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A Clean Operating Room is a Happy Operating Room

By Dr. Courtney Campbell



Every surgeon wishes that was true but there is a lot more to happiness in the operating room than cleanliness. However, a dirty operating room could potentially lead to unhappiness and disastrous consequences.

Cleaning the operating room is perhaps one of the most understated aspects of veterinary surgery. Although it may not seem like this should be included as part of the surgical procedure, cleaning is just as critical as any other aspect of the surgery to ensure asepsis and excellent surgical outcomes. To be sure, there are a variety of factors related to surgical site infections, including patient factors, environmental factors, and surgical technique (among others), however minimizing the influence of environmental factors should be the goal of all surgeons.

Three Phases of Surgical Cleaning

Preoperatively

The axiom, *an ounce of prevention is worth a pound of cure*, can be applied to cleanliness as well. It's much easier to clean an OR that is not severely soiled. Also, it is vitally important to not perform surgical procedures with debris from the surgical preparation. Therefore, ensure that all presurgical preparation occurs outside of the operating room. This includes clipping nails, manually evacuating the colon, clipping hair, and removal of gross debris with the initial skin preparation and other preparation. Local anesthetic agents should be administered after the preliminary skin preparation but before the final preparation. Avoid reusing needles between injections if multiple doses are needed from the same bottle. Before entering the surgical suite with the patient, ensure that no visible smudges or debris are found on any of monitoring devices or surfaces in the OR.

Intraoperatively

Before the surgery begins, and at all times, caps and masks should be utilized. In order to ensure that caps and mask are being worn before entering the OR, they must be stored out of the OR. It is important to minimize the anesthesia time, surgical time, the amount of people in the OR and the traffic in the OR. The OR should only include essential people of the surgical team and it's recommended to close the door when operating to both symbolically and physically minimize traffic in the surgical suite.

Postoperatively

This is perhaps the most critical phase of cleaning. There are a host of surgical procedures and steps the surgical team has to perform prior to the patient entering the operating room. By minimizing the need for cleaning, it will help focus your attention on the patient and the presurgical preparation. After the procedure is completed the majority of the OR cleaning can take place.

Small Cleaning

Small cleaning is used to refer to smaller surfaces. Like the instruments and monitoring devices that are used directly on the patient and other small surfaces. Ensure that the floor is clean and all gauze sponges have been picked up and all trash cans are emptied. If there is an errant splash of blood found on a wall, door knob, or monitoring devices, spot cleaning can be performed. All towels and blankets should be cleaned and warming devices should be replaced or cleaned by hand. All minimally invasive equipment like arthroscopy towers, light boxes, cameras and other materials should be hand cleaned. Instrument tables as well as the thermometers,

and pulse oximeters can be gently cleaned and wiped. Clean all equipment surfaces including cautery, IV pumps and IV poles scavenger, anesthesia machine carts, walls, cans, countertops and windows, and blinds.

Small cleaning also includes verifying that all the surgical instruments have been sterilized appropriately. Check lap sponges, the surgical packs, gauze, drapes, and instruments wrapped individually to make sure that they have been cleaned appropriately. The anesthetic equipment can be checked at this time to ensure the gas anesthetic is refilled, the soda lime is replaced and the anesthetic circuits and bags have been thoroughly cleaned.

Big Cleaning

This cleaning refers to larger surfaces and should be performed daily. Ensure that the patient table, shelves, the top of equipment, computers, keyboards and mayo stands are cleaned and wiped by hand. The floor is swept of debris and then mopped with the cleaning agent of choice. The walls are cleaned with a fresh, clean hand cloth. If possible, start the big cleaning in the center of the OR and move towards the periphery in the same spirit as surgical preparation of an abdomen. Start cleaning with the surgery table then gradually move out to items that are lower to the ground like foot pedals. Cabinet handles, sub sinks, chairs and wheel casters and eventually the phone and clock by the door. The OR can be visually sectioned into smaller areas (i.e. 3x4 ft) and each section is cleaned sequentially. It is also great to declutter your OR. Only essential items should be included in the operating room and there should be no opportunity for storage of books, clothes, mops, antiquated equipment or non-medical items.

When it comes to cleaning, the mechanical action of removing debris is the most essential component of the process however the proper use of disinfectants and cleaners is crucial as well. Ensure that the cleaning team has read the instructions on the proper use of the disinfectant which includes contact times and drying times.

The Team

Having a dedicated cleaning team is ideal. The quality of the cleaning process is likely to be superb with a group that has gained experience in the entire process. Hiring dedicated staff, arming them with a checklist, and supplying them with the necessary knowledge and experience are invaluable components of cleaning process. Less experienced members of the cleaning team should undergo a regimented training protocol under the guidance of the more experienced members. Staff safety is of particular concern during the cleaning process. Using nontoxic disinfectants and ensuring that your staff uses the proper PPE when cleaning will help keep everyone healthy.



The 10 Tenets of a Clean Operating Room include:

1. Have a dedicated cleaning team.
2. Use disinfectants strictly according to indications.
3. Have a dedicated cleaning schedule.
4. It takes a village. It's everyone's job to help maintain a clean OR.
5. Devote a separate set of cleaning supplies to each region of the hospital.
6. Safety is of critical importance.
7. Make a Checklist - Daily, Weekly Cleanings.
8. Minimize any exceptions to your protocol.
9. Never enter OR in your street clothes.
10. Minimize traffic in your surgical suite.

Create a list so that all items are considered part of the cleaning process. An orderly system of cleaning minimizes the potential that a dirty surface will be neglected.

Common Patient Factors that contribute to Surgical Site Infection (SSI)

- Obesity, poor nutrition, and recent surgery
- Skin infection, old age, radiation

Common Human Factors that Contribute to Surgical Site Infection (SSI)

- Ensure surgical team members are reducing their contribution to SSI risk with proper antiseptic preparation of the hands and forearms. Every member of the team should wear caps, masks, and disposable (or well-maintained cloth) gowns.
- Halsted's Principles (BADHAT) - Blood, Aseptic, Dead Space, Hemostasis, Apposition, Tissue Handling
- Long surgeries - each additional hour increases risk of surgical site infection (SSI) by 30%.
- Number of people in the OR
- Miscellaneous factors



Let's break down the surgical preparation in three phases.

Preoperatively

A safe and salubrious operating theatre is an environment in which all sources of pollution and any micro-environmental alterations are kept strictly under control. This can be achieved only through careful planning, maintenance and periodic checks, as well as proper ongoing training for staff.

1. Clip hair outside of surgery room.
2. Use different clipper blades for infected wounds than would be used for sterile surgeries.
3. Clean and disinfect blades - ensure that you are removing all organic debris, using the proper disinfectant, adhering to contact times and drying time. According to the Centers for Disease Control and Prevention the physical removal of microorganisms and soil by scrubbing is more important than the actual antimicrobial used.

Intraoperatively

1. A study regarding distractions in the OR found that cognitive stimulus had a negative impact on surgical performance while sensory distraction had a positive effect.¹
2. Keep traffic in the OR to a minimum.

3. Remember that questions from staff can increase times.
4. A cap and mask should be worn at all times when entering an OR especially prior to opening instruments

Postoperatively

1. Have a team. Maintaining a clean OR is a life-saving procedure. Have the most experienced person on your surgical team train the others on proper cleaning protocols
2. New Materials. If possible, new materials should be used for each patient including towels, blankets, new drapes, warmer blanket, etc.
3. Clean
 - a. Trash - replace the trash bag. This may sound clear and obvious to some but there may be those who - in an attempt to minimize environmental impact and exert some cost savings - may simply empty the trash while continuing to use the same bag.
 - b. Clean the OR free of organic material - blood, pus, eliminations including urine and feces, again using the proper disinfectant. Delicate cleaning should also include all the probes used for anesthetic monitoring.

- c. Forgotten surfaces - the surfaces in the operating room should be cleaned daily to reduce microbial burden. This includes horizontal surfaces which includes desks, shelves, the surgery table, surgical equipment, vacuuming and mopping, the floor, surgery lights, wheels, foot pedals, walls, cabinet handles, and computer mouse keyboard and monitor, arthroscopy, IV pumps and poles, anesthetic machines, anesthesia hoses and bags, cautery, laser units, countertops, shelves, windows, blind, and doors. Check dates of sterilization and check filters.
- d. Dedication - have a dedicated team, with dedicated equipment (including mops, wipes, and brooms), for cleaning on a daily and weekly schedule.
- e. Protect your staff - always wear gloves and follow appropriate safety measures. Some cleaning materials can be very caustic.

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Don't Forget the Sponge

By Dr. Courtney Campbell

Sponges - they help us visualize tissues and structures, they help with hemostasis, they help us retract tissue, and can be incredibly useful in dissection and other surgical procedures. But when sponges are coated in blood they can be incognito. They blend in with their surroundings, and they can be tucked under tissue or instruments out of sight. The dreaded situation of leaving a surgical sponge behind - meaning forgotten in a patient's body - is something anyone who does surgery wants to avoid. Despite that, it is still a situation that has befallen even the best surgeons.

What can happen when a surgical sponge is left behind? When an incision is sewn up with a

surgical sponge still inside, it can result in serious infections and other potentially debilitating complications which, in the most severe cases, can even lead to death.

The surface of the gauze sponge is soon enveloped in plasma proteins and festooned with neutrophils, lymphocytes, and monocytes. The monocytes differentiate into macrophages and form multinucleated giant cells, making up most of the cells surrounding the foreign material. Eventually a fibrous connective tissue capsule forms around the foreign material to create a microenvironment for the proliferation of abnormal mesenchymal stem cells, potentially setting the stage for a neoplastic process to start.

Risk factors:

1. Emergency surgery - when there is profuse hemorrhage during an emergency surgery, there is a tendency to use many sponges and pads. This increases the likelihood of some being forgotten if the surgeon and the scrub nurses are not vigilant.
2. Fatigue - late night surgeries, more surgeries than you're comfortable with.
3. Unexpected complications.
4. Unplanned procedures.
5. Distractions in the operating gallery.
6. Break in normal sequence of procedure.
7. Large patients (obesity).
8. Poor communication between the technical staff and surgeons
9. Staff changes.

Solutions:

1. Keep sponges a certain distance from the incision.
2. Communicate with team member(s). Ask your team member(s) to help you remember (i.e., "I placed a sponge next to the liver. Please record it to help us remember").
3. Pre-count sponges - and have that verified with your scrub nurse. If you're not scrubbing in with an assistant for that procedure, perform a scrub count twice.
4. Keep sponges in a centralized location.
5. When performing abdominal surgery, use laparotomy sponges if possible; keep radiopaque sponges to a minimum.
6. Perform a post op sponge count.
7. Radiographs - a radiograph is helpful if you are using a radiopaque gauze. However, if you leave one behind then that means you have to bring your patient back to the operating room, which is suboptimal.
8. Swabs should only be used intra-abdominally if they are "mounted on a stick" (cotton-tipped applicators).
9. Newer technologies for gauze tracing include electronic article surveillance systems which uses tagged surgical sponge that can be detected electronically, in which bar codes are applied to all sponges and detectable with bar code scanners. However, these new technologies are not yet in general use.
10. There are likely more solutions - please share your solutions with me @drcourtneydvm.

Dr. Courtney Campbell talks surgery

Veterinary surgeon and media personality, Dr. Courtney Campbell, joins Dr. Jen and Dr. Jason Chatfield on the Vet Candy Podcast to talk about hot topics in surgery. Dr. Courtney tells all, from how to choose the right suture to ways to gain confidence with your surgical skills. [Listen here.](#)

Three Things about Surgical Suture that can Keep You Up at Night

By Dr. Courtney Campbell

There's a lot to consider when suturing a wound. Suturing wounds and apposing tissue must be done in consideration of suture material, anticipated wound healing times, tissue types, local factors, location of the wound, as well as other specific patient factors like (e.g., age, weight, overall health status, presence of infection), and a host of other factors. The process of selecting suture shouldn't be another source of anxiety in the operating room.

Here are three factors about suture that, when considered appropriately, can help you sleep better at night.

Infection

The sources and potential causes for surgical site infection are plentiful. From surgical preparation, to patient health status, to surgical technique, and perioperative use of antibiotics, there are a host of variables that can potentially contribute to surgical site infection. Therefore, attention to detail during surgery is a top priority. One detail that warrants serious attention in the prevention of surgical site infections is suture choice.¹

Monofilament has an advantage over other sutures in helping to prevent surgical site infection.² The advantage of monofilament suture is rooted in its ability to decrease bacterial bio-adhesion and its ability for phagocytes to reach bacteria on the suture. To underscore the importance of monofilament suture, one company now has a monofilament option on every type of surgery in their armamentarium.*

* <https://www.prnpharmacal.com/products/sutures>

Triclosan coated suture can also be considered when looking to decrease surgical site infection. Although some earlier studies have questioned their use,³ a recent study indicated that suture type may be an important factor in the efficacy of triclosan.⁴ The in vitro study found that among the 3 triclosan-coated sutures used in the present study - triclosan-coated polydioxanone (monofilament, poliglecaprone-25 (monofilament), and polyglactin-910 (multifilament), polyglactin-910 had the smallest zones of inhibition for all of the bacterial isolates, and durations of inhibition were shorter for this suture type than for the 2 monofilament sutures. On visual assessment, uncoated polyglactin-910 suture was found to have the greatest burden of adherent bacteria (E coli). Although in vivo prospective investigation is required to confirm that their results would be similar in a clinical setting, their study provided compelling in vitro evidence to support the use of triclosan-coated materials in contaminated surgical sites or in patients for which the development of surgical site infection would lead to severe morbidity.

Due to the morbidity related to surgical site infections, the patient welfare implications, and other evidence suggesting that triclosan-coated suture materials are safe, it is wise to consider their use. Additionally, CDC recommendations in the human medical field support their potential to decrease the incidence of surgical site infections.⁵

Memory

Monofilament sutures have multiple advantages over multifilament sutures; however, multifilament does have the edge when it comes to memory. A suture with a high memory will spring back to its original position. While suture with high memory tends to be strong, it may be difficult to handle and have decreased knot security.

This may cause your suture line to tangle, induce a great deal of frustration, and risks knot failure during healing. The knot security is lower in sutures with high memory because the suture has a tendency to return to its original straight extruded state. Therefore, more throws in the knot are required to securely hold monofilament than braided nylon sutures. Furthermore, sutures with a high degree of memory can be more challenging to handle and can increase surgical time.

Although many surgeons stretch the suture to remove suture memory, that technique may cause inadvertent displacement of the swaged-on needle from the suture strand.

Fortuitously, sutures have been made available in racetrack packaging. This innovative storage solution gives sutures fewer turns around the track, which allow for less memory, easier handling and faster, more efficient, wound closure.



Absorption

It is not natural for the body to contain suture. By definition, suture material is a foreign body implanted into tissues. As a foreign material, it is possible for suture to elicit a foreign-body tissue reaction. Among the various characteristics of an ideal suture material, having a favorable absorption profile, low tissue reactivity and high tensile strength are some of the most important.

Absorbable sutures are intended to temporarily support the wound during the natural healing process. Absorption occurs by enzymatic degradation in natural materials and by hydrolysis in synthetic materials. Hydrolysis causes less tissue reaction than enzymatic degradation. If the suture degrades too quickly, the wound may dehiscence with normal movement and stress. Therefore, it is paramount to select suture material with the ideal tensile strength and the optimal absorption rate for the surgical wound. It is important to remember that loss of tensile strength and absorption rate are two separate characteristics.

Suture absorption rates can be generally defined as short term, mid term, and long term. In some circles, long term has also colloquially been referred to as “Max” as in the maximum time suture mass absorption occurs for the suture to still be considered absorbable.

The differences in the suture absorption rates can be complicated and difficult to remember. To help simplify your choice, consider selecting suture material with the absorption speed incorporated into the name of the suture. This may help make the process easier particularly in cases in which it's difficult to recall the exact mass absorption times. For example, it may be more challenging to remember the absorption time of suture labeled “Glyconate monofilament suture” versus a suture labeled “Glyconate - Short term” or “Glyconate Mid Term.”

Although the factors that influence final wound and tissue healing can seem overwhelming, allow your suture selection to improve your chance for an excellent surgical outcome.

¹Tan RH, Bell RJ, Dowling BA, Dart AJ. Suture materials: composition and applications in veterinary wound repair. *Aust Vet J*. 2003;81(3):140–145.

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³Etter, S. W., Ragetyl, G. R., Bennett, R. A., & Schaeffer, D. J. (2013). Effect of using triclosan-impregnated suture for incisional closure on surgical site infection and inflammation following tibial plateau leveling osteotomy in dogs. *Journal of the American Veterinary Medical Association*, 242(3), 355–358. doi:10.2460/javma.242.3.355

⁴McCagherty, J., Yool, D. A., Paterson, G. K., Mitchell, S. R., Woods, S., Marques, A. I., ... Nuttall, T. J. (2020). Investigation of the in vitro antimicrobial activity of triclosan-coated suture material on bacteria commonly isolated from wounds in dogs. *American Journal of Veterinary Research*, 81(1), 84–90. doi:10.2460/ajvr.81.1.84

⁵Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA Surg* 2017;152:784-91.

Five Ways to Get Surgical Confidence

1. Watch a skilled surgeon perform the surgery multiple times.
2. Before surgery, read about the surgery.
3. After surgery, read about the surgery again.
4. Sign up for surgical wet labs and lectures for continuing education.
5. Volunteer with a group that provides low cost spay and neuters for more experience.



Suture Material Made Easy

By Dr. Courtney Campbell



Suture material is not created equal. Absorption rates, material profile, and needles all have specific indications. While there is some variation on surgical use depending on surgeon preference, selecting the proper suture can dramatically change your surgical outcomes.

Size:

U.S.P. suture size ranges from 12-0 to 10. 12-0 is the smallest size; typically used in ocular surgery.

Structure:

Multifilament- more than one strand

- Good flexibility
- Rougher surface means increased risk for micro trauma, bacterial infection, and inflammatory response
- Nylon and polypropylene are synthetic monofilament materials

Monofilament- single strand

- Lower infection risk
- Less knot security
- Polyester is a multifilament synthetic

suture and silk is a multifilament natural suture

Pseudomonofilament- Braided core material coated with extruded material

- Fair flexibility
- Less knot security than multifilament

Texture:

Smooth - requires tying knots to anchor into tissues

Barbed - self-anchoring to tissues

Uses:

Non-Absorbable - used to provide long term support for tissues that heal slowly

- Newer polyethylene/polypropylene blends provide “flex” or “feedback” to surgeon prior to suture breakage
- Uses: Hernia closure, General soft tissue approximation; ligation; abdominal wound closure, sternal closure, ligament and tendon repair

Absorbable - used for tissues that heal rapidly

Short-term lasts for days

- Used in tissues which heal rapidly and require minimal support; ligating superficial blood vessels and suturing subcutaneous fatty tissue; internal soft tissue wounds or lacerations.
- Not for cardiovascular or neurological procedures.

Mid-term lasts for weeks

- Uses: subcuticular closure and soft tissue approximations and ligations, with the exception of neural, cardiovascular, ophthalmic, and microsurgical applications.


Long-term lasts for months or beyond

- This material is well-suited for many types of soft tissue approximation, including pediatric cardiovascular, orthopedic, gynecologic, ophthalmic, plastic, digestive, and colonic surgeries.

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Dennis C., et al: Suture Materials - Current and Emerging Trends, J Biomed Mater Res A, 104 (6), 1544-59, Jun 2016



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Suture your way to a Tension Free Life

By Dr. Courtney Campbell

Tension can build in the operating room and at the surgical site when an incision is tough to close. Fortunately, there have been talented surgeons over the decades that have developed some quick tension relieving techniques to help you close tough wounds. To help relieve tension there are a variety of plasty techniques that can be employed to relieve tension. Many are familiar with how to perform these common techniques but there are some nuances to consider when it's time to suture.

The Perennial Subcutaneous Suture

Placing a subcutaneous layer has a host of benefits including providing hemostasis, closing dead space and, perhaps most importantly, to relieve tension. The subcutaneous layer is mainly composed of adipose tissue. Nerve fibers, blood vessels, and hair follicles are located there as well. Although this layer may not be the principal holding layer, sutures placed in the subcutaneous layer are vital to encourage proper healing.

Regardless of the level of surgical experience, most are relatively familiar with the technique to how to oppose subcutaneous tissue. However there are nuances to the closure of the subcutaneous tissue that can be helpful.

Consideration Pearls:

More than one layer.

Be comfortable with closing the subcutaneous tissue in multiple layers. In situations where the wound contains excessive adipose tissues, close the deepest layer of fat first. The second layer of subcutaneous closure can include the fat layer just deep to the dermis.

Those two layers of subcutaneous closure can help to relieve tension adjacent to the skin. Fat doesn't really have the best holding power so if you find yourself pulling through the fat, the recommendation would be to take larger bites with a slightly larger suture. Additionally, tacking (or quilting) is an important step that can relieve tension over regions with minimal skin motion.

Tacking or a quilting suture pattern was described first in 1998 in humans as a way to prevent seroma formation. With this suture pattern, pass the suture through the rectus sheath on every second or third bite. By doing this, you are anchoring the subcutaneous tissue to the abdominal wall. This technique may help decrease seroma formation and postoperative pain.

The V to Y PLASTY

The suffix *plasty* originates from the Greek word *plastos* meaning: "formed, moulded." Like an artist, the skin can be molded or released to help you relieve tension from your closure. One of the most effective plasties, and my personal favorite, is a V to Y PLASTY. Although it is effective at mitigating tension on wound closure, it only provides a small amount of relaxation to the skin. If there is excessive skin tension, other tension relieving techniques should be employed, i.e. undermining or other appropriate technique, prior to closure of this technique. A V-shaped incision is made in the skin adjacent to a wound. The apex or point of the 'V' should be facing away from the wound. The primary surgical site is closed first, followed by closure of the V.

Consideration Pearls

The V incision that was performed can now be closed but there are some important nuances to consider. Begin the suture pattern by placing sutures on alternate ends at the top of the Y. This will help distribute tension more evenly. At this stage, it can be helpful to incorporate a tension relieving suture pattern like a far-near-near-far suture pattern while closing the arms of the Y. Once tension rises at the level of the V, then the stem of the Y can be closed side-to-side.

Tension Sutures

When the tension on a wound requires a more assertive approach to tension relief than what a skin plasty can provide, tensioning suture can be employed. Harness the power of the skin's natural biology via the phenomenon of mechanical creep. This phenomenon is defined as the elongation of skin with a constant load over time beyond its intrinsic extensibility. This unique characteristic of skin is exploited in other ways as well including during intraoperative tissue expansion, skin-stretching devices, and skin retraction with undermining. When constant, low-grade tension is gradually applied to skin over 2 to 4 days, collagen and elastic fibers straighten, elongate, and become parallel which lengthens the skin.^{1,2} Once the skin elongates, less force is required to maintain the collagen fibers in their new stretched position because the skin's elastic fibers lose their natural recoil (ie, stress relaxation).^{1,2} Tensioning sutures also have the advantage of being able to hold dressing in place.



Consideration Pearls:

For added strength, select a suture that is slightly larger than you would normally select. In most cases, this means selecting 0 instead of 2-0, or 1 over 0 monofilament suture material on a cutting needle. Start 3cm from skin edge and main perpendicularity to the wound. Take several bites in a simple continuous suture pattern maintaining this same distance from the wound edge with each bite. The suture is either placed loosely so that a wound dressing can be inserted under the tensioning sutures or it can be lightly tighten to the level of the skin. Both ends are then tied. The surgeon then pulls on the suture loops in the middle of the wound, gathering the excess suture in order to bring the skin edges closer in apposition. The excess suture is held in place with a reusable fishing split shot sinker or spring clasp. This process may need to be repeated multiple times for longer wounds.

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The Risky Gut: How to Win with Intestinal surgery and Avoid Dehiscence

By Dr. Courtney Campbell

If you've ever felt uneasy after closing an enterotomy, resection and anastomosis, or during any surgery involving the entering the gut, you are not alone. Intestinal surgery can be risky and major complications can have disastrous consequences. In fact, the reported dehiscence rate post intestinal surgery is between 12% and 16%.¹⁻⁴ There are a variety of factors that play a role in the rate of healing of intestines including the presence of a septic abdomen, failure of a previous surgery, a perforating foreign body, hypotension, hypoalbuminemia, and trauma.¹⁻⁴

The upregulation of collagenase during the inflammatory period makes the tissues of the intestinal incision weaker before they become stronger. There are three phases of intestinal wound healing - Lag Phase, Proliferative Phase, Maturation Phase - and they all overlap with the Lag Phase occurring during days 0 to 4. The Lag

Phase is associated with inflammation and edema of the intestinal wound. Most of the wound strength in early healing is attributed to sutures. Healing is biomechanically weakest at the end of the Lag phase because of fibrinolysis and collagen deposition and therefore dehiscence commonly occurs between day 3 and 5. After 5 days, the proliferative phase of wound healing predominates (between days 3 and 14) and there is a rapid gain in wound strength. An enterotomy (or enterectomy) should gain close to normal strength between 10 to 17 days following repair. Despite the increase in strength, healing continues with the Maturation phase (10 to 180 days) and this is when collagen is reorganized and remodeled. The goals of any intestinal surgery should be to decrease the length of the intestinal lag period, maintain a water tight seal, and ultimately improve the surgical outcome.

Here are 12 Ways to Create a More Propitious Environment for Intestinal Healing and Decrease the Risk of Dehiscence.

Salubrious Suture Pattern and Sagacious Suture Selection

My preference for intestinal closure is a synthetic monofilament of 3-0 or 4-0. There are a variety of other options for suture that can be selected based on the surgeon's preference however, multifilament sutures may increase tissue drag and serve as a scaffold for infection. Natural monofilament (i.e surgical gut) may not provide strength for long enough because its primary mechanism of dissolution is inflammation. A mid-term or short term absorbable suture may be chosen depending on the surgeon's preferences. I find that suture selection is easier when the rate of absorption is incorporated into the name of the suture material (i.e. [suture name]- short term (ST), [suture name] - mid term (MT), etc). A simple continuous pattern is faster than a simple interrupted suture and does not increase the risk

of dehiscence. Crushing sutures are no longer recommended when closing gastrointestinal incisions because they cause foci of necrosis in the postoperative period. Sutures should be pulled just tight enough to create a seal.

Handle With Care

All surgical procedures should be performed with Halstead's principles in mind. A successful intestinal surgery requires that the surgeon adhere to the pillars of Halstead's principles of gentle tissue handling, accurate tissue apposition, preservation of the intestinal blood supply, meticulous dedication to asepsis, and fastidious hemostasis.

The Almighty Submucosa

The submucosa is the holding layer of the intestine when suturing. Failure to engage the submucosa when suturing is a technical mistake that has a high potential to result in intestinal wound failure. Engaging the submucosa when performing an intestinal closure is absolutely essential.



The Lovely Lavage

Although inflammation can be expected as part of the healing process, excessive inflammation can lead to a breakdown of your intestinal closure. Peritonitis may be caused by irritants such as bacteria (e.g., perforating foreign body), bile, blood, barium, and other substances. In patients with existing peritonitis, lavaging the abdomen post intestinal closure will dilute the presence of some those substances which cause intestinal inflammation. This action is essential because anything that prolongs or intensifies the inflammatory phase of wound healing can increase collagenase activity. In patients without existing peritonitis, local lavage of the intestine is recommended. Avoid allowing the lavage fluid to enter the abdomen. Doing so may potentiate peritonitis by distributing bacteria and inhibiting phagocytosis by macrophages and neutrophils. Of course, if accidental spillage of intestinal contents occurs the abdomen should be thoroughly lavaged with warm saline (the solution to pollution is dilution).

Don't be Opposed to Appose

Everting and inverting patterns are not recommended for intestinal closure. Suture the intestinal edges together with an approximating pattern (rather than inverting or everting) in order

to maximize the potential for primary intestinal wound healing. Everting or inverting patterns inhibit fibrin deposition and the migration of enterocytes. Fibrin deposition and migration of enterocytes work best when the edges are apposed.

The Glorious Gambee

The modified Gambee suture pattern was shown to be able to sustain a significantly higher initial leak pressure than skin staple closures and had the greatest maximum leak pressure of all enterotomy closure patterns tested in an ex vivo setting. Although a similar study needs to be replicated in the clinical setting, and it may take slightly longer to place this suture pattern, it is worth the time investment to improve your surgical outcome. Hand-sutured anastomosis will typically have some degree of microscopic eversion⁵ even with dutiful attention to apposition. However deliberately everting and interposing mucosa between the wound edges will result in focal mucosal necrosis and a prolonged inflammatory response. Biomechanically, everted closures have lower bursting strength during the lag phase of healing, suggesting an increased tendency to leak during this phase.⁶



The Omnipotent Omentum

Surgical sites in the intestine can be supported with the use of omentum. Omentalization - placement of the omentum around organs or within cavities - is a commonly utilized technique to support healing. The omentum's healing power comes in the form of the extensive supply of blood and lymphatic vessels, it is a plentiful source of immunogenic cells and it helps with lymphatic drainage and absorption of bacteria and particulate matter. Moreover, it encourages neovascularization and activation of macrophages. These properties help to support the early fibrin seal and improve the overall healing environment. Place an omental patch over your intestinal closures by using multiple simple interrupted sutures of rapidly absorbable monofilament suture. For end-to-end anastomotic sites, suture two portions of the caudal omental fold (the junction of the ventral and dorsal leaves) or the distal edge of an extended flap to either side of the incision line so that each covers half of the circumference of the anastomosis site. And if you need to extend the omentum, unfolding the dorsal leaf omentum will double its length. Incising the omentum in an L-shape will give you further extension.

Omnipresent Oxygen

Maximizing oxygen delivery to the tissues that you are closing is essential for intestinal perfusion. Correct fluid deficits preoperatively, monitor serial lactate levels in both blood and peritoneal effusion, and ensure optimal oxygen saturation during the surgery which will decrease the risk of gastrointestinal dehiscence. Applying more inspired oxygen during surgery lessens the risk of GI dehiscence by increasing oxygen delivery to the tissues. Be sure to replace fluid deficits and losses postoperatively.

Vasculature is Valuable

The idea of removing more intestine than initially seems necessary may not be an appealing thought but it is imperative for intestinal healing. When performing a jejunal resection and anastomosis, the transection sites should be in close proximity to a jejunal artery. Incise the intestine at an angle that preserves the vascularized mesenteric side which is the more vascularized portion of the intestine. When closing the mesenteric window that was created by your dissection take care not to ligate the mesenteric vessels or the jejunal arteries.

Terrible Tension

Tension across the anastomosis site should generally be avoided. Tension can originate from surgical technique, poor mobilization of tissues (i.e. ileocolonic anastomosis) or due to ingesta, fluid, gas, or ileus. Tension will increase the potential for intestinal dehiscence and appears to be least tolerated in the large intestine.⁸



Clamp Off Contamination

Intestinal contents will likely contaminate your surgical site - especially if they are under pressure from a mechanical obstruction - unless conscientious steps are taken to avoid that potentiality. After the surgical site has been identified, isolate the site with the use of lap sponges and move that segment off to the side away from the remainder of the abdomen. Milk intestinal contents away from the surgical site use atraumatic clamps to restrict its flow. Once the surgery has been completed, perform local lavage of the surgery site and change gloves after that portion of the procedure.

Excessive Enterotomies

Linear foreign bodies can wreak havoc on the intestine. There can be multiple sites of intestinal attachment or regions that have perforated the intestine. In these situations, multiple enterotomies may need to be performed. Despite the need to perform multiple enterotomies, plan each enterotomy well to limit multiple intestinal surgical sites.⁸ Each additional enterotomy

increases the potential for intestinal leakage and prolongs surgery time. Ideally, an intestinal foreign body could be gently milked into the stomach and a gastrotomy performed, or gently milked into the distal colon and digitally removed per rectum.

Nutrition is Necessary

Nothing per os (NPO) is no longer the preferred treatment post intestinal surgery. Doing so may potentiate dehiscence, mortality and infection. Offering enteral nutrition as soon as the patient is interested is ideal. Offering a highly digestible diet or placing a feeding tube in those patients who are reluctant to eat should be strongly considered.

Intestinal surgery is tricky, humbling, and, at times, very unforgiving. There are a host of other factors that make this type of surgery challenging. Hopefully by following these 13 tips, it will decrease the risk of intestinal dehiscence and improve your surgical outcomes.



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Operating Room Reproductive Hazards for Female Surgeons

By Dr. Courtney Campbell

Higher rates of infertility and pregnancy complications have been found for female surgeons compared with the general population.¹

Occupational hazards exist in the operating room that may be factors in increased rates of infertility and adverse pregnancy outcomes for surgeons. It is important for the workplace and for surgeons to understand what information is available. At a minimum, workplaces need to comply with existing guidelines or standards, recognizing that these may not be protective for reproductive outcomes, and so that it may be wise to do more. Alternative work duties and/or conditions should be readily available. Priority should be given to controlling exposure rather than restricting surgeons' activity. According to studies done in the human medical field, female surgeons have first pregnancies later in life, have fewer children, and report more issues with infertility. Assisted reproductive technology is implemented more often by female surgeons than the general population.²

To the author's knowledge similar studies have not been performed in the veterinary field.

Researchers in this review article discuss occupational reproductive hazards for female surgeons in the operating room, including radiation exposure, surgical smoke, working conditions and physical demands, sharps injuries, anesthetic gases and the use of toxic agents.

To read the study, click on the link below:

[Occupational Reproductive Hazards for Female Surgeons in the Operating Room](#)

1. <https://pubmed.ncbi.nlm.nih.gov/31895444/>

2. <https://pubmed.ncbi.nlm.nih.gov/25260684/>



Secrets of Great Communication

By Dr. Courtney Campbell

You're in the room speaking with a client and your mind starts to wander. You have a patient in the back who is really in need of attention and later on that day, you know you will be having a potentially difficult conversation with a team member. You start to speak and you're immediately interrupted. You want to have a smooth conversation whereby you can communicate effectively but minute-by-minute it's becoming more difficult.

Veterinary health professionals can have very stressful days. Not having the ability to communicate with our patients in the same language can be an additional stressor. While the ability to communicate effectively with our patients is always a work in progress, our ability to communicate effectively with clients can have profound healthcare implications. Learning to slow down, listen, and understand your clients will likely lead to better care for our patients and more satisfied clients.

Here are three keys for more effective communication with your clients.

Consider your audience

One of the most intricate relationships to ever exist is the human-animal bond. This dynamic can be complicated because it is highly individualistic and may be based on a specific set of circumstances. As you discuss pertinent medical details, always try to consider your audience. A millennial may have different concerns about their pet than a retiree. An avid duck hunter may have special considerations about their black Lab than a novelist who relaxes with a Maltese when she's in her creative space. Also, the mode of communication may change depending on the listener. Someone who is slightly older may prefer face-to-face communications, whereas many millennials or gen Z-ers may prefer to communicate via text, social media, and email. Actively listening to your clients is the only way to know the individual preferences (or concerns) of your audience.

Listen

It's tough to be an effective communicator if you aren't listening to the other person. Being an engaged listener is challenging when you have a deluge of emergency patients to triage and reams of diagnostics to evaluate. One study showed that on average, doctors interrupt patients within 12 seconds of them first speaking during primary care visits and throughout the appointment—often, before they have finished explaining an issue.¹

One effective technique to help you focus on listening is put whatever you have in your hands down. Similar to looking up from your phone when someone is speaking to you, the act of freeing your hands signals to the other person that you are letting go of what is currently occupying your mind so you can concentrate on them. Essentially, it sends the message to your clients that you value and care about what they have to say. And what if the object you are carrying pertains to the person you are talking to (i.e. a client's medical record)? Start writing notes about what they are saying during the conversation. Perhaps what they are saying is easy to remember and note taking isn't essential, but the act of writing may help you listen actively and reflect deeply on the situation at hand.

Announce your goals and objectives

There is a reason why the phrase “Head's up” is so common. It's a powerful alert to keep people out of danger or prepare them for what's ahead. This phrase is also helpful to make someone aware of something so they can plan appropriately. They can then adjust to the information being said before it's too awkward or too late. You can give your client's a professional head's up by announcing to them what you would like to discuss. Common examples of this include, “I would like to discuss a few details regarding [condition].” Or, “I have a few concerns about [condition] and I would like to discuss a few of them with you now.” This helps you to focus the client's attention so they can be present in that moment. A “head's up” informs your clients and other listeners that what you are about to say is important, it may impact them, and that there is something they may need to prepare for.

Following these three keys will help you communicate more effectively, save time, save money, and potentially, avoid needless litigation. Most importantly, it will likely result in better care for the animal. We are all a work in progress and all team members can work in concert toward better communications and deeper client-patient connections.

¹ <https://pubmed.ncbi.nlm.nih.gov/11456245>

About the author



Dr. Courtney A. Campbell is a board certified veterinary surgeon who specializes in orthopedic, soft tissue, and minimally invasive surgery. He is also a host, author and producer. Dr. Campbell is known for hosting and producing the veterinary news show, *VetCandy Watch* and a popular podcast, *Anything is Pawsible*, on *PetLife Radio*. He is also a former co-host of *Pet Talk* on *Nat Geo Wild*, and a recurring guest expert on *The Rachael Ray Show*, *CBS The Doctors*, *Home and Family*, and other daytime talk shows.

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