17 Open Parastomal Hernia Repair

Matthew Z Wilson, Joshua S Winder, and Eric M Pauli

17.1 Introduction

Parastomal hernia formation, the presence of visceral contents protruding through an abdominal wall defect adjacent to an ostomy, represents a complex problem for the hernia surgeon. When compared to other types of ventral hernias, they occur at a higher rate, they are technically more difficult to repair, and they are associated with higher rates of surgical site occurrences and hernia recurrences. Recent reviews suggest that hernia formation complicates up to 50% of stoma formation [1–6]. The presence of a parastomal hernia also increases the likelihood of a concomitant incisional hernia formation, which further complicates the repair of both hernias [7, 8]. Parastomal hernias have additional morbidity not associated with other hernias, including poorly fitting stoma appliances, parastomal skin breakdown, stoma level obstruction and pain, which results in an overall negative impact on quality of life [9]. This chapter will provide an overview of the various types of open repair of parastomal hernias.

17.2 Risk Factors and Prevention

Multiple factors predispose patients to parastomal hernia formation. Initial stoma placement is perhaps the most critical. Maturation of the stoma through the rectus muscle and above the arcuate line is of primary importance [3, 10, 11]. Stomas that are inadvertently created near or through the linea semilunaris are predisposed to hernia formation due to the thinness of the abdominal wall at this location (Fig. 17.1). Patient factors, such as waist circumference, may play an important role as well. Reports suggest that a waist circumference exceeding 100 cm confers a 75% probability of hernia formation [12]. Pre-operative stoma marking has also been shown to significantly reduce hernia occurrence [13]. The type of stoma being formed also influences the rate of hernia formation, with lower rates of hernias for ileostomy and higher rates for colostomy [14].

Recent literature suggests that staple or mesh reinforcement of the stoma site at the time of creation reduces the risk of hernia formation [15–23]. This topic is further covered in Chapter 23.

Electronic supplementary material: The online version of this chapter (doi:10.1007/978-3-319-27470-6_17) contains supplementary material, which is available to authorized users.

M.Z. Wilson, M.D.
Penn State Milton S. Hershey Medical Center, Hershey, PA, USA

J.S. Winder, M.D.
Department of General Surgery, Division of Minimally Invasive Surgery, Penn State Milton S. Hershey Medical Center, Hershey, PA, USA

E.M. Pauli, M.D. (✉)
Department of Surgery, Division of Minimally Invasive and Bariatric Surgery, Penn State Hershey Medical Center, Hershey, PA, USA
e-mail: epauli@hmc.psu.edu

Y.W. Novitsky (ed.), *Hernia Surgery*, DOI 10.1007/978-3-319-27470-6_17

Fig. 17.1 Computed Tomography of a parastomal hernia with loss of domain. The patient's main risk factor for hernia formation was the formation of his end ileostomy through the linea semilunaris. The ostomy disconnected the rectus abdominis (R) from the external oblique (E), internal oblique (I), and the transversus abdominis (T) muscles. The thin contralateral linea semilunaris can also be appreciated (arrowhead)

17.3 Current Repair Strategies

17.3.1 Surgical Technique: Open vs. Laparoscopic

Please see Chapter 23 for an overview of the advantages and disadvantages of each of these techniques in the repair of parastomal hernias.

17.3.2 Surgical Method: Primary Repair vs. Mesh Repair

Primary fascial approximation with sutures alone has a low morbidity and mortality and can be conducted through a peristomal incision alone without the need for a midline laparotomy or laparoscopic access to the abdominal cavity. While technically simple, suture repair of parastomal hernias is discouraged as it has been shown to have a 46–100% recurrence rate, ninefold higher than mesh techniques [24–26]. Given the low overall risk of mesh-related complications, prosthetic reinforcement during parastomal hernia repair is recommended. Suture repair, however, still remains a viable option for repairs being conducted in circumstances where the surgeon wishes to avoid the morbidity associated with mesh implantation.

17.3.3 Mesh Configuration: Sugarbaker, Keyhole, and Cruciate

Three primary mesh configurations for parastomal hernia repair have been described. The Sugarbaker repair utilizes a large piece of uncut prosthetic mesh placed over the stoma defect and proximal bowel intraperitoneally (underlay) and sutured into position [27, 28]. This approach was initially described using open weave mesh but is modified using polytetrafluoroethylene (PTFE) in order to minimize clinically significant interaction with the bowel (adhesions or erosions) during both open and laparoscopic repairs [29]. This modified Sugarbaker technique is technically simpler and has fewer recurrences compared to the keyhole approach when performed laparoscopically [1, 24, 30]. The major advantage is an uncut piece of mesh which widely overlaps the original stoma and fascial defect (Fig. 17.2a).

Keyhole repairs utilize mesh wrapped circumferentially around the stoma in order to reduce the fascial aperture [31]. The mesh is cut from a free edge toward a central defect giving it the appearance of a keyhole (Fig. 17.2b). This technique is advantageous because it does not require the stoma to be relocated, but does require division of the mesh which predisposes it to retraction and hernia recurrence. Mesh can be placed in an underlay, sublay, or onlay position with this configuration.

Cruciate repairs involve relocation of the stoma within the abdominal wall. The cut end of the bowel is delivered through intersecting linear cuts within the mesh, generally forming an X-shape (Fig. 17.2c) [32]. While this method requires stoma relocation, it permits a very small defect to be made in the mesh to reduce the likelihood of mesh retraction during mesh incorporation. Mesh can also be placed in an underlay, sublay, or onlay position with this configuration.

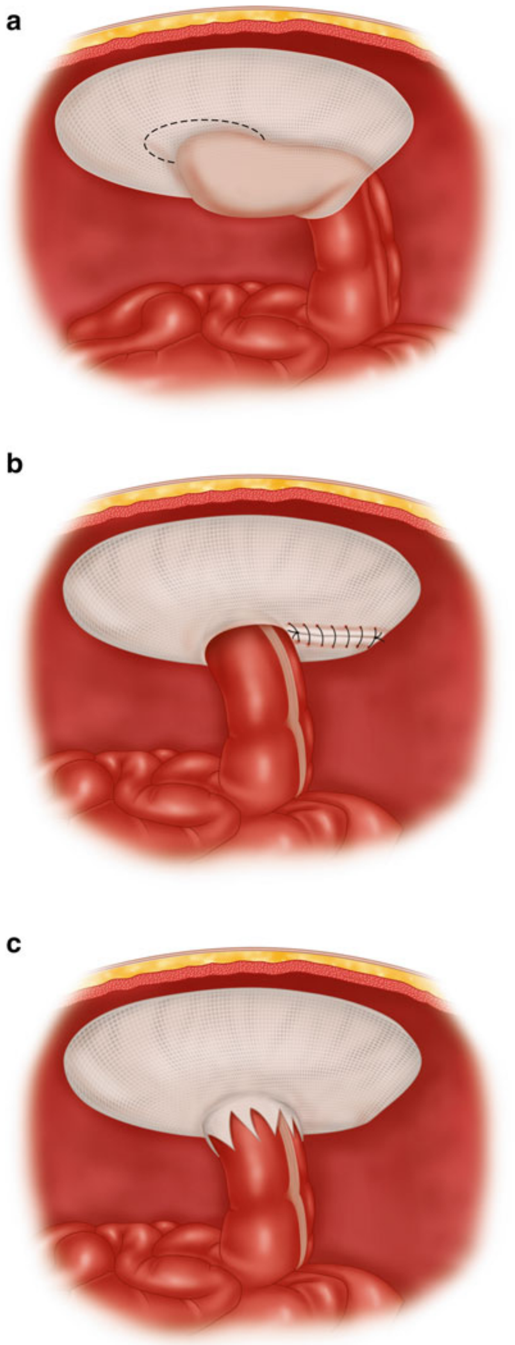

Fig. 17.2 Mesh configurations for open parastomal hernia repair (**a**) Sugarbaker configuration with a large uncut sheet of mesh widely overlapping the hernia defect (*transparent circle*) (**b**) Keyhole configuration mesh is cut, placed around the bowel, and then sewn back together once positioned (**c**) Cruciate mesh configuration permits the bowel to be drawn through a small aperture in the mesh

17.3.4 Mesh Selection: Synthetic vs. Biologic Mesh

Biologic mesh has been widely used in clinical practice in locations susceptible to contamination and is considered in repairs when contamination is present. Evidence does not support the use of biologic mesh over carefully chosen synthetic mesh, even in contaminated fields [33–37]. Data suggests that placement of large pore synthetic mesh (generally light or mid weight polypropylene) in parastomal hernia repairs is safe, effective, and inexpensive [36, 38–41].

17.3.5 Stoma Options: Closure, Relocation, or In Situ Position

Some patients are candidates for ostomy takedown but have not been offered definitive closure because of the complexity of their parastomal hernia (Fig. 17.3). Consideration should be given to closing the ostomy at the time of hernia repair. If a two-staged procedure is indicated (primary stoma takedown with creation of a protecting proximal ileostomy), a bridged hernia repair may be considered at the initial operation followed by definitive abdominal wall reconstruction with ostomy takedown at the second operation.

Many advocate leaving the stoma in situ during parastomal hernia repair [42]. This approach is advantageous because it avoids: the need to transect the bowel, the need to free adhesions to transpose the ostomy to another location, and the additional wound to manage. Disadvantages include: difficulty with primary fascial re-approximation, seroma formation around the ostomy, and the need to use a keyhole mesh configuration which has a higher risk of hernia recurrence than other configurations [1, 30, 33].

Stoma relocation is best performed with the assistance of an enterostomal therapist performing pre-operative marking. As with primary ostomy site localization, a transrectus position is the preferred location. Examination of the patient in standing, sitting, and recumbent positions further facilitates localization by avoiding skin folds or a large pannus. Often, in the case of a large

Fig. 17.3 54-year-old male with Crohn's disease who received an emergency end ileostomy and developed a large symptomatic parastomal hernia. The patient was never offered stoma reversal due to his loss of domain, obesity, inflammatory bowel disease, and concomitant midline hernias

parastomal hernia or herniorraphy involving a simultaneous ventral hernia, the pre-operative stoma marking is inadvertently placed away from the rectus abdominis muscle due to lateralization of the rectus muscles from the hernia. In these cases we respect the original cranio-caudal marking, but move the stoma site medial or lateral as necessary to achieve a mid-rectus position following hernia repair with midline re-approximation. Relocation has the advantage of permitting the stoma to be created through a small fascial opening, with a cruciate (not keyhole) mesh configuration in an ideal location for the patient. However, this creates two additional abdominal wounds (old and new stoma sites) and requires transection of the bowel with mobilization of the intestine to reach the new location. Often, especially with a urostomy, there is insufficient bowel length to permit relocation.

17.3.6 Operative Approach: One Team vs. Two Teams

Our group utilizes a two-team approach to parastomal hernia repair. The abdominal wall reconstruction is undertaken by the primary team while a secondary team, typically from the colorectal surgery division, is responsible for intestinal mobilization and reconstruction (as necessary). The patient is seen pre-operatively and the appropriate studies are undertaken to determine the feasibility of stoma takedown. If the patient is a candidate for stoma closure, then the secondary team will perform the reduction of the stoma, anastomosis, and any necessary resections after the lysis of intra-abdominal adhesions by the secondary team. If the patient is not a candidate for stoma closure, the primary team will reduce the stoma after the lysis of adhesions, determine the appropriate placement for a new stoma, and then return to mature the new stoma after the abdominal wall reconstruction is finished. Coordination of two teams can be somewhat difficult. Performing stoma takedown or re-siting can certainly be performed by one team; however, the fatigue factors associated with lengthy reconstructive procedures should not be underestimated.

17.4 Patient Selection

Absolute indications for surgery include obstruction caused by the herniation and incarceration with strangulation. Relative indications for surgery include incarceration, prolapse, stenosis, difficulty with appliance management, intractable dermatitis, large size, pain, and cosmesis [43]. Contraindications to surgical repair include future reversal of the stoma, short life expectancy such as in the case of widely metastatic disease, and other life-threatening diseases such as cardiopulmonary distress that would preclude patients from surgery. A BMI great than 45 is a relative contraindication to elective surgical repair.

When determining the approach to repair (laparoscopic or open) we consider multiple factors. Older patients, those with smaller defects (<6 cm), those with parastomal hernias who are anticipated to have sufficient bowel length to permit a Sugarbaker repair are offered a laparoscopic parastomal repair. Younger patients, those with need for a functional abdominal wall (e.g., patients who perform manual labor), those with defects above 6 cm, those with parastomal defects through or including the linea semilunaris, those with loss of domain hernias, those with simultaneous midline (or other location) hernia, those with a need for additional GI tract procedure, urostomy patients, those who failed prior laparoscopic repair, and those patients in whom laparoscopic repair cannot be performed are offered an open retromuscular repair.

As with other hernia repairs, medical comorbidities must be optimized prior to surgery: management of blood glucose levels, obesity, and pulmonary function should all be addressed in the pre-operative period. Smoking cessation is an absolute.

Because many parastomal hernias occur in the setting of a simultaneous ventral hernia, our preferred method of herniorraphy is open posterior component separation with transversus abdominis release (TAR) [40, 41].

17.5 Surgical Techniques of Open Parastomal Hernia Repair

All patients are marked for new stomas by an enterostomal therapy nurse prior to the procedure. The patient is positioned supine with arms out. A Foley catheter as well as an orogastric tube is placed. All previous scars are marked and gastrointestinal stomas are oversewn and excluded via an iodophor adhesive drape. Urostomies are sterilely intubated with a Foley catheter for drainage and as an adjunct to identify the conduit intra-operatively.

17.5.1 Sugarbaker Technique

The procedure begins with an exploratory laparotomy and full lysis of adhesions. The stoma is identified and any incarcerated loops of bowel are reduced. The hernia sac is dissected free from the defect and removed. Mesh (typically PTFE-based) is brought to the field and sized such that a minimum of 4 cm of defect overlap is achieved in all directions. The bowel proximal to the stoma is lateralized on the abdominal wall, which may require additional mobilization to prevent kinking of the bowel at the lateral aspect where it arches over the mesh. Transfascial sutures or tacks are placed around the periphery of the mesh at 1 cm intervals to secure it in place (Fig. 17.4).

17.5.2 Anterior Component Separation (External Oblique Release)

A full midline laparotomy is made incorporating the old scar, all visceral adhesions are lysed, and all previous mesh or other foreign bodies are removed. The stoma is then reduced in prepara-

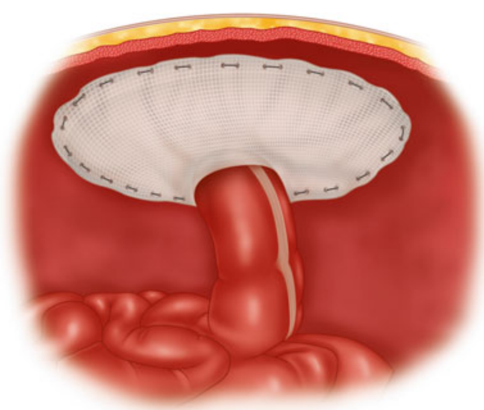

Fig. 17.4 Mesh placement following the Sugarbaker technique with tacks placed at 1 cm intervals around the periphery of the mesh to secure it in place on the abdominal wall

tion for re-siting or anastomosed for restoring continuity and the fascial defect closed with monofilament absorbable suture. At this point, any mobilization of bowel loops in preparation for the new stoma is performed.

The linea alba is identified and lipocutaneous flaps are raised by dissecting the subcutaneous tissue free from the anterior rectus fascia on the side of the parastomal hernia. The flaps are carried laterally to at least 2 cm beyond the linea semilunaris, inferiorly to the inguinal ligament, and superiorly to the coastal margin. Peri-umbilical perforator sparing (PUPS) and endoscopic methods of anterior component separation have been described and are reviewed in Chapters 15–16.

The external oblique aponeurosis is divided 1–2 cm lateral to the linea semilunaris from the costal margin to a point just superior to the inguinal ligament. Care must be taken to not injure the linea semilunaris itself as this can result in the development of a hernia lateral to the rectus muscle. Assessment of the ability to re-approximate the linea alba is made; if the sides can be approximated with no tension, the mesh placement and closure can begin. If tension remains, then the contralateral external oblique aponeurosis can be divided.

The stoma is created through the rectus muscle in a new position and the fascia is closed with a running absorbable monofilament suture. Mesh is placed using an onlay technique, where a closely sized cruciate aperture is made where the stoma will penetrate the mesh. The mesh is secured to the lateral cut edges of the external oblique fascia using monofilament absorbable suture. Several interrupted sutures are placed evenly into the anterior rectus fascia to eliminate dead space. The stoma is now matured and the cutaneous flaps closed in layers over closed suction drains.

17.5.3 Posterior Component Separation (Transversus Abdominis Release)

The initial procedure for a posterior component separation begins identically to that of the anterior component separation. The old scar is removed and an exploratory laparotomy is performed with full lysis of adhesions. The stoma is then reduced in preparation for re-siting or anastomosed for restoring intestinal continuity.

Posterior component separation with TAR is described in detail in Chapter 13. Briefly, using electrocautery, the posterior rectus sheath is incised approximately 5 mm from the medial border and opened superiorly and inferiorly along the entire length of the rectus. Using a combination of blunt dissection and electrocautery, the plane is developed laterally to the linea semilunaris taking care not to injure the neurovascular bundles that penetrate the lateral aspect of the rectus or the epigastric vessels which should remain on the back of the muscle belly. The plane is then developed superiorly into the retrosternal space and interiorly into the space of Retzius. Here blunt dissection can expose the symphysis pubis and Cooper's ligaments bilaterally. There will be a defect in the posterior layer in the location of the previous stoma (Fig. 17.5).

Retrorectus dissection alone is generally insufficient to permit wide mesh overlap lateral to the stoma defect as the rectus sheath ends at the lateral boarder of the rectus muscle. To provide wider lateral overlap, transversus abdominis release is performed. Using cautery, the anterior

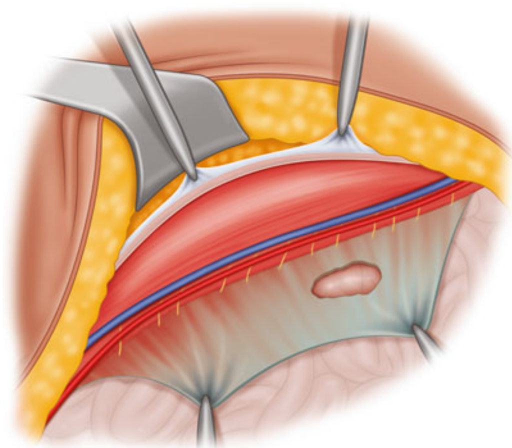

Fig. 17.5 Posterior rectus sheath taken down from the rectus muscles lateral to the linea semilunaris as identified by the traversing neurovascular bundles. There is a defect in the posterior sheath at the location of the old ostomy

aspect of the posterior sheath is incised at a point approximately 5 mm medial to the linea semilunaris, preferably in a more cephalad location where the muscle is better defined and more medial (Fig. 17.6). Using a right angle clamp for assistance, cautery is used to transect the anterior layer of transversalis fascia and the transversus muscle belly, taking care to avoid injury to the peritoneum/posterior transversalis fascia deep to the muscle. Release of the transversus continues inferiorly through the level of the arcuate line. Once the muscle has been divided, blunt dissection can be undertaken laterally to the psoas muscle, superiorly under the costal margin and inferiorly to the myopectineal orifice providing a large sublay space for mesh to be positioned.

Retrorectus dissection on the contralateral side is then undertaken. This is necessary to permit the posterior layers from both sides to be closed together to recreate the visceral sac. The retromuscular space created will permit the mesh to cover the old stoma site and reinforce the midline incision and the new stoma site on the contralateral rectus muscle. If the midline fascia cannot be easily approximated, contralateral release of the transversus abdominis can be accomplished at this juncture. This may be necessary in the case of large parastomal hernias with loss of domain or with simultaneous parastomal and midline ventral hernia repairs.

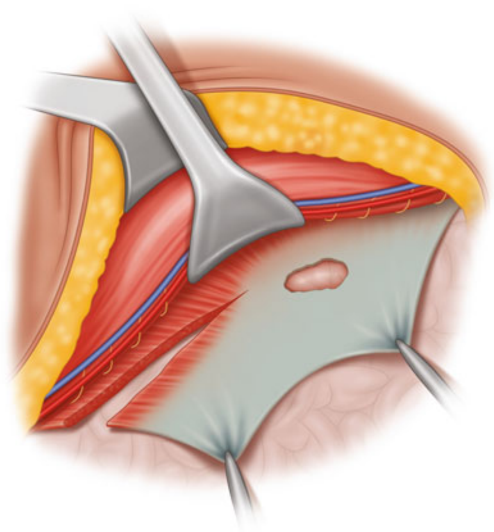

Fig. 17.6 Identification of the transversus abdominis muscle within the posterior rectus sheath is best performed in the upper abdomen, below the costal margin

The posterior layer is then approximated in the midline using running 2-0 absorbable suture. All defects in this layer must be closed to prevent bowel from contacting the mesh or herniating into the space between the posterior layer and the mesh (intra-parietal hernia). Larger holes not amenable to primary suture repair may be patched with vicryl mesh and secured with a running absorbable suture. This may be necessary in the location of the old stoma as the defect here can be quite substantial. Primary closure of the parastomal hernia fascial defect is then performed using 0 monofilament absorbable sutures. Occasionally, the stoma cannot be repositioned to a new location. In these cases, the posterior component separation and transversus abdominis release are still completed with the stoma in situ. The mesh is key-holed around the stoma and then sewn back together laterally in a running fashion.

The aperture for the new stoma is created one layer at a time through closely sized cruciate incisions orienting the stoma properly to avoid kinking. A defect is created in the closed posterior layer and the bowel is delivered into the retromuscular plane taking care to properly orient the mesentery (Fig. 17.7).

The mesh is placed in a diamond configuration and anchored transfascially with absorbable 0 monofilament sutures (Figs. 17.8 and 17.9). We preferentially use medium-weight polypropylene mesh when performing posterior component separation parastomal hernia repairs. This mesh is tightened to a physiologic tension by using a Kocher clamp to pull the linea alba medially toward the midline as the transfascial sutures are placed. This will later allow close approximation of the linea alba without tension. After securing the mesh, a cruciate incision is made at the location of the new stoma and the bowel is delivered through the mesh (Fig. 17.9). A defect is then created in the skin, subcutaneous tissues, anterior rectus sheath and rectus muscle and the bowel delivered through. Drains are placed in the retro muscular space and the dead space of the hernia sac(s) as desired. The linea alba is recreated in

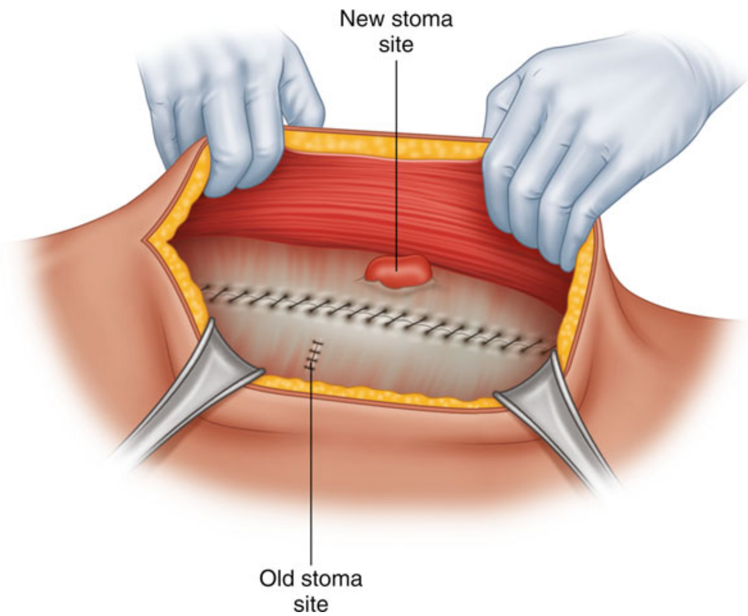

Fig. 17.7 Transversus abdominis release is accomplished by dividing the anterior portion of the transversalis fascia and the transversus muscle belly but leaving the posterior layer of transversalis fascia and the peritoneum intact deep to the muscle

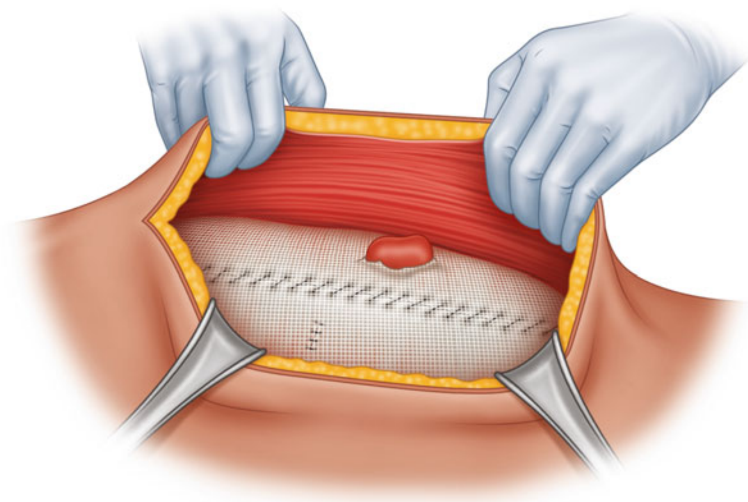

Fig. 17.8 Mesh is placed in a diamond configuration and positioned in the retromuscular space. This covers the old stoma site and the entire midline (and any midline defects) and reinforces the new stoma location

the midline using 0 monofilament absorbable sutures taking only bites of fascia. The subcutaneous tissues are closed in layers with absorbable suture and the skin stapled.

17.5.4 Pauli Parastomal Hernia Repair (PPHR)

This novel method of open parastomal hernia repair avoids ostomy relocation, obviates the need to alter the mesh with either a cruciate or keyhole incision, and permits simultaneous coverage of parastomal and midline defects. This is achieved by combining posterior component separation and TAR with a modified Sugarbaker mesh configuration (essentially a retro-muscular Sugarbaker herniorraphy).

The initial steps of the PPHR are completed as outlined above in the "Posterior Component Separation" section. Here, however, the TAR is carefully completed while maintaining the stoma in situ (Fig. 17.10). With the retromuscular dissec-

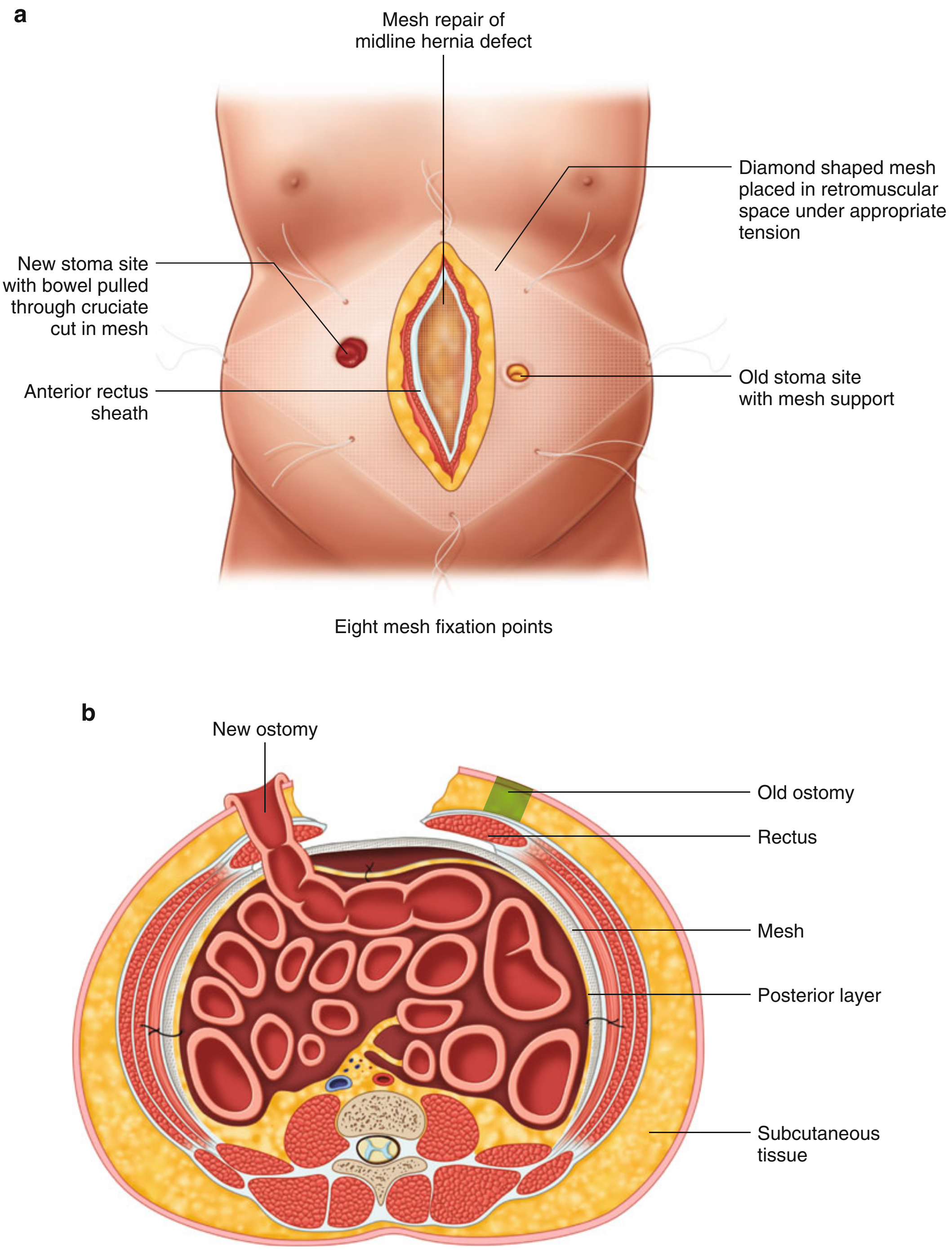

Fig. 17.9 The posterior layer of transversalis fascia/peritoneum is closed to recreate the visceral sac. A defect is created at the new ostomy location to deliver the bowel through

Fig. 17.10 Posterior component separation with TAR completed during PPHR with stoma left in-situ

Fig. 17.12 Proximal bowel is delivered through defect into retromuscular plane. The defect is then closed from medial to lateral

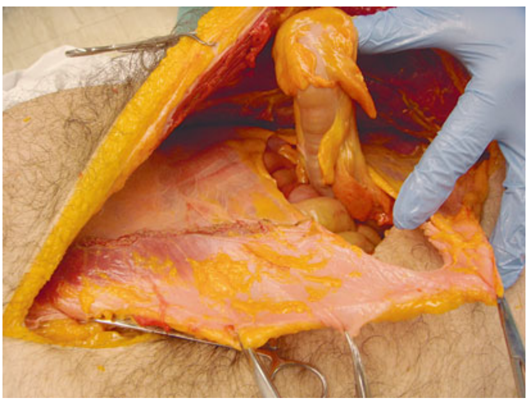

Fig. 17.11 Defect in posterior layer extended laterally

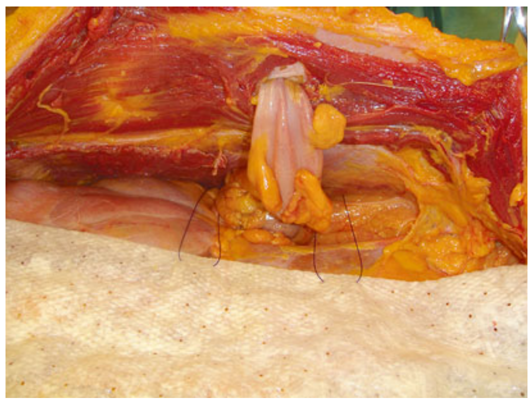

Fig. 17.13 Transfacial sutures are placed on either side of the lateralized bowel to fixate the mesh and create a sling for the stoma

tion extended well beyond the boundaries of the parastomal hernia in all directions, the defect in the posterior layer (through which the stoma exits the abdominal cavity) is intentionally extended laterally (Fig. 17.11). On the contralateral site, retrorectus dissection (or TAR, if needed) is completed. The bowel proximal to the stoma is then delivered into the retromuscular space. The posterior layer is subsequently closed with running absorbable suture simultaneously recreating the visceral sac and lateralizing the location where the proximal bowel enters the retromuscular space (Fig. 17.12).

Mesh is placed in a sublay position within the retromuscular plane with a lateral configuration resembling a Sugarbaker repair. Transfacial sutures are placed in all cardinal directions and on either side of the stoma to create a sling of mesh around the bowel proximal to the stoma (Fig. 17.13). Placing mesh in this fashion provides wide overlap of any additional midline defects while creating a modified Sugarbaker configuration around the stoma that was left in situ (Fig. 17.14). Parastomal and midline defects are primarily closed as described above.

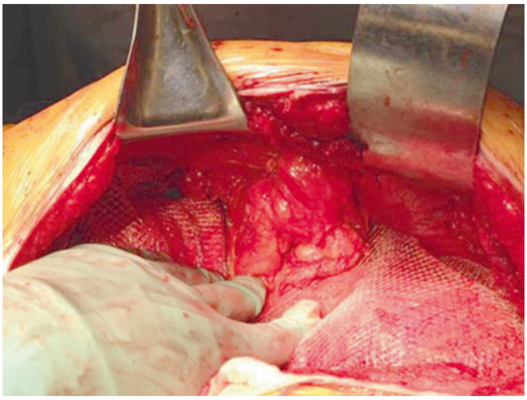

Fig. 17.14 Retromuscular placement of mesh provides wide mesh overlap of any abdominal wall defects and creates a modified Sugarbaker configuration of mesh around the stoma

17.6 Post-operative Care

Parastomal hernia repair patients follow routine post-operative pathways similar to other abdominal wall reconstructive procedures. Antibiotics are routinely stopped at 24 hours and diet is advanced when bowel function has returned. The stoma is observed for any complication and the patient is monitored for signs of infection. Routine venous thromboembolic prophylaxis is mandatory. Abdominal binders are routinely used in the immediate post-operative period. Drains are monitored and typically removed prior to discharge, unless biologic mesh was used, in which case they are maintained for 2 weeks post-op.

17.6.1 Incisional Negative Pressure Wound Therapy

It has been our practice to place negative pressure dressing on the closed midline wound in the operating room when performing open parastomal hernia repair. While this has not been shown to be of benefit for high risk abdominal wall reconstruction incisions, there is support for this practice when performing open colorectal procedures [44, 45]. A narrow strip of petroleum jelly-impregnated gauze is applied to the midline wound and loosely closed old stoma site in a T-shaped configuration (Fig. 17.15). This is followed by a similar sized strip of open cell foam. A plastic dressing is applied over top. The suction adaptor is placed over the old stoma site such that the suction will draw to the old ostomy (theoretically the most contaminated wound) and not away from it to the midline wound. Pressure is placed to −75 mmHg suction. This dressing remains in place for 7 days or until discharge. While the exact mechanism of action is not known, one likely benefit is the exclusion of the midline wound from any stoma effluent that may leak around the ostomy appliance and saturate dressings or flow onto the incision.

Fig. 17.15 Negative pressure wound dressing applied to the closed midline wound and the loosely closed old stoma site in a T-shaped configuration. Suction is applied over the old stoma site and is set to −75 mmHg

17.6.2 Mechanical Ventilation

In patients with loss of domain hernias, care must be paid to respiratory mechanics following reconstruction. If plateau airway pressure increases more than 6 mmHg above the baseline level, then intubation is maintained for 24 hours [46]. Neuromuscular blockade is added if plateau airway pressure increases more than 10–11 mmHg after re-approximation of the linea alba [46]. Maintaining urinary and gastric decompression is beneficial in these circumstances to reduce the elevated intra-abdominal pressures that occur following primary fascial re-approximation.

17.7 Results of Open Parastomal Hernia Repair

Results of various types of open parastomal hernia repair are summarized in Table 17.1.

17.8 Complications of Open Parastomal Hernia Repair

General complications of open hernia repair are covered in Chapter 20. Open parastomal hernia repair has some inherent complications not applicable to general open repairs and these will be reviewed here.

17.8.1 Wound Infection

Wound infections following gastrointestinal stoma takedown or relocation remain one of the most common post-operative complications, with rates as high as 41% [47–50]. This is of particular concern in complex parastomal hernia repair, as wound infections can lead to mesh infection and hernia recurrence (Fig. 17.16). There are a variety of options available for managing the old stoma site, including primary closure (with or without a subcutaneous drain), delayed primary closure, closure by secondary intention and negative pressure wound therapy. The method of closure is partially dependent on the details of the herniorraphy: how large is the subcutaneous dead space, where is the mesh located within the abdominal wall, was the fascia fully closed over the mesh, what type of mesh was used, does the patient have any additional risks for developing a wound infection (immunosuppression, diabetes, malnutrition). Our preference is to close all wounds primarily and place a negative pressure dressing on the closed midline wound and the old stoma site. If there is a large subcutaneous dead space under either of these wounds, a separate closed suction drain may be placed subcutaneously.

17.8.2 Stoma Complications

Complications related directly to the ostomy are unique to parastomal repairs. Rates of these complications are fortunately low, but they can have significant morbidity when they do occur. Stoma ischemia, necrosis, or retractions are often technical complications from tension on the ostomy, twisting of to the mesentery during stoma delivery through the abdominal wall or a tight stoma aperture in the rectus muscle or the mesh (Fig. 17.16). Patient-related factors such as obesity, atherosclerosis, and post-op hypotension can contribute to these complications.

Table 17.1 Results of multiple types of open parastomal hernia repair techniques

Type of repair	Number of patients	Infection% (95% CI)	Mesh infection% (95% CI)	Other complication% (95% CI)	Mortality% (95% CI)	Recurrence% (95% CI)	Mean follow-up (months)
Primary fascial repair[2]	141	9.4 (4.9–15.8)	na	14.1 (8.6–21.3)	2.8 (0.8–7.1)	57.6 (48.4–66.4)	30
Mesh onlay[2]	216	1.9 (0.5–4.7)	1.9 (0.5–4.7)	11.1 (7.3–16.1)	0 (0–1.7)	14.8 (10.2–20.4)	40
Mesh sublay[2]	76	3.9 (0.8–11.1)	0 (0–4.7)	14.5 (7.5–24.4)	0 (0–4.7)	7.9 (3–16.4)	24
Mesh underlay[2]	65	3.1 (0.4–10.7)	1.5 (0–8.3)	15.4 (7.6–24.4)	0 (0–5.5)	9.2 (3.5–19)	38
Mesh sublay[34]	48	31.3	0	25	0	11	13

Fig. 17.16 Midline wound infection with exposed synthetic mesh and muco-cutaneous disruption and stoma retraction following a component separation parastomal hernia repair. The stoma output is being managed with a Foley catheter

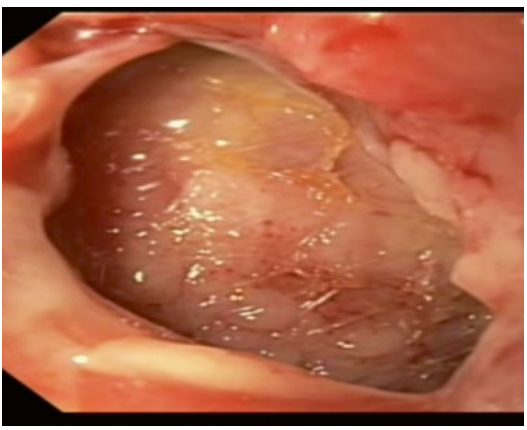

Fig. 17.17 Endoscopic view of polypropylene mesh eroded into the colon following an open parastomal hernia repair

Kinking of the ostomy can result in delayed stoma function or obstruction. This complication can happen with any type of parastomal repair, but is commonly associated with the bowel bending over the lateral edge of the mesh when performing a Sugarbaker repair. It can also occur during posterior component separation with transversus abdominis release if care is not taken to properly align the three individually made holes in the abdominal wall (peritoneum/transversalis layer, mesh layer, rectus muscle/anterior rectus sheath/subcutaneous tissue layer).

Mesh erosion is a rare complication of parastomal hernia repair, but may require stoma takedown and mesh excision. As noted above, placement of synthetic mesh in the vicinity of the stoma is considered safe during both stoma creation and parastomal hernia repair. However, mesh may erode into the bowel if there is significant kinking of the bowel over the edge of the mesh or tension of the bowel over the cut edge of the mesh (Fig. 17.17).

References

1. Hotouras A, et al. The persistent challenge of parastomal herniation: a review of the literature and future developments. Colorectal Dis. 2013;15(5):e202–14.
2. Al Shakarchi J, Williams JG. Systematic review of open techniques for parastomal hernia repair. Tech Coloproctol. 2014;18(5):427–32.
3. Nastro P, et al. Complications of intestinal stomas. Br J Surg. 2010;97(12):1885–9.
4. Rieger N, et al. Parastomal hernia repair. Colorectal Dis. 2004;6(3):203–5.
5. Carne PW, Robertson GM, Frizelle FA. Parastomal hernia. Br J Surg. 2003;90(7):784–93.
6. Israelsson LA. Parastomal hernias. Surg Clin North Am. 2008;88(1):113–25. ix.
7. Timmermans L, et al. Parastomal hernia is an independent risk factor for incisional hernia in patients with end colostomy. Surgery. 2014;155(1):178–83.
8. Powell-Chandler A, Stephenson BM. Avoiding simultaneous incisional and parastomal herniation. Colorectal Dis. 2014;16(12):1020–1.
9. Kald A, et al. Quality of life is impaired in patients with peristomal bulging of a sigmoid colostomy. Scand J Gastroenterol. 2008;43(5):627–33.
10. Sjodahl R, Anderberg B, Bolin T. Parastomal hernia in relation to site of the abdominal stoma. Br J Surg. 1988;75(4):339–41.
11. Al-Momani H, Miller C, Stephenson BM. Stoma siting and the 'arcuate line' of Douglas: might it be of relevance to later herniation? Colorectal Dis. 2014; 16(2):141–3.
12. De Raet J, et al. Waist circumference is an independent risk factor for the development of parastomal hernia after permanent colostomy. Dis Colon Rectum. 2008;51(12):1806–9.
13. Baykara ZG, et al. A multicenter, retrospective study to evaluate the effect of preoperative stoma site marking on stomal and peristomal complications. Ostomy Wound Manage. 2014;60(5):16–26.
14. Shah NR, Craft RO, Harold KL. Parastomal hernia repair. Surg Clin North Am. 2013;93(5):1185–98.
15. Serra-Aracil X, et al. Randomized, controlled, prospective trial of the use of a mesh to prevent parastomal hernia. Ann Surg. 2009;249(4):583–7.

16. Wijeyekoon SP, et al. Prevention of parastomal herniation with biologic/composite prosthetic mesh: a systematic review and meta-analysis of randomized controlled trials. J Am Coll Surg. 2010;211(5): 637–45.
17. Figel NA, Rostas JW, Ellis CN. Outcomes using a bioprosthetic mesh at the time of permanent stoma creation in preventing a parastomal hernia: a value analysis. Am J Surg. 2012;203(3):323–6. discussion 326.
18. Hauters P, et al. Prevention of parastomal hernia by intraperitoneal onlay mesh reinforcement at the time of stoma formation. Hernia. 2012;16(6):655–60.
19. Lee L, et al. Cost effectiveness of mesh prophylaxis to prevent parastomal hernia in patients undergoing permanent colostomy for rectal cancer. J Am Coll Surg. 2014;218(1):82–91.
20. Janes A, Cengiz Y, Israelsson LA. Randomized clinical trial of the use of a prosthetic mesh to prevent parastomal hernia. Br J Surg. 2004;91(3):280–2.
21. Janes A, Cengiz Y, Israelsson LA. Preventing parastomal hernia with a prosthetic mesh: a 5-year follow-up of a randomized study. World J Surg. 2009;33(1): 118–21. discussion 122-3.
22. Williams NS, Nair R, Bhan C. Stapled mesh stoma reinforcement technique (SMART)—a procedure to prevent parastomal herniation. Ann R Coll Surg Engl. 2011;93(2):169.
23. Koltun L, Benyamin N, Sayfan J. Abdominal stoma fashioned by a used circular stapler. Dig Surg. 2000; 17(2):118–9.
24. Hansson BM, et al. Surgical techniques for parastomal hernia repair: a systematic review of the literature. Ann Surg. 2012;255(4):685–95.
25. Horgan K, Hughes LE. Para-ileostomy hernia: failure of a local repair technique. Br J Surg. 1986;73(6):439–40.
26. Rubin MS, Schoetz Jr DJ, Matthews JB. Parastomal hernia. Is stoma relocation superior to fascial repair? Arch Surg. 1994;129(4):413–8. discussion 418-9.
27. Sugarbaker PH. Peritoneal approach to prosthetic mesh repair of paraostomy hernias. Ann Surg. 1985;201(3):344–6.
28. Sugarbaker PH. Prosthetic mesh repair of large hernias at the site of colonic stomas. Surg Gynecol Obstet. 1980;150(4):576–8.
29. Mancini GJ, et al. Laparoscopic parastomal hernia repair using a nonslit mesh technique. Surg Endosc. 2007;21(9):1487–91.
30. Tran H, et al. Single-port laparoscopic parastomal hernia repair with modified sugarbaker technique. JSLS. 2014;18(1):34–40.
31. Zacharakis E, et al. Laparoscopic parastomal hernia repair: a description of the technique and initial results. Surg Innov. 2008;15(2):85–9.
32. Raigani S, et al. Single-center experience with parastomal hernia repair using retromuscular mesh placement. J Gastrointest Surg. 2014;18(9):1673–7.
33. Slater NJ, et al. Repair of parastomal hernias with biologic grafts: a systematic review. J Gastrointest Surg. 2011;15(7):1252–8.
34. Lee L, et al. A systematic review of synthetic and biologic materials for abdominal wall reinforcement in contaminated fields. Surg Endosc. 2014;28(9):2531–46.
35. Fleshman JW, et al. A prospective, multicenter, randomized, controlled study of non-cross-linked porcine acellular dermal matrix fascial sublay for parastomal reinforcement in patients undergoing surgery for permanent abdominal wall ostomies. Dis Colon Rectum. 2014;57(5):623–31.
36. Krpata DM, et al. Evaluation of high-risk, comorbid patients undergoing open ventral hernia repair with synthetic mesh. Surgery. 2013;153(1):120–5.
37. Rosen MJ, et al. A 5-year clinical experience with single-staged repairs of infected and contaminated abdominal wall defects utilizing biologic mesh. Ann Surg. 2013;257(6):991–6.
38. Novitsky YW, et al. Transversus abdominis muscle release: a novel approach to posterior component separation during complex abdominal wall reconstruction. Am J Surg. 2012;204(5):709–16.
39. Pauli EM, Rosen MJ. Open ventral hernia repair with component separation. Surg Clin North Am. 2013; 93(5):1111–33.
40. Carbonell AM, et al. Outcomes of synthetic mesh in contaminated ventral hernia repairs. J Am Coll Surg. 2013;217(6):991–8.
41. Carbonell AM, Cobb WS. Safety of prosthetic mesh hernia repair in contaminated fields. Surg Clin North Am. 2013;93(5):1227–39.
42. Hofstetter WL, et al. New technique for mesh repair of paracolostomy hernias. Dis Colon Rectum. 1998;41(8):1054–5.
43. Leslie D. The parastomal hernia. Surg Clin North Am. 1984;64(2):407–15.
44. Pauli EM, et al. Negative pressure therapy for high-risk abdominal wall reconstruction incisions. Surg Infect (Larchmt). 2013;14(3):270–4.
45. Bonds AM, et al. Incisional negative pressure wound therapy significantly reduces surgical site infection in open colorectal surgery. Dis Colon Rectum. 2013; 56(12):1403–8.
46. Blatnik JA, et al. Predicting severe postoperative respiratory complications following abdominal wall reconstruction. Plast Reconstr Surg. 2012;130(4): 836–41.
47. Lahat G, et al. Wound infection after ileostomy closure: a prospective randomized study comparing primary vs. delayed primary closure techniques. Tech Coloproctol. 2005;9(3):206–8.
48. Hackam DJ, Rotstein OD. Stoma closure and wound infection: an evaluation of risk factors. Can J Surg. 1995;38(2):144–8.
49. Vermulst N, et al. Primary closure of the skin after stoma closure. Management of wound infections is easy without (long-term) complications. Dig Surg. 2006;23(4):255–8.
50. van de Pavoordt HD, et al. The outcome of loop ileostomy closure in 293 cases. Int J Colorectal Dis. 1987; 2(4):214–7.