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## Indications

Tumor  
Trauma  
Strangulation  
Perforation  
Crohn's enteritis with complications  
Ischemic enteritis

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## Preoperative Preparation

Nasogastric intubation in selected cases (obstruction, perforation)  
Perioperative antibiotics

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## Pitfalls and Danger Points

Small bowel anastomosis is generally safe unless the blood supply is impaired or advanced peritoneal sepsis is present. When a small bowel anastomosis fails because of technical errors, the leak almost invariably occurs at the mesenteric border, where the serosa has not been adequately cleared of blood vessels and fat.

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## Operative Strategy

### Open Versus Laparoscopic Technique

As with other abdominal procedures, laparoscopic techniques have been successfully applied to small bowel resection and anastomosis. This chapter details basic principles essential for success with either approach and stresses safe performance of small bowel anastomoses (sutured or stapled). For laparoscopic techniques, see the reference at the end of the chapter.

### Successful Bowel Anastomosis Requirements

1. *Good blood supply.* Determine this by noting pulsatile flow after dividing a terminal arterial branch in the region where the bowel is to be transected. There should be no hematoma near the anastomosis, as it could impair circulation.
2. *Accurate apposition of the seromuscular coats.* There should be no fat or other tissue between the two bowel walls being sutured. The seromuscular suture must catch the submucosa, where most of the tensile strength of the intestine is situated. Optimal healing of an anastomosis requires serosa-to-serosa approximation. Devote special attention to the mesenteric border of any anastomosis. This is the point at which several terminal blood vessels and accompanying fat are dissected from the bowel wall to provide visibility for accurate seromuscular suture placement. Clear fat and blood vessels from a 1-cm-wide area of serosa around the circumference of an anastomosis. This allows increased accuracy for suture placement without causing ischemia.
3. *Sufficient mobility of the two ends of bowel.* A sufficient length of bowel must be freed proximal and distal to each anastomosis to ensure there is no tension on the healing suture line. Remember to allow for some degree of foreshortening if postoperative distension occurs.

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<sup>†</sup>Deceased

4. *No excessive force.* Force must not be excessive when tying the anastomotic sutures, as it would result in strangulation of tissue. If the suture should inadvertently have been placed through the full thickness of the bowel and into the lumen, the strangulated tissue will cause a leak. Tie sutures with no more tension than is needed to approximate both intestinal walls.
5. *No excessive force applied to the forceps.* When manipulating the ends of the bowel to be anastomosed, there must be no excessive force. If the imprint of forceps teeth is visible on the serosa after the forceps have been removed, the surgeon obviously compressed the tissue with too much force. Pass the curved needle through the tissue with a rotatory motion to minimize trauma. As discussed in Chap. 4, it does not matter whether an intestinal anastomosis is sutured or stapled so long as proper technique is employed.
6. *Learn the pitfalls.* One must learn the pitfalls (technical and conceptual) before constructing stapled intestinal anastomoses. Study the strategy of avoiding the complications of surgical stapling (see Chap. 5).
7. *Avoid common errors.* One must avoid the common errors seen among neophytes learning the art of anastomotic suturing:

Do not insert the outer layer of seromuscular sutures with the collapsed bowel resting on a flat surface. An even worse error consists in putting the left index finger underneath the back of the anastomosis while inserting the anterior seromuscular sutures. Both errors make it possible to pass the seromuscular suture through the bowel lumen and catch a portion of the posterior wall. When the sutures are tied, an obstruction is created. Although some of these sutures may later tear out of the back wall in response to peristalsis, others remain permanently in place and produce a stenosis. To prevent this complication, simply have the assistant *grasp the tails of the anastomotic sutures that have already been tied.* Skyward traction on these sutures keeps the lumen of the anastomosis open while the surgeon inserts additional sutures.

Another error consists in inserting anastomotic sutures while the bowel is under linear tension. This practice stretches the bowel wall, so it becomes relatively thin, making it difficult to enclose a substantial bite of tissue in the suture. *A sufficient length of intestine, proximal and distal, should be loosely placed in the operative field.* After the first seromuscular bite has been taken, the needle is ready to be reinserted into the wall of the opposite segment of intestine. At this time it is often helpful to use forceps to elevate the distal bowel at a point 3–4 cm distal to the anastomosis. Elevation relaxes this segment of the bowel and permits the suture to catch a substantial bite of tissue, including the submucosa. Each bite should encompass about 4–5 mm of tissue. These stitches should be placed about 4–5 mm from each other.

## Contraindications to Anastomosis

Because of the excellent blood supply and substantial submucosal strength of the small bowel, anastomoses are often successful even in the presence of such adverse circumstances as intestinal obstruction and gross contamination of the abdominal cavity. Consequently, the only major contraindications to a primary small bowel anastomosis are peritoneal sepsis, a questionable blood supply, or a patient whose condition on the operating table is precarious. In these cases both ends of the divided small bowel may be brought to the skin as temporary enterostomies or simply stapled closed and returned to the abdomen for a planned second look.

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## Documentation Basics

Findings  
 Extent of resection  
 Location of resection (proximal versus distal, ileum versus jejunum)  
 Length of remaining bowel

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## Operative Technique

### Small Bowel Anastomosis by Suturing

#### Incision

Use a midline vertical incision for the best exposure of the small bowel.

#### Division of Mesentery

Expose the segment of intestine to be resected by laying it flat on a moist gauze pad on the abdominal wall. With a scalpel make a V-type incision in the mesentery to be removed, carrying it through the superficial peritoneal layer only, to expose the underlying blood vessels (Fig. 43.1). Apply medium-size hemostats in pairs to the intervening tissue. Divide the tissue between hemostats and ligate each with 2-0 PG. After the wedge of mesentery has been completely freed, apply Allen clamps to the bowel on the specimen sides. Apply noncrushing intestinal clamps proximally and distally to prevent spillage of intestinal contents. Remove the diseased segment of intestine by scalpel division.

#### Open Two-Layer Anastomosis

Considerable manipulative trauma to the bowel wall can be avoided if the anterior seromuscular layer of sutures is the first layer to be inserted. This should be done by successive bisection (see Chap. 4). First, use 4-0 silk on an atraumatic

needle, and insert a seromuscular suture on the antimesenteric border followed by a second suture on the mesenteric border (Fig. 43.2). Tie both sutures. Next, bisect the distance between these two sutures, and insert and tie the third Lembert suture at this point. Follow this sequence until the anterior seromuscular layer has been completed (Fig. 43.3a). Retain the two end sutures as guys, but cut the tails of all the remaining sutures. *Rotate the bowel by passing guy suture A behind the anastomosis* (Fig. 43.3b) so the posterior layer is on top (Fig. 43.3c).

Close the mucosal layer with a running 5-0 double-armed PG suture. Insert the two needles at the midpoint of the deep layer (Fig. 43.4). Tie the suture and close the posterior layer, which should include the mucosa and a bit of seromuscular tissue, with a continuous locked suture (Figs. 43.5, 43.6,

and 43.7). Turning in the corners with this technique is simple. Bring the needle from inside out through the outer wall of the intestine (Fig. 43.8). Then, complete the final mucosal layer using the Connell technique or a continuous Cushing suture (Fig. 43.9). After this mucosal layer has been completed, insert the final seromuscular layer of interrupted 4-0 silk Lembert sutures (Fig. 43.10). The technique of successive bisection is not necessary in the final layer because the two segments of bowel are already in accurate apposition.

After all the suture tails have been cut, carefully inspect for imperfections in the suture line, especially at the mesenteric margin. Test the patency of the lumen by invaginating one wall of the intestine through the anastomosis with the tip of the index finger.

### Open One-Layer Anastomosis

The first step in constructing an end-to-end anastomosis in one layer is identical to the steps in Figs. 43.2 and 43.3a. Insert interrupted 4-0 silk Lembert sutures on the anterior seromuscular layer. Cut the tails of all the sutures except the two at the end and rotate the bowel to expose the opposite, unsutured bowel (Fig. 43.3b, c). Approximate this too with interrupted 4-0 silk *seromuscular* Lembert sutures, paying special attention to the mesenteric border, where fat and blood vessels may hide the seromuscular tissue from view if the dissection has not been thorough.

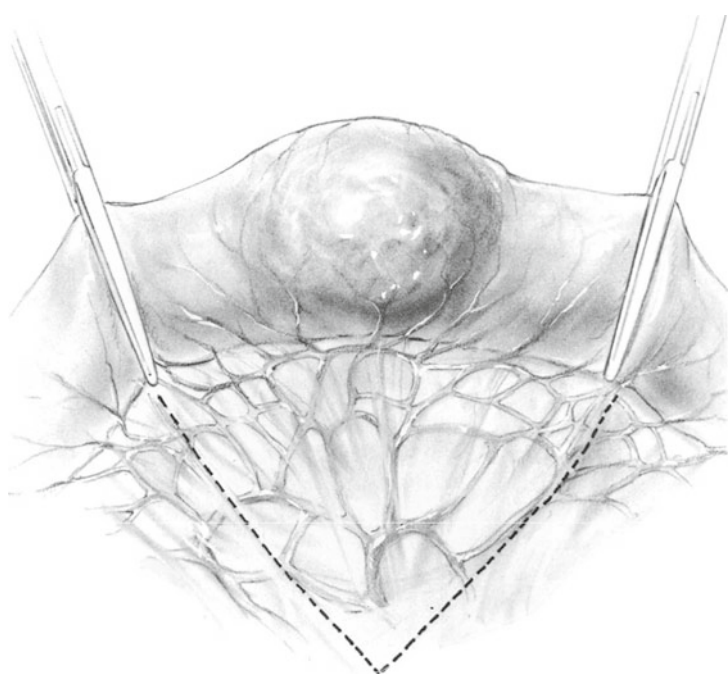


Fig. 43.1

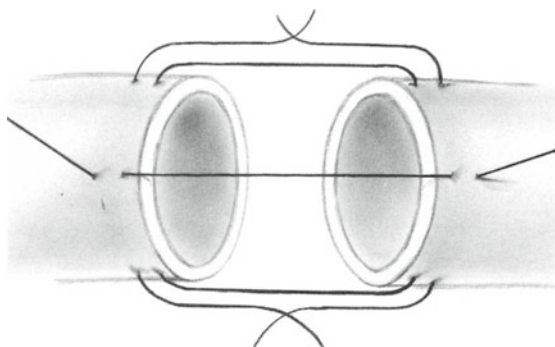


Fig. 43.2

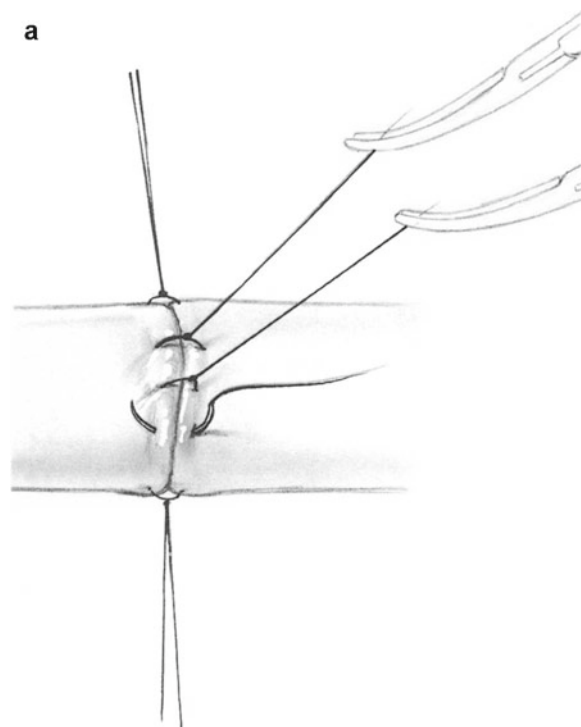
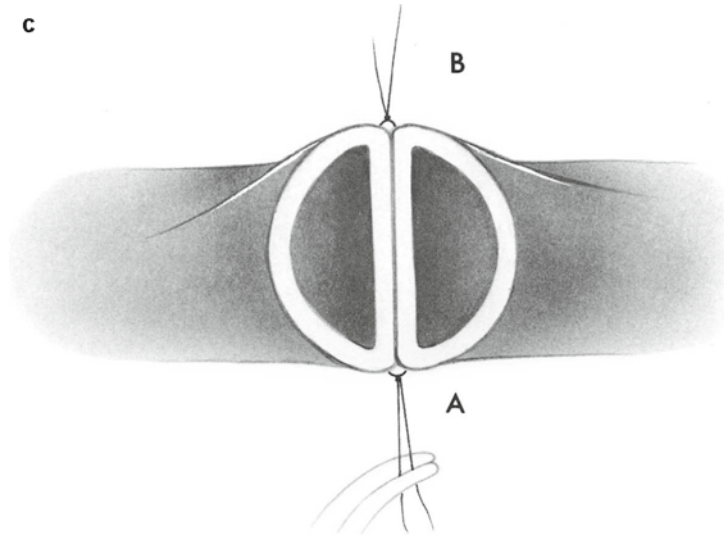
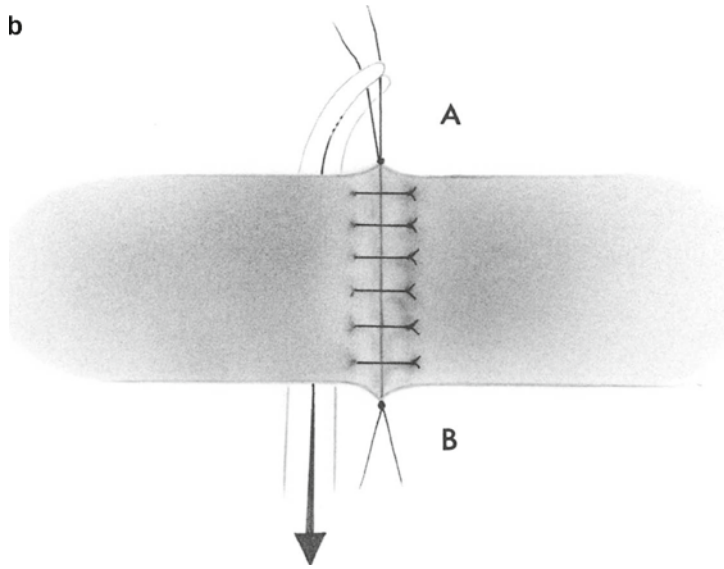
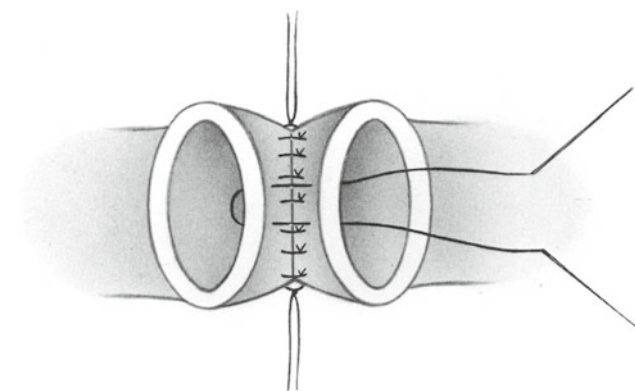


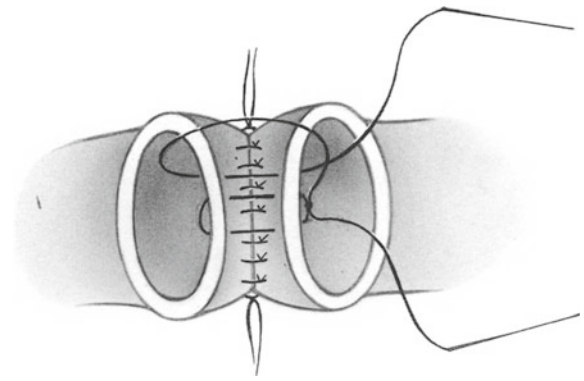
Fig. 43.3



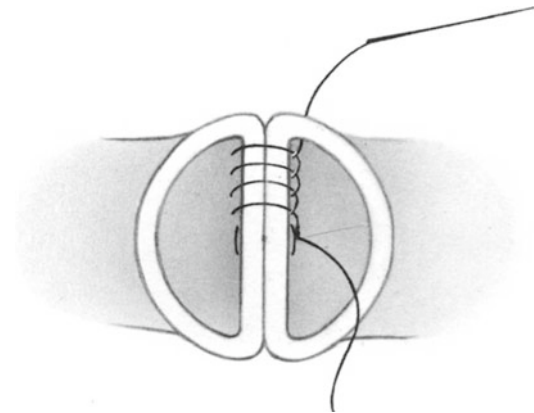
**Fig. 43.3** (continued)



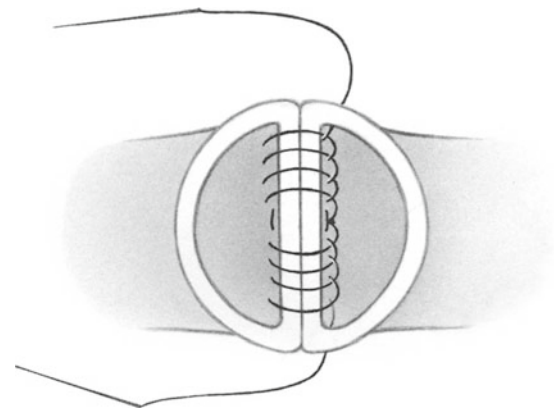
**Fig. 43.4**



**Fig. 43.5**



**Fig. 43.6**



**Fig. 43.7**

After the anastomosis is completed, check it closely for defects. Test the size of the lumen by invaginating the wall with a fingertip.

Alternatively, instead of Lembert sutures, “seromucosal” stitches may be inserted (Fig. 43.11). This suture enters the seromuscular layer and, like the Lembert sutures, penetrates the submucosa; but instead of emerging from the serosa, the needle emerges just beyond the junction of



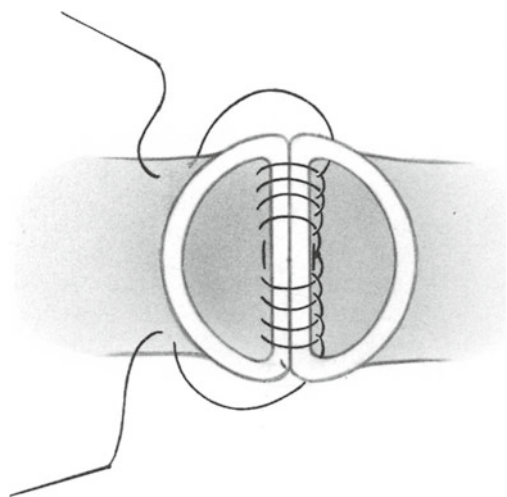


Fig. 43.8

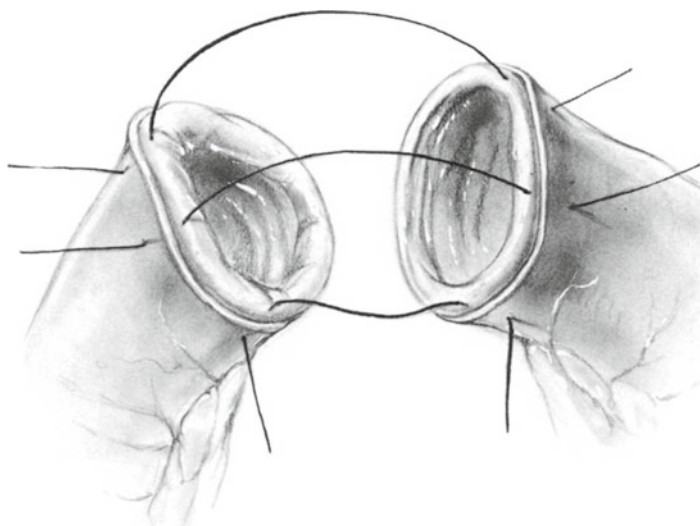


Fig. 43.11

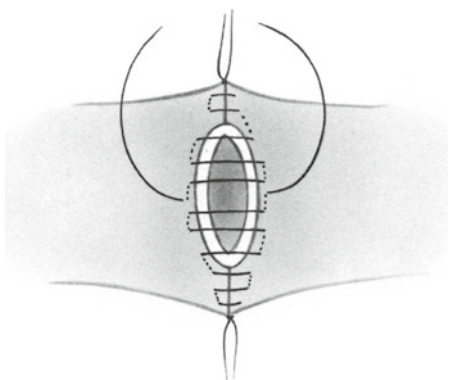


Fig. 43.9

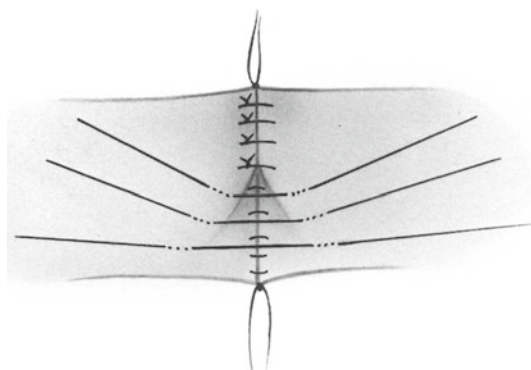


Fig. 43.10

the cut edge of the serosa and underlying mucosa. This stitch has the advantage of inverting a smaller cuff of tissue than does the Lembert or Cushing technique and may therefore be useful when the small bowel lumen is exceedingly small. When inserted properly the seromucosal suture inverts the mucosa but not to the extent seen with the Lembert stitch.

### Closure of Mesentery

Close the defect in the mesentery by a continuous suture of 2-0 PG on a large, intestinal-type needle. Take care not to pierce the blood vessels.

### Small Bowel Anastomosis Using Stapling Technique

In our experience, the most efficient method for stapling the small bowel is a two-step functional end-to-end technique. It requires the two open-ended segments of the small bowel to be positioned, so their antimesenteric borders are in apposition. Insert a cutting linear stapling device, one fork in the proximal and the other fork in the distal segment of the intestine (Fig. 43.12). Fire the stapling instrument, which forms one layer of the anastomosis in an inverting fashion (Fig. 43.13). Apply Allis clamps to the anterior and posterior terminations of the staple line. Then, draw the two Allis clamps apart (Figs. 43.14 and 43.15). Close the remaining defect in the anastomosis in an everting fashion after applying four or five Allis clamps to maintain apposition of the walls of the proximal and distal segments of bowel (Fig. 43.16).

After all the Allis clamps have been aligned, staple the bowel in eversion by applying a 90/3.5 mm linear stapling device just deep to the Allis clamps (Fig. 43.16). If the bowel wall is thick, use 4.8 mm staples. It is essential that the line of staples cross both the anterior and posterior terminations of the anastomotic staple line to avoid gaps in the staple line. Fire the stapler, and excise the redundant bowel flush with the stapling device using Mayo scissors. Lightly electrocoagulate the everted mucosa.

Carefully inspect the staple line to be sure each staple has formed a proper B. Bleeding may be controlled by conservative electrocautery or by using interrupted 4-0 atraumatic PG sutures.

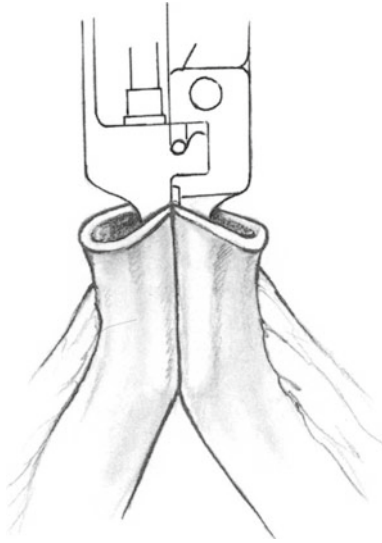


Fig. 43.12



Fig. 43.13



Fig. 43.14

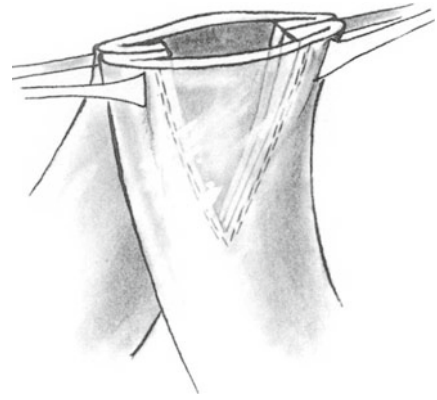


Fig. 43.15

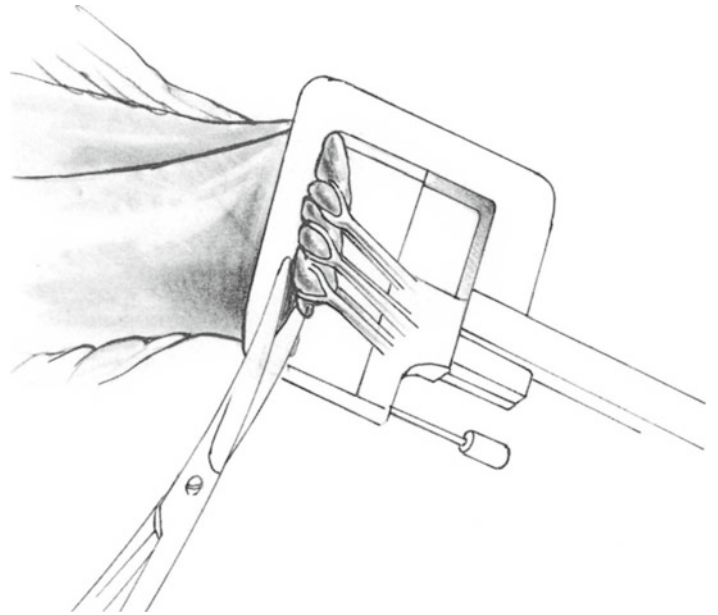


Fig. 43.16

Close the defect in the mesentery with a continuous 2-0 atraumatic PG suture. If feasible, cover the everted mucosa by the mesenteric suture line to minimize the possibility of it becoming a nidus of adhesion formation. Cover the anastomosis with a layer of omentum, whenever possible, to prevent adhesions.

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## Postoperative Care

Consider nasogastric suction until bowel function resumes.

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## Complications

Although it is uncommon for the patient to develop complications following a small bowel anastomosis, postoperative obstruction does occasionally occur.

Anastomotic leaks accompanied by intraperitoneal sepsis or enterocutaneous fistula are rare except after resection in the face of sepsis or when mesenteric circulation is impaired.

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## Further Reading

Soper NJ, Scott-Conner CEH. The SAGES manual, vol. I. New York: Springer Science+Business Media; 2012.