Both the *Guide for the Care and Use of Laboratory Animals* (PHS/NIH) and the Animal Welfare Act (USDA) stipulate that survival surgery for rodents (in the case of USDA covered species only) be conducted in a humane and appropriate manner. All peri-operative care (pre-operative, intra-operative and post-operative) care of the animals should be in accordance with established veterinary practices.

**Items of note with regard to rodent survival surgery:**

- All survival surgery will be performed using aseptic procedures. This includes use of masks, sterile gloves, sterile instruments and aseptic techniques. All surgical instruments, implantable devices and equipment that will contact the surgical site must be sterilized before use. (See Disinfectants and Sterilization.) Any parenteral solutions to be use during surgery (e.g. anesthetics, pharmacologic agents, biologic substances) must be prepared and maintained in a sterile manner.

- All personnel performing surgery must be appropriately trained such that all aseptic procedures are followed routinely and that good surgical technique is practiced. All ACUC mandated training in surgical technique and anesthesia (including completion of the EH & S halothane powerpoint program and viewing of the cd-ROM NIH Training in Survival Rodent Surgery) must be completed prior to any hands on surgical training.

- While use of a dedicated surgical facility is not necessary, the surgical area should be uncluttered and disinfected prior to performance of any procedure. If performing rodent survival surgery in a laboratory, do so in an isolated area away from the flow of traffic and where contamination from other lab activities will be minimized.

- Instruments and gloves may be used for a series of animals during the same surgical session provided they are kept clean and disinfected between animals (see Disinfectants and Sterilization, Table 4).

**Personal Protective Equipment (for the benefit of both human and animal):**

1. Clean lab coat or surgical scrubs
2. Mask
3. Surgical Gloves (exam gloves may be substituted if wiped down with a disinfectant followed by sterile saline and only the tips of the sterile surgical instruments contact the surgery site.
4. Head Cover

**General and Pre-operative Essentials:**

1. The physical area where surgery will be performed must be prepared by removal of all extraneous items not immediately needed for surgery and the surface disinfected (see Disinfectants and Sterilization, Table 1).
2. Animals are to be in good health. Rodents should be alert, exhibit normal behavior and have good coats, clean eyes and be of normal weight. Should the animal not appear healthy, contact the LAR veterinarians for a physical assessment before proceeding with surgery. Animals must have undergone at least 1 week of conditioning following receipt before surgery may be performed.
3. Withholding food and/or water is usually not necessary for rodents. If such is dictated by the surgical procedure, consult with a LAR veterinarian for the length of time needed.

4. If necessary, anesthetize the animal before skin preparation. Prepare the surgical site on the animal by clipping or shaving of hair. Fur should be clipped, shaved, plucked or depilated to at least 1 cm surrounding from the intended incision site (if possible). Fur removal should be done in an area away from the surgery ‘table’ to avoid contamination with hair clippings. If necessary, vacuum or use tape to remove hair clippings that cannot be brushed away. This will reduce contamination of the surgical incision.

5. Prepare the surgical site with appropriate skin disinfectants (see Disinfectants and Sterilization, table 2). The surgical incision site must be scrubbed with either a povidone-iodine scrub (e.g. Betadine®) or a chlorhexidine scrub (e.g. Nolvasan®). Scrub should be applied either working from the center outward in a circular fashion or from the center to one end, taking care never to backtrack. Surgical scrub should be wiped off with 70% alcohol. This process should be repeated three times (more if the animal is very dirty). Try not to soak the animal as this may lead to hypothermia. Surgeons may wish to ‘paint’ the site with a povidine-iodine or chlorhexidine solution for a final disinfectant following scrubbing but this is not necessary. Alcohol may be substituted and used as a sole disinfectant provided it has been approved as such in the animal use protocol and remains in contact for a minimum of 1 minute.

6. If not done prior to skin disinfection, position and fix the animal into place. If using a stereotaxic apparatus, only blunt ear bars may be used to avoid trauma to the ear drum.

7. Any animal that will remain anesthetized for 30 minutes or longer should have a bland ophthalmic ointment (Paralube® or Lacrilube®) instilled into the eyes to avoid corneal drying.

8. Provide any pre-operative analgesic or antibiotic if stipulated in the animal use protocol.

9. Surgeons must wash hands prior to donning gloves. If using exam gloves, wipe down the gloves with an appropriate disinfectant (see Disinfectants and Sterilization, Table 4) and rinse with sterile saline before handling any instruments or touching the disinfected surgical site. Drape the animal or surgical site with a sterile drape if desired. Use of a sterile drape to protect the surgical site is also useful for providing a sterile surface upon which sterile instruments may be placed.

**Intra-operative Essentials**

1. All animals must be checked and in a surgical plane of anesthesia prior to making any incision. All animals must be maintained in a surgical plane of anesthesia throughout the procedure. Monitor the patient using species appropriate techniques (tail pinch, toe pinch, respiratory rate, heart rate, mucous membrane color) for plane of anesthesia and viability. More sophisticated methods may also be used but are not required.

2. Maintain body temperature by use of drapes, re-circulating warm water pad, warm water bottles, etc.). Dry electric heating pads may be used only if the setting is kept on low and there is a towel placed between the animal and the pad. Such pads must be checked routinely for ‘hot’ spots and if found, the pad discarded. Use of heat lamps are discouraged during surgery due to the tendency to dry out the corneas and manipulated tissues.

3. Begin surgery with sterile instruments and handle all instruments, implants, catheters and sutures to insure continuity of sterility for the duration of the procedure.
Instruments must be sterilized using an appropriate technique (see Disinfectants and Sterilization). Instruments may be used for more than one animal, but must have any gross contamination with organic matter removed before disinfection via an appropriate method. (see Disinfectants and Sterilization, Table 3). To allow for appropriate disinfection contact time, have two (2) or more surgical packs of instruments sterilized before starting a group of animals. (see Disinfectants and Sterilization, Table 4)

4. If at any time in a procedure gloves or an instrument becomes contaminated, stop and discard the contaminated item and replace with sterile or disinfected items.

5. Practice good surgical technique. Use gentle tissue handling, minimize any tissue dissection to avoid tissue trauma and dead space, use instruments appropriately and provide effective hemostasis.

6. Close surgical incisions with the appropriate suture and suture pattern or wound clips. Use a layered closure if appropriate for the surgical incision. Refer to Wound Closure Guidelines for more information on this subject.

Post-Operative Essentials

1. Move animal to a warm and dry area for recovery. Use of a heat lamp or electric heating pad is acceptable provided the animal is closely monitored the entire time and that the animal can relocate to an area of the cage away from the heat source. **Unconscious animals may not be left unattended.** Monitor all animals recovering from anesthesia at least until they are able to achieve and maintain sternal recumbency.

2. Return the animal to its usual housing area only after it has fully recovered from anesthesia. NEVER place an anesthetized animal in a cage with an awake animal.

3. Administer any analgesic as described in the animal use protocol. **Analgesia must be administered as described in the animal use protocol unless otherwise scientifically justified and approved by the ACUC.** (FSU ACUC Policy on Post-operative Analgesia in Rodents) If significant blood loss occurred during surgery or if surgery was prolonged, administer an appropriate amount of warmed sterile saline or lactated ringers solution (1-2 ml/mouse; 1-2 ml/100 grams body weight rat)

4. Fill out daily and maintain post-operative records for a minimum of ten (10) days (FSU ACUC Peri-operative Records Policy).

5. Monitor the animals regularly after surgery. Administer additional doses of analgesic in accordance with the animal use protocol or if needed based upon an individual animal’s behavior/appearance. Signs of distress in rodents include inactivity (is the animal active and inquisitive?), lack of grooming, discoloration around the eyes or nose or on paws, lack of food or water intake, lack of fecal or urine output. Problems with a surgical incision may be noted by swelling around or under the incision, oozing from the incision, reddened wound edges or missing staples/sutures. If weighing animals post-operatively, report any animal with a weight loss equal to or greater than 20% of its pre-surgical weight.

6. Remove skin sutures or wound clips at 7-10 days after surgery (FSU ACUC Suture Removal Policy).

**NOTE:** Surgery training and practice surgeries must be done under the supervision of the attending veterinarians or a protocol’s principal investigator.