

## INTESTINAL ANASTOMOSIS

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If you would like a copy of this surgical procedure on DVD go to [www.videovet.org](http://www.videovet.org).

### Key Points

- Pay attention to basic surgical principles
- Submucosa is the layer of strength
- Use synthetic absorbable suture materials
- Appositional techniques are best
- Intestinal sutures should engage at least 3 - 4 mm of submucosa
- Intestinal sutures should be no further apart than 2 - 3 mm
- Always handle bowel wall using atraumatic technique
- Examine the integrity of your anastomosis visually
- 50 - 60% of the 'small intestine' of dogs and cats can be resected

### General principles of small intestinal surgery

- 1) Incorporation of the collagen laden submucosal layer in the surgical closure.
- 2) Minimize trauma and contamination.
- 3) Maintain good blood supply to the surgical site.
- 4) Avoid tension across the suture line as this may increase the possibility of leak and/or breakdown.
- 5) Pay attention to your established criteria when suturing intestinal defects.

### Operative Considerations

- 1) Proper "**packing off**" of the surgical field using moistened laparotomy pads should be performed around the **exteriorized** bowel to prevent accidental abdominal contamination from intestinal contents.
- 2) Keep abdominal contents warm and **moist** throughout surgery with a warm, balanced electrolyte solution.
- 3) Handling abdominal viscera should be kept to a minimum. **Gentle manipulation** of intestine with moistened gloves or stay sutures is helpful in preventing unnecessary tissue trauma. **DeBakey** forceps are the most atraumatic forceps for handling abdominal visceral organs.
- 4) The collagen laden, tough **submucosa** is the layer of strength in the small intestine; this layer must be incorporated into any small intestinal closure.
- 5) It may be difficult to visualize the submucosal layer due to **mucosal eversion**. Visualization of submucosa may be enhanced if everted mucosa is trimmed away.
- 6) Intestinal contents should be "milked" away from the anastomosis site. **Intestinal clamps** (e.g., Doyen intestinal clampS, Alice tissue forceps with a rubber feeding tube interposed, hair clips, or Penrose drains) may be used to prevent intestinal contents from contaminating the surgical site whilst manipulating intestine during anastomosis.
- 7) The anastomosis should be **irrigated** prior to its return to the abdominal cavity and instruments and gloves changed prior to abdominal closure.
- 8) **Abdominal lavage** with 2-3 liters of body temperature, sterile, physiologic saline solution should be accomplished prior to closure. The objectives of repeated abdominal lavage include dilution of bacteria and endotoxin and mechanical removal of fibrin and necrotic

debris. The fluid of choice is body temperature, sterile, physiologic saline solution with no additives (i.e. betadine solution, chlorhexidine, antibiotics, etc). Lavage solution is poured into the abdominal cavity using a sterile stainless steel bowl, the abdominal viscera gently agitated, and fluid and debris suctioned out with a suction device and a Poole suction tip. Injecting antimicrobials or other products into the abdominal cavity is not recommended.

## **Suture Material**

### **Absorbable suture**

Catgut. Catgut is NOT recommended for any visceral organ surgery. Its unpredictable absorption and rapid loss of tensile strength in such situations may result in an unacceptably high number of anastomotic leaks and /or breakdowns. Use of catgut suture in gastrointestinal surgery is not recommended.

Dexon, Polysorb, and Vicryl. Synthetic absorbable braided suture (i.e., polyglactin, polyglycolic acid) have become very popular. The braided nature however does result in increased tissue drag and difficult knotting ability.

Biosyn and Monocryl. These sutures have similar properties to Dexon, Polysorb and Vicryl however they are monofilament. They were developed to overcome the problem of tissue drag and knot slipping found in the braided synthetic absorbables. Their predictable hydrolytic absorption is unaffected by their immediate environment (i.e., infection, contamination, hypoproteinemia). They retain high tensile strength for a long period of time (2-3 weeks) and have very good handling characteristics. These suture materials are ideal for use in gastrointestinal surgery. These sutures are the authors choice for gastrointestinal surgery.

PDS and Maxon. PDS and Maxon, are synthetic absorbable monofilament suture materials with similar properties to that of Dexon and Vicryl. They have been shown to retain approximately 70% of their tensile strength at 3-4 weeks, and are absorbed by hydrolysis (unaffected by infection, contamination, hypoproteinemia). These suture materials are ideal for use in gastrointestinal surgery. Possible disadvantages include stiffness, a tendency to kink and prolonged absorption time.

### **Nonabsorbable suture**

Nylon, Polypropylene. Monofilament, nonabsorbables are excellent suture materials for use in contaminated or infected surgical sites. They have a high tensile strength, are relatively inert in tissue, noncapillary, and do not act as a nidus for infection. These materials pass through tissue with essentially no tissue drag and have excellent knot tying security at sizes 3-0 to 5-0. For their properties, effectiveness, and cost, these are the author's nonabsorbable sutures of choice for intestinal anastomosis and enterotomy closure. Possible disadvantage of these materials is their memory.

Silk, Mersilene, Bronamid, Vetafil. In general, stay away from burying multifilament or braided nonabsorbable suture material. These sutures may harbor infection for years and may result in suture related abdominal abscesses or draining tracts. They should never be used in gastrointestinal surgery.

## **Suture size**

For the majority of small intestinal surgical procedures in dogs, 3-0 or 4-0 size suture material is adequate; in cats, 4-0 is recommended. The tensile strength of this size suture is greater than the tensile strength of the tissues that are being sutured (i.e., intestinal wall). Larger size suture may contribute to anastomotic failure by increased trauma to tissues and its effect on the blood supply of tissue margins.

### **Needles**

Swaged-on "atraumatic" reversed cutting, narrow taper point, or fine taper-cut needles can all be used for gastrointestinal surgery. The author prefers a narrow taper point needle. Needle diameter should approach the diameter of the suture.

### **Suture Placement**

When suturing intestine, sutures should be placed 3 - 4 mm from the cut edge of the intestinal serosa and no more than 2 - 3 mm apart. It is important to recognize everted mucosa and be sure the 3 - 4 mm bite in the intestinal wall is not just in mucosa but engages all layers of the intestinal wall. Measure your intestinal wall bite from the cut edge of the serosa.

### **Suture Patterns**

There is considerable controversy regarding specific suture pattern for use in small intestinal surgery. Everting, inverting, and appositional suture patterns have been used experimentally and clinically for suturing enterotomies and anastomoses. Appositional patterns are recommended as they cause little lumen compromise postoperatively.

**Everting:** Everting patterns (i.e., horizontal mattress) have been shown to encourage adhesions and result in lumen stenosis. This technique is NOT recommended. The everting technique is not to be confused with the mild eversion of mucosa that occurs in the appositional techniques described below.

**Inverting:** In small animals adequate lumen diameter is an important consideration with any technique. Inverting patterns result in substantial lumen compromise of the small intestine and are NOT recommended in dogs and cats.

**Apposition:** Anatomic apposition of individual layers of the bowel wall (i.e., mucosa, submucosa, muscularis, and serosa) result in primary intestinal healing. This technique is superior to inverting or everting techniques because apposition of intestinal margins eliminates lumen compromise. This is the authors preferred technique for suturing all hollow viscus organs in the abdominal cavity. Suture patterns of choice include:

1) Simple interrupted apposing. This technique involves suturing **all** layers of the intestinal wall and tying the knots on top of the serosa to approximate cut edges. The sutures should be tied tight enough to effect a watertight seal, yet not so tight as to blanch the tissue and cause ischemia of intestinal margins. This technique is simple, fast, reliable, and does not result in lumen compromise.

2) Simple continuous apposing. This technique is similar to the simple interrupted appositional technique however, a continuous suture pattern is used rather than an

interrupted pattern. Advantages include faster anastomosis, equal suture tension over the entire anastomosis, airtight-watertight seal, and mucosal eversion is minimized. This is the authors preferred suture pattern for suturing all hollow viscus organs in the abdominal cavity.

**INTESTINAL ANASTOMOSIS:** Intestinal anastomosis is indicated for resection of nonreducible intussusception, necrotic bowel wall secondary to complete intestinal obstruction, intestinal volvulus, stricture secondary to trauma, linear foreign body with multiple perforations, and intestinal neoplasia (e.g., leiomyoma, leiomyosarcoma, adenocarcinoma).

After a complete abdominal exploration, the affected length of bowel is delivered from the peritoneal cavity and isolated with the use of moistened laparotomy pads and crib towels. If possible, the intestinal anastomosis should be performed on a water resistant surface (e.g., plastic drape, crib towel) to prevent 'strike' through contamination.

Once the level of resection has been determined, the appropriate mesenteric vessels are identified and ligated, and the portion of intestine to be resected is isolated by clamping the bowel at a 60° angle away from the mesenteric border. This angle ensures adequate blood supply to the antimesenteric border.

**Everted mucosa:** Occasionally when the segment of intestine to be removed is amputated mucosa 'everts' from the cut edge of the intestinal wall making it difficult to visualize the cut edge of the serosa. If this occurs it is 'highly' recommended to excise the everted mucosa to enable the surgeon to easily visualize the cut edge of the intestinal serosa. It is vital that the surgeon engage at least 3 – 4 mm of intestinal wall with each suture to guarantee adequate bites in the collagen laden submucosa.

**Bowel lumen diameters:** In cases where the oral end of the bowel is dilated and the aboral end is normal size, several options exist to create intestinal lumens of equal diameter:

- 1) Increase the angle of resection on the smaller diameter segment of bowel (i.e., aboral segment). This will increase the orifice size by 5-10 mm depending upon bowel diameter (e.g., dog vs cat).
- 2) In larger lumen size discrepancies the antimesenteric border of the smaller diameter stoma can be incised longitudinally to enlarge the lumen diameter.
- 3) An end-to-side anastomosis can be performed by closing the larger diameter stoma of the intestinal resection with a single layer continuous apposing suture pattern then anastomosing the smaller diameter segment of bowel to an appropriate size enterotomy made in the antimesenteric border of the larger diameter segment of bowel.
- 4) The larger diameter segment of bowel can be made smaller in diameter by suturing its cut edge until its lumen is equal in size to the smaller diameter intestine (this technique is often used for subtotal colectomy in cats).

#### **Intestinal Anastomosis Technique:**

See the DVD for a detailed video description of this technique ([www.videovet.org](http://www.videovet.org)).

When suturing an anastomosis, atraumatic handling of bowel wall and perfect anatomic apposition of incised margins is important. It is recommended to begin suturing at the mesenteric border as this allows adequate visualization of mesenteric vessels and helps prevent encircling these vessels when placing the first few sutures. Any of the appositional

suture patterns previously described (i.e., simple continuous or interrupted) will result in a high success rate, both in the short-term (i.e., leakage, breakdown) and long-term (i.e., stricture, stenosis).

The following tips may prove helpful when performing an intestinal anastomosis (see the anastomosis video clip at [www.videovet.org](http://www.videovet.org) for detailed description of the surgery tips below:

- 1) First, place a stay suture to hold the mesenteric border of each segment of bowel in apposition. Tie this suture, leave the ends long, and place a hemostat on the suture end without the needle.
- 2) Place a second stay suture in the antimesenteric borders of each segment to be sutured to bring the ends of the intestinal segments into apposition. Place a hemostat on the ends of this suture.
- 3) Place gentle traction on the mesenteric and antimesenteric stay sutures to bring the two intestinal segments into apposition.
- 4) Using the needled segment of suture from the mesenteric stay suture, begin a simple continuous appositional anastomosis being careful to get a 3 - 4 mm bite in the submucosa and placing each suture no more than 2 - 3 mm apart (2 mm apart in cats). When the anastomosis is complete, tie the suture to the mesenteric stay suture.
- 5) If a simple interrupted apposing suture pattern is used, be careful to get a 3 - 4 mm bite in the submucosa and place each suture no more than 2 - 3 mm apart.
- 6) Evaluate the integrity of the anastomosis. The author's preference for evaluating the integrity of anastomotic closure is to **visually** examine each suture to be certain that suture placement is no more than 2 - 3 mm apart and that each suture has a 3 mm bite in the submucosa.

### **Postoperative care**

Intravenous fluids to maintain hydration and ensure renal function are continued postoperatively, until the patient begins to eat and drink. Intravenous fluids should then be tapered over a 24 to 48 hour period.

Systemic antibiotics are continued postoperatively for 5-7 days; 10 - 14 days in cases with peritonitis and/or sepsis.

**Feeding:** Early return to enteral feeding is best for the overall health of the intestine. Feeding the postoperative gastrointestinal surgical patient is generally based on the following criteria:

- a) preoperative condition of the patient
- b) the condition of the bowel at the time of surgery
- c) surgical procedure performed (i.e., enterotomy, anastomosis, pylorotomy)
- d) presence or absence of peritonitis
- e) postoperative condition of the patient.

The earlier patients can be returned to oral alimentation the better.

### **Complications**

The most common postoperative complication of small intestinal surgery is leakage; leak is either associated with breakdown of the anastomosis or improper surgical technique (i.e., improper suture placement, inappropriate suture material, knot failure, sutures too far apart, inappropriate bite in the collagen laden submucosal layer, suturing nonviable bowel).

A presumptive diagnosis may be accomplished by the following:

- 1) Body temperature (may be up if acute or down if moribund).

- 2) Abdominal palpation: periodic, gentle abdominal palpation for pain (gas or fluid?).
  - 3) General attitude (depression-anorexia).
  - 4) Incision: examination of the patients incision for drainage (look at cytology if drainage is present)
  - 5) CBC: leukocytosis followed by leukopenia (sepsis), or a degenerative left shift may imply breakdown.
  - 6) Glucose: low glucose generally implies sepsis (this occurs early in sepsis and may be used as a screening test).
  - 7) Abdominal radiographs: generally not helpful, they are difficult to critically assess due to the presence of postoperative air and lavage fluid. It can take 1 - 3 weeks for peritoneal air to diffuse from the abdominal cavity after routine abdominal surgery. Time variation is dependant upon the amount of air remaining in the abdominal cavity postoperatively (i.e., large deep chested animal vs a small obese animal).
  - 8) **Abdominal tap** (paracentesis): a four quadrant abdominal tap is accomplished by aspirating fluid using a 5cc syringe and 20 gauge needle or placing a plastic IV catheter into the peritoneal cavity and allowing fluid to drip onto a slide. This may be the most sensitive diagnostic test for determining the presence or absence of intestinal leak.
  - 9) Peritoneal lavage (if paracentesis is not productive): infuse 10-20cc/kg of sterile physiologic saline solution into the abdominal cavity, then gently palpate the abdomen and repeat the four quadrant paracentesis. This technique increases the sensitivity of paracentesis to 90%.
- Once fluid has been obtained, a smear should be stained and evaluated microscopically. Depending upon the cell types seen, a determination of the presence of leakage can be made.

Below are examples of expected cytology in patients with and without leak.

- 1) Healthy PMNs with few degenerate PMNs and a moderate number of red blood cells: This cytology may be expected in any postoperative abdominal procedure (e.g., OHE, abdominal exploratory, cystotomy). Your index of suspicion for anastomotic breakdown should be low. However, if clinical signs continue to deteriorate, repeat paracentesis (2 - 3 times daily, if necessary) to determine the "trend" of the abdominal fluid cytology is recommended.
- 2) Healthy polymorphonuclear leukocytes with bacteria located intra or extracellularly, degenerate PMNs with intracellular bacteria, free bacteria, or food particles--imply breakdown. Exploratory laparotomy is indicated.

In a recent morbidity/mortality study of patients undergoing intestinal surgery it was found that animals requiring a second abdominal surgery to treat intestinal disorders were less likely to survive than patients requiring only one laparotomy. Also, the longer it took to determine whether or not intestinal leakage had occurred the less likely the patient would survive reoperation. **The take home message is:** pay attention to detail during the first surgery and if a leak occurs, diagnose it and treat it as soon as possible.

**Prognosis** The overall prognosis for uncomplicated GI surgery is excellent. The surgeon must pay attention to detail when suturing any hollow viscus organ with liquid contents.