhexidine 2%, ~~hibitane~~, povidone-iodine solution **used alternatively with 70% alcohol; or ready-to-use chlorhexidine-alcohol solution; or one-step surgical prep solution)** ~~3.7 70% alcohol~~ ~~3.8. Dry bead sterilizer or cold sterilization agents (e.g. glutaraldehyde) and 70% alcohol (as a rinsing agent)~~ **3.7. Autoclave or gas sterilization equipment** 3.14. ~~Physiological~~ Monitoring equipment: thermometer, pulse oximeter, capnograph, blood pressure monitor 3.16. Clean scrubs, shoe covers, mask **or N95 respirator**, bonnet
2023.02.20	4.5. ~~Explants and~~ Implants must be the smallest possible **within the experimental confines and as approved in the AUP**, made of biocompatible material, and adapted to each animal. Use imaging and 3-D printing to design the devices **when possible**.
2023.02.20	4.6. Imaging or computer-assisted technology to insert electrodes or cannulas is to be used **whenever possible** to increase the accuracy of placement and minimize invasiveness.
2023.02.20	~~4.8.1. A major surgery is defined as a penetration of the cranial cavity.~~
2023.02.20	4.8.2. Implants~~/explants~~ might become defective before the end of an experiment. It is generally acceptable to relocate them to another area, e.g., contralateral. A recovery period might be necessary between the removal and the replacement surgeries. The veterinarian will determine the best approach in collaboration with the Principal Investigator.
2023.02.20	4.9.1. Post-operative care should be determined by the ~~veterinary care staff~~ **veterinarian**. 4.9.2. The required recovery period is procedure-dependent, should be determined in collaboration with the ~~veterinary care staff~~ **veterinarian** and must be indicated in the Animal Use Protocol. 4.9.3. Cranial ~~explants~~ **implants** require regular cleaning and routine maintenance of the margins. Refer to SOP 210.
2023.02.20	~~5.3.1. Number of penetrations:~~ ~~5.3.1.1. If known, a maximum limit is to be stated in the Animal Use Protocol for the number of electrode/cannula penetrations in the brain to reduce the risks of adverse effects.~~ ~~5.3.1.2. If unknown initially, the number of penetrations will be documented and used to establish the humane endpoints and reported to the FACC at the annual review of the Animal Use Protocol.~~
2023.02.20	4.10.2. ~~Number of~~ Multiple surgeries: 4.10.2.1. There is no set number of sequential ~~or major~~ surgeries. This is to be determined by the FACC during the protocol review process, based on scientific justification and expected or potential adverse effects. 4.10.2.2 In any case, after approval by the FACC and prior to performing a second ~~major~~ surgery, the veterinarian conducts a physical exam and an Animal Welfare Assessment (see SOP 632) to establish the condition of the animal and determine the potential impact of the next surgery and if humane endpoints have been or could be reached.
2023-08-15	~~3.7. Autoclave or gas sterilization equipment~~
2023-08-15	3.9. **Sterile** suture material
2023-08-15	3.15. Clean scrubs, ~~shoe covers, mask or N95 respirator, bonnet~~ **appropriate Personal Protective Equipment (PPE)**
2023-08-15	~~3.18 Emergency airway equipment~~