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The surgical procedure itself should maintain a routine sequence of events to assure that each patient is receiving the same standard of care. The surgeon should ensure that the technicians follow a thorough protocol for surgical prep of the patients, including, but not limited to, complete clip, debris removal, surgical scrub, and bladder expression in females.

As the surgeon approaches the patient in the OR, a generally accepted practice would be to double-check the status of the patient. Parameters include:

- The patient should be properly connected to the anesthesia machine;
- Oxygen and isoflurane levels should be appropriate;
- The monitoring equipment should be operational;
- It should be confirmed that the patient is at the correct plane of anesthesia and the veterinary surgeon must verify sex of the patient, especially with cats;
- Finally, it should be noted that the patient is in proper position for the surgery and that the light source is directed toward the incision site. At this point, the veterinary surgeon may proceed.

The patient is draped in with 3 or 4 quarter drapes, with or without a fenestrated drape. Any combination of the above is considered acceptable, as long as there is an appropriate barrier to prevent contamination of the surgical site.

The incision placement will obviously vary with both the sex and the species of the patient. We have also determined that varying the incision placement depending on the age of the patient can improve the efficiency of the entire procedure. Incisions in adult female dogs are generally placed directly caudal to the umbilicus (see Figure 1), while the incision in a pediatric female dog would be placed approximately half-way between the umbilicus and pubis (see Figure 2). When spaying an adult or pediatric cat, the incision is also placed approximately half-way between the umbilicus and pubis.
In female dogs, there are several factors which will influence the craniality of your incision placement. The older, larger, heavier, and deeper-chested a dog is, the more cranial the incision should be centered.

Adult male dogs are neutered with either a pre-scrotal or scrotal incision. However, in pediatric male dogs, the routine approach is scrotal.

The most important factor in proper surgical technique is that meticulous, careful tissue handling is observed in any procedure. The following additional points will also be emphasized:

- A rigorous ability to maintain sterile technique at all times;
- Incision placement and its importance;
- Removing minimal subcutaneous tissue, which will reduce dead space and facilitate efficient entry into the abdomen;
- Proper and gentle spay hook technique;
- Cutting the ovary away prior to ligation (female dog) / pedicle tie (female cat);
- Using a modified Miller's knot, and setting using the carmalt;
- Four throws (2 square knots) on all sutures. This technique has been proven to decrease the incidence of dehiscence, and must always be used;
- Large bites on the linea alba: include at least 5 to 8 mm rectus tissue in the linea closure in cats and up to 10 to 12 mm in large dogs. A cruciate suture pattern with a Surgeon's throw is used to decrease tension and speed closure time;
- No crushing sutures in closing - linea and subcutaneous tissue should be snugly and completely closed but never crushed;
- Linea and subcutaneous tissue are closed with PDS suture (see FAQ’s for discussion on suture material);
- At least 3-layer closure-linea, SQ, and subcuticular plus skin glue. Staples are used if skin edges are not apposed;
- Skin edges should be properly apposed - never allow one side to flap over the other or extend above the other. Skin glue should not be applied between the skin edges but on the surface after apposing the edges. Skin glue should only be used as a protective barrier, and never used for “added strength,” or used in place of properly placed skin sutures.

**TATTOOING**

- A tattoo is applied to all patients to ensure no future unnecessary anesthesia or surgery.
- We perform a “scoring” procedure to accomplish the tattoo, by placing a small (~1cm) incision in the dermis near the incision site, or near the umbilicus in the case of male cats, and applying ink.
- We prefer paste vs. liquid ink, in that it is neater and stays in place better, and green-colored paste is more obvious, especially on animals with darkly pigmented skin.
The overall size of an incision for a canine ovariohysterectomy will vary depending upon various factors, the most obvious being the experience and/or comfort level of the surgeon. Repetition over time will tend to naturally decrease the size of the incision to as little as 0.75 cm in some patients.

Once the skin has been excised, a small amount of subcutaneous adipose tissue is removed to improve visualization of the linea. This technique decreases the time necessary to enter the abdomen.

The linea is incised by utilizing the thumb forceps to tent the linea. The scalpel blade is positioned sharp side up to incise the linea and the incision is extended while using the thumb forceps as a guide to safeguard the abdominal contents. Once entry is made to the abdomen, the falciform ligament is dissected as necessary.

Due to the small size of the incision, it is typical practice to utilize a spay hook to locate and exteriorize the first ovary. Learning to properly use a spay hook can occasionally be challenging. As a rule, the thumb forceps are used to elevate and tense the body wall and the spay hook is inserted with the “hook” facing cranially, but held tightly against the body wall. The spay hook is advanced to the dorsal most aspect of the abdomen. The ovary retrieved first is surgeon’s preference.

After locating the ovary, the suspensory ligament is broken or stretched. This is accomplished by placing caudal traction on the ligament and applying controlled digital pressure. It is helpful to recognize the “groove” created just below the border of the proper ligament. In rare cases you may need to nick the suspensory ligament with a blade to facilitate its rupture. After breaking or stretching the suspensory ligament, in order to isolate the ovary, create a window low in the broad ligament side of the ovarian pedicle and place the appropriate size carmalt below the ovary. The clamp should be placed low enough to allow a 2-3 mm tissue tag above the clamp after the ovary has been cut away. This will prevent slippage of the pedicle from the carmalt. After the carmalt has been placed appropriately, hold the ovary and use metzenbaums to cut the ovary away. A clamp or digital hemostasis is used to prevent back flow of blood from the ovary. Select the appropriate size suture and place a modified Miller’s knot below the carmalt. Double ligation is not necessary if the first ligature is properly tied. Release the clamp on the pedicle; the pedicle can be inspected for hemorrhage at this time. Ligate, cut, or tear the broad ligament (depending on vasculature).

Follow the uterine horn to the bifurcation and repeat the steps above on the opposite ovary.

Proceed to the uterine body and exteriorize it to allow for proper placement of ligature(s). Place a modified Miller’s knot distal to the cervix, but proximal to the bifurcation, if possible. It is not necessary to place the Miller’s knot below the bifurcation, as research has shown no benefit to ligating the uterine body in this manner. As long as the ovaries are completely removed, there is no risk of a “stump pyometra,” since that is a hormone-driven disease process. In fact, it is prudent not to place excess tension on the uterus to achieve ligation at the bifurcation. Keep in mind that in pregnant patients when the uterus is removed, a natural reflex will be contraction of the tissue. Thus, in pregnant patients, a modified transfixing suture is also necessary in addition to the modified Miller’s knot. In patients with extremely friable tissues, take care not to cut through the uterus with the ligature. After ligating the uterine body, the uterus can be cut away, leaving appropriate tissue tags, and inspected for hemorrhage. Complete a visual sweep of the abdomen.

Perform closure by taking bites of the external rectus (the holding layer of the abdomen). Bites do not need to be full thickness. The surgeon should select an appropriate suture size and close with cruciates. The cruciate pattern is more efficient because it can be placed faster than a simple interrupted pattern, and allows for effective apposition without relying on one pattern (i.e. simple continuous) to hold the entire incision closed. It is also a tension-relieving pattern.
Perform closure of the subcutaneous and subcuticular tissues. A simple continuous pattern in the subcutaneous tissue is performed, leaving the free tag end loose, as opposed to anchored with a knot. The pattern is then continued in the opposite direction through the skin in a subcuticular pattern, parallel to the incision, back to the free tag of the subcutaneous tissue. The runner is then tied off to the subcutaneous tag which will bury the knot. The knot is buried to prevent wicking and to ensure appropriate skin apposition. The closed incision then has glue applied to the skin surface. The glue should be applied ON, not IN, the incision. Glue in the incision can act as a foreign body and delay healing.

**CANINE CASTRATION (ADULT)**

- In the adult male, the closed technique is the preferred method because it is more efficient (saves time not to close tunic), there is less foreign material (suture) in closure, and there is less bleeding.
- At Humane Alliance, we most often perform scrotal castrations. The testicles are exteriorized through an incision in the median raphe of the scrotum, and ligated with a modified Miller's knot, or whichever knot the surgeon prefers. The incision is then apposed with one simple interrupted suture in the subcutaneous tissues using 3-0 absorbable suture.

**CANINE CASTRATION (PEDIATRIC)**

- In the pediatric male, one incision is placed over the scrotum along the median raphe. The testicle is exteriorized and excess tissue is stripped away. Either the open or closed technique work equally well in the pediatric male.
- A “figure 8” or overhand knot is placed and a tag left. This procedure is repeated on the opposite testicle. The incision is closed with glue and a “rolling technique” is used to prevent licking.

**ANATOMY REVIEW: ABDOMINAL CAVITY**

This illustration depicts the abdominal cavity. Take note of the omentum, originating from the greater curvature of the stomach, and extending from there over the abdominal contents.
Feline Sterilization

FELINE OVARIOHYSTERECTOMY

The feline spay is performed in much the same way as the canine spay, with a couple notable exceptions. We routinely use a method commonly referred to as the “pedicle tie.”

- An overhand instrument tie is performed on the ovarian pedicle, similar to the technique many veterinarians use in neutering a male cat.
- Upon isolation of the ovarian pedicle, the pedicle is feathered over the surgeon’s finger to allow identification of the individual structures.
- The suspensory ligament is located and torn/cut. The ligament can be cut with scissors or blade.
- A curved mosquito forcep is utilized to tie off the ovarian pedicle. The surgeon then slides the knot off of the hemostat.
- When ligating the ovarian body, the same techniques that were used in the female dog are used in the female cat. Close attention must be paid when ligating a friable uterus in a post-partum or multi-parous cat, as the ligature can cut through the uterine tissue easily if attention is not paid when tightening it. The Miller’s knot is specifically designed not to cut through tissue, as it is a 2-pass knot, and therefore distributes pressure over a larger surface area. However, it can still cut through friable tissue, at which point, suture of a larger size must be used to tie a new ligature. Closure is achieved by placing one 3-0 cruciate in the linea and a horizontal mattress in the intradermal tissue. If the incision requires more than one cruciate then it should be closed similarly to the dog, minimizing closure of the subcutaneous tissue.

FELINE CASTRATION

- An incision is made centrally or over each testicle. Open or closed techniques both work well.
- An overhand knot or figure 8 knot can be used to ligate the cord, depending on the surgeon’s preference, and the thickness of the cord (figure 8 knots are more difficult to perform on thick cords). This technique is repeated on the opposite side and the incisions are left open.

ANATOMY REVIEW: ANATOMY OF THE FEMALE REPRODUCTIVE TRACT

This illustration depicts the anatomy of the female reproductive tract. Take note of the position and location of the ovaries, the attachment of the broad ligament, and the location at the uterine body in relation to the bladder.
DO YOU PREFER CLIPPING OR PLUCKING FOR CAT CASTRATIONS?

We clip for all surgical procedures, including cat castrations. While plucking is an acceptable form of hair removal, we choose to clip these patients to give us a broader hair-free surgical field, which can decrease contamination, particularly in long-haired cats. Clipping is also a faster way of preparing the surgical site for us than plucking is.

CAN I FOCUS ON CERTAIN PROCEDURES DURING MY TRAINING?

While we make every effort to provide the types of surgeries that you would like to perform, ultimately, this is up to the discretion of your instructor and the types of animals that we have come through the clinic. If your instructor feels that you need work in a certain area, he/she will let you know and will work with you to also incorporate the cases that you would like to work on. Keep in mind that some cases (such as cryptorchids) are not always available.

CAN I TAKE PICTURES/VIDEO OF PROCEDURES, EQUIPMENT, SETUP, ETC.?

To protect our patients, we prefer you to NOT take pictures while in the surgical area. If there is a specific piece of equipment you would like a photo of, we may have it already available to view on our E-Learning site, along with purchasing information. If not, we’d be happy to take a photo for you. Just let us know.

WHY DO YOU USE PDS SUTURE? WHY ON A REEL INSTEAD OF IN PACKETS?

Simply put, it is the best choice for the HQHVSN arena. Suture on a reel is much less expensive than swaged-on suture (suture with the needle attached), and PDS has the balance of strength and decreased reactivity that we need in an absorbable suture that is to be used on a large, varied population of cats and dogs. Keep in mind that the body wall takes 2-4 weeks to heal completely after surgery. When you look at the chart below of commonly used suture types, you will see that PDS retains its strength longer than plain catgut, chromic catgut, and Monocryl™. Catgut’s short duration of strength and high level of reactivity makes it unsuitable for use in the HQHVSN setting (even on the pedicles, uterine stump, and testicular cords). Although Monocryl™ has less reactivity in subcutaneous tissue than PDS, its short duration of strength retention makes it a less than ideal choice for anything but young, fast-healing patients.

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<th>STRENGTH RETENTION PROFILE</th>
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<tr>
<td>Catgut (plain)</td>
<td>90% lost in 7-10 days</td>
<td>70 days</td>
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<tr>
<td>Chromic catgut</td>
<td>90% lost in 21-28 days</td>
<td>90 days</td>
</tr>
<tr>
<td>Monocryl™</td>
<td>70% lost in 14 days</td>
<td>100 days</td>
</tr>
<tr>
<td>PDS</td>
<td>70% lost in 6 weeks</td>
<td>180 days</td>
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WHY DO YOU USE PDS SUTURE? (CONT.)

% Strength of unwounded tissue

Days since healing started

Actual Strength (lbs)

Vicryl* Plus/Coated Vicryl*

PDS* II

Monocryl*

Vicryl Rapide*
GENERAL

- UC Davis Koret Shelter Medicine Program: Shelter Health Portal
  www.sheltermedicine.com

- Humane Alliance Standards of Care
  http://humanealliance.org/elearning/Veterinary_Standards_Of_Care.pdf

- Association of Shelter Veterinarians Veterinary Medical Care Guidelines for Spay/Neuter Programs
  http://avmajournals.avma.org/doi/pdf/10.2460/javma.249.2.165

- Supplemental Anesthesia & Analgesia Information, Veterinary Task Force to Advance Spay/Neuter Association of Shelter Veterinarians’ Spay/Neuter Task Force - Andrea Looney, DVM, DACVA et al.
  http://humanealliance.org/downloads/Reference_Anesthesia_Analgesia.pdf

- Pet Statistics

- Early spay/neuter current research: www.whentospay.org/get-the-facts

- ASPCA Pro: http://aspcapro.org

BIRTH PREVENTION ESTIMATES (HUMANE ALLIANCE FORMULA)

- NUMBER OF CAT BIRTHS PREVENTED
  = No. of sexually mature female cat patients x 3 litters/year x 4 kittens/litter

- NUMBER OF DOG BIRTHS PREVENTED
  = No. of sexually mature female dog patients x 2 litters/year x 4 puppies/litter

CLEANING

- UC Davis Koret Shelter Medicine Program: Sanitation in Animal Shelters Information Sheet

WORKPLACE SAFETY

- Occupational Safety & Health Administration: www.osha.gov

INVENTORY/CONTROLLED SUBSTANCES

- Drug Enforcement Administration - Controlled Substances Act
  www.deadiversion.usdoj.gov/21cfr/21usc/index.html
SURGERY

• Confidential Enquiry into Perioperative Small Animal Fatalities
  David C. Brodbelt, MA VetMB DVA DipECVA MRCVS
  http://humanealliance.org/downloads/Reference_Anesthesia_Abstract.pdf

• Already Been Spayed? Already Been Neutered?
  Brenda Griffin, DVM, MS, DACVIM College of Veterinary Medicine University of Florida
  http://humanealliance.org/downloads/Reference_Already_Been_Spayed.pdf

• Surgery STAT: Don’t Forget the Miller’s Knot
  Robert J. Hardie, DVM, Dipl. ACVS, Dipl. ECVS

• Optimal Age For Surgical Sterilization of Dogs and Cats
  Margaret V. Root Kustritz, DVM, PhD, DACT University of Minnesota College of Veterinary Medicine

• Onset of Sentience: The Potential For Suffering in Fetal and Newborn Farm Animals
  David Mellor, Tamara Diesch – Animal Welfare Science & Bioethics Centre, Massey University, NZ

• Pedicle Ties Provide a Rapid and Safe Method for Feline Ovariohysterectomy
  Miller et al., Journal of Feline Medicine and Surgery

• Scrotal Approach to Canine Orchiectomy
  Brian A. DiGangi, DVM, MS, DABVP; Matthew Johnson, DVM, MVSc, DACVS; Natalie Isaza, DVM
  humanealliance.org/downloads/Reference_Scrotal_Approach.pdf

ANESTHESIA

• Humane Alliance Anesthetic Protocols Reference List

• Risk Factors For Anesthetic-Related Death in Cats: Results From the Confidential Enquiry into Perioperative Small Animal Fatalities (CEPSAF)
  Brodbelt, Pfeiffer, Young, Wood
  www.bja.oxfordjournals.org/content/99/5/617.full

• How Safe is Anesthesia For Dogs and Cats?
  Sheliah A Robertson, BVMS (Hons), PhD, DACVA, DECVA, MRCVS
  humanealliance.org/downloads/Reference_Safe_Anesthesia.pdf
COMMUNITY CATS

- American Association of Feline Practitioners’ Feline Retrovirus Management Guidelines

- Humane Strategies for Controlling Feral Cat Populations
  Journal of the American Veterinary Medical Association 2004; 225:1354-1360

- Alley Cat Allies
  Organization advocating trap/neuter/return as a method of reducing feral cat populations