

1. PURPOSE

This Standard Operating Procedure (SOP) outlines procedures for routine care and cleaning of implants and recording chambers, as well as treatment of infected implants and chambers in non-human primates (NHP).

2. RESPONSIBILITY

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

3. MATERIALS

- 3.1. Sterile swabs and gauze sponges
- 3.2. Hydrogen peroxide
- 3.3. Sterile 0.9% saline
- 3.4. Chlorhexidine 2%
- 3.5. Triple antibiotic ointment
- 3.6. Povidone-iodone ointment
- 3.7. Povidone-iodine, 2% and 10% solutions
- 3.8. 0.5% bleach solution
- 3.9. Personal protective equipment (PPE):
 - 3.9.1. N95 mask
 - 3.9.2. Gloves
 - 3.9.3. Lab coat or gown
 - 3.9.4. Goggles/face shield
- 3.10. Treats/rewards
- 3.11. Antibiotics

4. CONSIDERATIONS

- 4.1. Wear the adequate PPE at all times for the procedures.
- 4.2. Proper maintenance and cleaning of implant margins and chambers helps to prevent infections which jeopardize not only the health of the animal, but also the ability of the animal to continue working in the research protocol, and hence the ability to acquire meaningful data. Once an infection is noted, it must be treated promptly and aggressively, based on culture and sensitivity testing if possible.
- 4.3. Log all procedures and observations, including solutions used and drugs administered, into the animal's permanent medical record.
- 4.4. To maintain the viability of the acrylic implant and the surrounding tissue, these areas must be frequently cleaned and maintained. The principal investigator is responsible for designating the individual responsible for the regular cleaning of implants and chambers.
- 4.5. Implant margins should be inspected at least once weekly. Chambers should be inspected at least three times weekly.
- 4.6. Use food rewards as a form of positive reinforcement after each procedure. Rewards can include dried or fresh fruit, nuts, etc.

5. MAINTENANCE PROCEDURES FOR RECENTLY IMPLANTED ANIMALS

- 5.1. When cleaning implants and chambers, avoid contamination of the chamber by first working on the chamber, then cleaning the implant edge.
- 5.2. Avoid the use of hydrogen peroxide for at least 2-3 weeks following surgery.
- 5.3. Chamber cleaning may begin one week after surgery.
- 5.4. Animals should not be head fixed for 6-8 weeks following placement of the head post. If the head post and chamber are placed during the same surgery, chamber cleaning can be done either with the animal awake (with a second person distracting the monkey by feeding treats) or anesthetized.
- 5.5. Clean the exterior surface of the acrylic implant, recording chamber, and cap.
 - 5.5.1. Prior to opening the chamber, clean the exterior surface of the chamber, its cover, and the surrounding acrylic with 0.05% chlorhexidine solution (for external use only) or 10% povidone-iodine solution and a gauze sponge or animal-specific toothbrush.
 - 5.5.2. The minimum contact time is 3 minutes, after which the surface should be wiped clean using a new dry gauze sponge.
- 5.6. Clean the recording chamber.
 - 5.6.1. Chambers should be cleaned at least 3 times weekly.
 - 5.6.2. Use an Allen wrench to remove the chamber's cap.
 - 5.6.3. Thoroughly clean the cap by scrubbing it with 10% povidone-iodine solution and hydrogen peroxide. Then soak the cap in 10% povidone-iodine solution.
 - 5.6.4. Remove bone wax and use sterile gauze to remove accumulated liquid inside the chamber.
 - 5.6.5. Flush the chamber 5 times with copious amounts of sterile saline/2% povidone-iodine solution.
 - 5.6.6. A sterile gauze pad should be placed into the chamber and a few drops of 2% povidone-iodine solution may be placed on the gauze to reduce bacterial growth. Do not overfill with gauze as this may cause increased cranial pressure. Alternatively, the chamber may be filled with dilute sterile saline/povidone-iodine solution.
 - 5.6.7. The cap is removed from the povidone-iodine soak, rinsed with alcohol, dried with a clean gauze sponge, and replaced on the chamber.
- 5.7. Cleaning the wound margin/implant edge.
 - 5.7.1. Prior to cleaning the wound margin, the exterior surface of the chamber, its cap, and the surrounding acrylic should be wiped with alcohol to remove any material remaining from the chamber cleaning. Avoid getting alcohol on the wound margin of a newly implanted animal.
 - 5.7.2. The tissue surrounding an implant must be allowed to heal for at least 2-3 weeks. Cleaning/rough handling of the tissue can promote swelling and infection and delay healing. Gentle flushing is all that is required during this critical healing period.
 - 5.7.3. Dried blood may be removed by placing a gauze sponge soaked in sterile saline over the area for a short period, repeating as necessary. Cleaning the area of all dried material is not necessary and could be deleterious to wound healing.
 - 5.7.4. The wound edge should be flushed with copious amounts of saline/2% povidone-iodine-sterile solution, as needed. Following cleaning, a small amount of povidone-iodine ointment or triple antibiotic ointment should be applied to the wound edge.
- 5.8. Any abnormal appearance of the wound edge (swelling, discharge, bleeding) or chamber (discharge, foul odor) should be reported to Veterinary Services.

6. MAINTENANCE PROCEDURES FOR CHRONICALLY IMPLANTED ANIMALS

- 6.1. All established chambers (present and in use for several months) should be inspected at least once weekly for evidence of discharge, granulation tissue, or infection.
- 6.2. Cleaning of the exterior surface of the acrylic implant, recording chamber, and cap.

- 6.2.1. Prior to opening the chamber, clean the exterior surface of the chamber, its cover, and the surrounding acrylic with 0.05% chlorhexidine solution (for external use only) or 10% povidone-iodine solution and a gauze sponge or animal-specific toothbrush.
- 6.2.2. The minimum contact time is 3 minutes, after which the surface should be wiped clean using a new dry gauze sponge.
- 6.3. Cleaning the recording chamber.
 - 6.3.1. Chambers should be cleaned at least 3 times weekly.
 - 6.3.2. Use an Allen wrench to remove the chamber's cap.
 - 6.3.3. Thoroughly clean the cap by scrubbing it with 10% povidone-iodine solution and hydrogen peroxide. Then soak the cap in 10% povidone-iodine solution.
 - 6.3.4. Remove bone wax and use sterile gauze to remove accumulated liquid inside the chamber.
 - 6.3.5. Flush the chamber 5 times with hydrogen peroxide followed by flushing 5 times with copious amounts of sterile saline or sterile saline/2% povidone-iodine solution.
 - 6.3.6. A sterile gauze pad should be placed inside the chamber and a few drops of 2% povidone-iodine solution may be placed on the gauze to reduce bacterial growth. Do not overfill with gauze as this may cause increased cranial pressure. Alternatively, the chamber may be filled with sterile saline/2% povidone-iodine solution.
 - 6.3.7. The cap is removed from the povidone-iodine soak, rinsed with alcohol, dried with a clean gauze sponge, and replaced on the chamber.
- 6.4. Cleaning the wound margin/implant edge.
 - 6.4.1. Prior to cleaning the wound margin, the exterior surface of the chamber, its cap, and the surrounding acrylic should be wiped with alcohol to remove any material remaining from the chamber cleaning. Use of hydrogen peroxide should be limited to areas which require a more rigorous approach to cleaning.
 - 6.4.2. The tissue surrounding the implant must be handled in a gentle manner to prevent trauma, swelling, and secondary infections.
 - 6.4.3. Removing hair from the wound margin facilitates cleaning but removal of all hair is not routinely required. Periodically remove hair from the wound margin with small scissors (depilatory cream and clippers are not recommended). Care must be taken when removing hair around eye coil wires, at the rostral margin of the wound edge.
 - 6.4.4. Gentle flushing and soaking is usually sufficient to maintain the wound margin. The wound edge should be flushed copiously with 2% povidone-iodine solution. Following cleaning, a small amount of povidone-iodine ointment or triple antibiotic ointment should be applied to problem areas at the wound edge.
- 6.5. Any abnormal appearance of the wound edge (swelling, discharge, bleeding) or chamber (discharge, foul odor) should be reported to Veterinary Services.

7. PROCEDURES FOR PROBLEM IMPLANTS AND CHAMBERS

- 7.1. Implant margins showing significant granulation tissue, crusting, bleeding, or discharge should be reported to Veterinary Care staff.
- 7.2. Problem chambers should be cleaned daily for a minimum period of 14 days. Investigators are encouraged to clean as often as possible within the 14-day period, including at least one day on weekends.
- 7.3. Cleaning should include a daily flush with hydrogen peroxide to remove any build-up of proteinaceous material. The chamber is then flushed copiously with sterile saline/2 %povidone-iodine solution. After flushing, the chamber should be filled with sterile saline/2% povidone-iodine solution prior to capping.
- 7.4. If the technique described in 7.3 successfully clears the problem, return to cleaning the chamber 3 times weekly using the routine dry gauze technique described above in section 6.3.
- 7.5. If the technique described above in 7.3 fails to clear the problem, the chamber should be cleaned daily for a maximum of 14 additional days as follows:
 - 7.5.1. First, flush with hydrogen peroxide to remove any build-up of proteinaceous material.
 - 7.5.2. Next, flush copiously with sterile saline/2% povidone-iodine solution.
 - 7.5.3. Finally, fill the chamber with 0.5% bleach solution prior to replacing the cap.

- 7.6. After the 14-day treatment as described in 7.5, return to cleaning the chamber 3 times weekly as described in section 6.3, filling the chamber with sterile saline/2% povidone-iodine solution after each cleaning.
- 7.7. If the condition returns or persists, contact the Clinical Veterinarian. Any abnormal appearance of the wound edge (swelling, discharge, bleeding) or chamber (discharge, foul odor) should be reported to Veterinary Care staff.
- 7.8. The decision to use topical or systemic (oral or injectable) antibiotics must be made in consultation with the Clinical Veterinarian, and based on culture and sensitivity testing whenever possible.