Reoperative pelvic surgery is technically challenging and carries with it significant potential risk. The inherent risks of any pelvic operation, such as bleeding and injury to critical structures such as the ureters, are magnified by the obliteration of previous embryonic fusion planes and anatomic relationships within the confines of a narrow, deep operative field. This topic review addresses the surgical indications, techniques, and pitfalls when dealing with recurrent pelvic pathology and provides an overview of safe and effective approaches to reoperative pelvic surgery.

Pelvic pathology that requires reoperative surgery in the gastrointestinal tract usually involves four surgical themes: (1) recurrent malignancies, for which we use recurrent rectal cancer as an example; (2) complications from ileal pouch-anal anastomoses (IPAA) for inflammatory bowel disease; (3) complications from low pelvic anastomoses; and (4) palliative situations. For any of these indications, the goals of reoperative pelvic surgery are twofold: (1) resection/repair of the primary indication, which could include pelvic exten-teration for recurrent rectal cancers to resection/repair of a problematic coloanal anastomosis, and (2) reconstruction when possible, which could include complex soft tissue and genitourinary constructs to restoration of gastrointestinal continuity.

Pelvic Anatomy

An advanced understanding of pelvic anatomy that includes soft tissue, gastrointestinal, genitourinary, neurovascular, and osseous structures is essential in the evaluation and management of complex pelvic pathology. Previous surgery, pelvic radiation, and large tumors can distort the well-defined embryologic fusion planes such as the presacular space, making pelvic dissections particularly difficult and dangerous. Several important neural and vascular structures, such as the pelvic autonomic plexus and iliac vessels, respectively, are located in the pelvis, and injury or removal of them as part of en bloc resection may have important physiologic sequelae as well as long-term neurologic and musculoskeletal consequences.

Bleeding is one of the most significant risks of reoperative pelvic surgery. The arterial and venous anatomy associated with the rectum, as well as the urologic and gynecologic organs, must be clearly delineated so that mobilization and/or ligation of vessels necessary to remove these organs can be safely performed. When dissection is carried out in the lateral pelvic sidewall, for example, multiple branches of the internal iliac arteries and veins will be encountered, resulting in major blood loss when not approached carefully. In the previously irradiated pelvis, the vascular dissection necessary for en bloc tumor removal or sacral resection can be facilitated by an experienced vascular surgeon as vessels are often densely fibroed and yet highly fragile.

If sacrectomy is to be performed, the surgeon must be familiar with the relationship between the thecal sac, sacral nerve roots, sciatic nerve, piriformis, obturator internus muscles, and ligaments, including the sacrotuberos and sacrospinous. For extended sacropelvic resections, an experienced orthopedic oncologic spine surgeon greatly enhances the ability to preserve important nerve roots and ensure adequate oncologic musculoskeletal margins.

Operative Management

RECURRENT MALIGNANCY: RECTAL CANCER

Despite modern management, locally recurrent rectal cancer remains a significant problem, with the incidence of recurrence as high as 33% in some series.1-3 Only approximately 20% of patients with recurrent disease, however, may be amenable to repeat curative resection.4 Although the incidence of metastatic disease in recurrent rectal cancer approaches 70%, up to 50% of patients die with local disease only.5-9 In addition, although most local recurrences occur within the first 2 to 3 years following initial curative resection, a small number do recur after longer periods of time.10,11 The 5-year survival following surgery for recurrent rectal carcinoma is reported to be as high as 58%. Morbidity, however, is reported to be between 20 and 80%, with most postoperative complications consisting of wound complications.3,12,13

Several controversies exist regarding surgery for locally recurrent rectal cancer. These controversies include the effectiveness and response to adjuvant chemoradiotherapy, intraoperative electron beam radiotherapy (IOERT), and operative parameters such as the timing of resection. These factors affect not only the prognosis of the patients but also patient selection and final outcomes. The selection of patients for recurrent pelvic operation includes a wide range of variables, including the patient’s fitness for surgery, the extent of recurrent disease, the presence of metastatic disease, and the intent of the resection (cure versus palliation). The extent and magnitude of the operation must be discussed with the patient. The possibility of a permanent colostomy and urostomy and the complications of reoperative pelvic surgery, such as hemorrhage, poor wound healing, and urinary and sexual dysfunction, should be reviewed in detail.

Operative Planning

Patients being considered for resection should undergo evaluation and staging by a multidisciplinary team. Physical examination of the rectum, inguinal nodal basins, and vagina in women helps determine the extent of recurrence and resectability. Evaluation of the remaining colon via endoscopy is imperative to rule out synchronous tumors and adequacy of bowel for reconstruction. Staging of the extent of locoregional disease is best accomplished with computed tomography (CT) or magnetic resonance imaging (MRI). Positron emission tomography (PET) is useful to
assist in distinguishing tumor recurrence from postradiation scar and to rule out distant metastatic disease. In the setting of recurrent pelvic tumor and previous treatment, MRI may better delineate the tumor in relation to the musculoskeletal anatomy.

Evaluation of all outside records, including operative notes, chemotherapy regimens, and total radiation doses, provides invaluable information for both perioperative and intraoperative management. In reoperative pelvic surgery, it is imperative that the technical details of any previous operations be thoroughly reviewed as this information helps formulate a strategy for resection and reconstruction while decreasing ambiguity at the time of reoperation.

Radiation history is important in the evaluation of patients with recurrent rectal cancer because treatment with chemoradiation is a significant part of the multidisciplinary management of recurrent disease. The type and extent of radiation are crucial in decision making as maximum allowable dosages need to be calculated. In a multicenter study, Valentini and colleagues reported an 8.5% complete pathologic response and a 29% downstaging following reirradiation. Das and colleagues similarly reported an improved 3-year survival of up to 66% in patients with recurrent rectal cancer treated with preoperative chemoradiation. If additional external-beam radiation is administered, plans for surgical intervention are expedited, thus allowing for the synergistic benefits of both external and intraoperative radiation.

Without any treatment, mean survival is approximately 8 months in patients with locally recurrent rectal cancer. Chemoradiation may alleviate symptoms, but 5-year survival remains poor at less than 5%. The prognostic factors associated with poor outcomes after resection for recurrent rectal cancer are listed here [see Table 1], but surgery remains the best chance for cure in patients with recurrent rectal cancer. Although absolute and relative contraindications for exenterative surgery are reported [see Table 2], management algorithms continue to evolve, with a paradigm shift from palliation to cure in patients with recurrent, locally advanced, and even metastatic disease.

Resection with negative microscopic margins (R0 resection) and appropriate regional lymphadenectomy is the goal of reoperative surgery for pelvic recurrence. R1 and R2 resection rates of up to 58%, however, have been reported after reoperative surgery for recurrent rectal carcinomas. In a Mayo Clinic series, the reported curative negative resection margin was 45% in 394 patients who underwent surgical exploration for recurrent rectal carcinoma. These patients had a statistically significant improved 5-year survival of 37% compared with 16% in patients in whom negative margins were not achieved. MD Anderson Cancer Center similarly achieved negative margins in 76% of 85 patients undergoing resection for recurrent rectal cancer. The 5-year disease-free survival was 46%, and multivariate analysis showed that an R1 resection was associated with a negative prediction of survival. Surgical margins therefore remain the most significant factor for long-term survival when operating for recurrent rectal carcinoma.

In the published literature, multiple classification schemas exist that categorize the extent and boundaries of pelvic exenterations. For the purposes of this topic review, we classify exenteration into (1) anterior, (2) posterior, or (3) combined anteroposterior resections using the rectum or neorectum (if a previous low anterior resection or coloanal anastomosis was performed) as a focal point of the malignant process. An anterior exenteration includes resection of the rectum or neorectum and any involved viscera in front of the rectum, such as the reproductive organs, the bladder, or both [see Figure 1]. A posterior exenteration includes resection of the rectum or neorectum and any tissue posterior and lateral, such as musculoskeletal tissue and neurovascular structures [see Figure 2]. Based on this definition, we therefore consider sacrectomy a potential component of a posterior exenteration. An anteroposterior exenteration involves a combination of anterior and posterolateral structures, including the bony sacropelvic components [see Figure 3].

### Operative Technique

**Anterior exenteration** We use ureteral stents for all reoperative cases and when extensive pelvic radiation has been given. The Lloyd-Davies position is used to allow access to the perineum. Care is taken to protect the extremities from nerve injury with adequate padding of both the tucked arms and lateral lower extremities in the stirrups. A midline exploratory laparotomy is used to confirm the absence of extrapelvic disease and determine local resectability. Any suspicious extrapelvic lesions are biopsied and sent for frozen-section analysis. Biopsy-proven extrapelvic disease may preclude pelvic resection for cure.

The left colon is mobilized and transected at the appropriate level for subsequent end colostomy. The entrance to the

### Table 1 Prognostic Factors Negatively Impacting Outcomes Following Surgery for Recurrent Rectal Cancer

<table>
<thead>
<tr>
<th>Factor</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inability to achieve R0 resection</td>
<td>25</td>
</tr>
<tr>
<td>Type of primary surgery (worse for APR vs LAR)</td>
<td>20,25</td>
</tr>
<tr>
<td>Rising CEA</td>
<td>6</td>
</tr>
<tr>
<td>Advanced stage of primary tumor, i.e., T4, nodal disease</td>
<td>42</td>
</tr>
<tr>
<td>Recurrence-free interval &lt; 12 months</td>
<td>42</td>
</tr>
<tr>
<td>High sacral involvement (above S2)</td>
<td>24</td>
</tr>
<tr>
<td>Multiple points of tumor fixation within pelvis</td>
<td>20</td>
</tr>
<tr>
<td>Major blood transfusion, neural invasion</td>
<td>25</td>
</tr>
<tr>
<td>Cortical and marrow sacral involvement</td>
<td>35</td>
</tr>
<tr>
<td>Presence of pain preoperatively — sciatica</td>
<td>42</td>
</tr>
</tbody>
</table>

APR = abdominoperineal resection; CEA = carcinoembryonic antigen; LAR = low anterior resection.

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### Table 2 Absolute and Relative Contraindications for Exenterative Surgery

<table>
<thead>
<tr>
<th>Contraindication</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute contraindications</td>
<td></td>
</tr>
<tr>
<td>Unresectable distant metastasis</td>
<td></td>
</tr>
<tr>
<td>Bilateral pelvis sidewall disease</td>
<td></td>
</tr>
<tr>
<td>Poor performance status</td>
<td></td>
</tr>
<tr>
<td>Relative contraindications</td>
<td></td>
</tr>
<tr>
<td>Extensive unilateral sidewall disease</td>
<td></td>
</tr>
<tr>
<td>Inability to achieve R0 resection</td>
<td></td>
</tr>
<tr>
<td>Sacral involvement above S3</td>
<td></td>
</tr>
<tr>
<td>Encasement of iliac vessels</td>
<td></td>
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</tbody>
</table>
pelvis must be completely cleared of extraneous tissue for optimal pelvic exposure. Any adherent tissue (often small bowel) to the pelvic tumor should be resected en bloc. Deep pelvic dissection to the presacral space then proceeds posteriorly along the distal aorta and continues caudally over the iliac vessels and ureters [see Figure 4]. Vesseloops are used to retract the ureters and vascular structures. In the reoperative pelvis, dense fibrosis and distorted anatomy require careful, meticulous dissection to avoid inadvertent injuries and major bleeding complications. The most at-risk region for significant bleeding occurs during mobilization of the left common iliac vein, and this dissection should proceed with caution. Posterior lumbar branches, if not identified, can also lead to significant blood loss if avulsed.

The anterior and lateral lines of resection (decided on during preoperative review of imaging) are delineated, and the involved structures and organs are mobilized widely for subsequent en bloc resection. The presacral space is further developed, and the dissection is carried distally along the anterior sacrum while staying anterior to the Waldeyer fascia. The dissection is then carried laterally along the pelvic sidewall on each side with careful protection of the lumbosacral plexus and internal iliac vessels.

In women, anterior involvement may require resection of the posterior wall of vagina, which can be approached transvaginally and transabdominally. In contrast, anterior fixation in men often requires cystoprostatectomy due to invasion of the trigone and prostate. Partial cystectomy may
be sufficient in rare cases. When the bladder is resected, the ureters are mobilized as close to the bladder as possible to provide adequate length for urinary conduit reconstruction. To mobilize the bladder, the space of Retzius is entered to fully mobilize the anterior portion of the bladder. The blood supply to the bladder is taken by serially ligating the arteries and veins along the pelvic sidewall, coursing back and forth from the internal iliac vessels. The wings of peritoneum to the bladder are then taken down until the bilateral vasa are identified and clipped. We then isolate and trace both ureters to the bladder before clipping and bringing them out of the pelvis. The distal margins are sent and confirmed to be negative by pathology. With the ureters both isolated and out of the pelvis, we then take down the pedicles to the bladder and prostate and continue the anterior dissection by opening the endopelvic fascia bilaterally. The dorsal venous complex is subsequently ligated. We then reach the urethra, and after delivering the catheter into the wound, we transect the urethra.

Construction of an end colostomy and urinary conduit completes the procedure. In women who require posterior vaginal wall removal, reconstruction may be necessary [see Reconstruction, below]. For anterior resection, soft tissue reconstruction to fill a void in the pelvis is used selectively.

Posterior exenteration (sacrectomy) First stage: anterior approach After placement of ureteral stents, a midline exploratory laparotomy is used to confirm the absence of extrapelvic disease and determine local resectability. The left colon is mobilized and transected at the appropriate level to be used later for colostomy, exposing the presacral space. Deep pelvic dissection then proceeds posteriorly along the lower aorta and continues distally over the iliac vessels and ureters. The anterior and lateral lines of resection are delineated, and the involved structures and organs are mobilized widely for subsequent en bloc resection. Frozen-section biopsies are taken as needed to establish that margins are negative at the level of the proximal sacral transection.

Vascular exposure often requires mobilization of the lower aorta and vena cava, in addition to the iliac arteries and veins. Circumferential mobilization of the common and external iliac arteries may be needed to facilitate exposure of the veins. The internal iliac artery branches are ligated and divided distal to the takeoff of the posterior division of the superior gluteal artery branch to preserve blood flow to the gluteal flaps [see Figure 5]. Multiple internal iliac vein branches are ligated after control of the main trunk(s) of the internal iliac vein. The branches are divided before ligation.
of the main trunk to avoid venous distention of the branches, which can lead to troublesome bleeding. Lateral and middle sacral vein branches, which drain into the posterior aspect of the left common iliac vein and caval confluence, are ligated and divided. Suture ligature is preferable for short, broad-based internal iliac vein branches. The vascular dissection is carried along both sides of the sacrum onto the pelvic floor.

During this anterior stage of the operation, a colostomy and ileal or colonic urinary conduit are constructed as needed. A rectus abdominis myocutaneous flap is then prepared for subsequent perineal reconstruction. Using intraoperative fluoroscopy, the sacral level of transection is determined and anterior osteotomies are performed. A screw is placed in the osteotomy site to facilitate alignment for fluoroscopy [see Figure 6]. Prior to closing and turning the patient prone, a thick Silastic mesh is placed anterior to the sacrum and posterior to the vessels and soft tissue structures, to protect against injury when blind osteotomies are performed during the second stage (prone) of the procedure [see Figure 7]. The abdomen is then closed, stomas are matured (fecal, urinary), and the patient is turned and placed in the prone position.

Second stage: posterior approach  The second stage of the procedure is carried out with the patient in the prone position. A posterior midline incision is made along the midportion of the sacrum, and the gluteus maximus muscles

Figure 5  (a) Vascular exposure and dissection. Internal iliac artery branches are ligated, preserving gluteal blood flow. (b) Ligation of the lateral sacral branches of the internal iliac vein, all the way down to the distal sacrum. (c) High ligation of the internal iliac vein. Reproduced with permission from the Mayo Clinic.

Figure 6  Unicortical transverse osteotomy, marked with a “screw” (arrow) to facilitate alignment with fluoroscopy during posterior dissection. Reproduced with permission from the Mayo Clinic.
are dissected away from the sacral attachments. The sacrospinous and sacrotuberous ligaments are divided to access the pelvic cavity posteriorly [see Figure 8]. The piriformis muscle is divided while protecting the sciatic and pudendal nerves. Laminectomy, dural sac ligation, and sacral resection are then carried out [see Figure 9]. Final osteotomies are performed based on imaging studies that ensure tumor-free margins. After resection, the specimen is examined by the pathologist and the surgical team to assess for gross margins. The posterior wound is then reconstructed with a pedicled myocutaneous rectus flap [see Figure 10]. Depending on the extent of resection and estimated operative time for each stage, the entire operation may be performed in 1 day or, increasingly in our experience, on separate operating days.

Combined anteroposterior exenteration When a combined anteroposterior component exenteration is performed, the steps outlined above apply. The sequence of this extensive procedure depends on multiple factors, but the anterior exenteration is typically completed first, followed by the posterior exenteration. When high sacral or extended sacropelvic resection is done, the operation is best executed in separate stages on distinct operating days. Our typical approach would be to start with the anterior dissection on day 1, complete the posterior approach with removal of tumor on day 3, and conclude with the spinopelvic reconstruction on day 5.

**Reconstruction** Reconstruction after exenteration typically involves the perineum and the gastrointestinal and/or genitourinary tracts. In women, vaginal reconstruction may be necessary when extended resections include the posterior vagina. Perineal wound complications after extended pelvic resections represent a considerable source of morbidity for patients. Nonhealing perineal wounds after extended pelvic resections are reported to occur in 7 to 66% of patients, and the addition of radiotherapy has been associated with major wound complications in 41% of patients after perineal resection for rectal cancer. Exenterative surgery that includes sacropelvic resections represent some of the most challenging wounds to fill and cover.

**Omental flap** The main advantage of the omental pedicled flap after exenteration is its ability to fill the pelvic dead space. Filling this space with vascularized tissue may decrease the risk of pelvic sepsis and prevent small bowel from adhering to the raw surfaces, which may cause small bowel obstructions. The omentum is mobilized and a right or left omental pedicle is constructed based on the greatest length and bulk. Spreading and lengthening techniques can be performed by detaching the gastroepiploic arcade from the stomach on the origin side of the right or left gastroepiploic pedicle. The gastroepiploic artery and vein on the opposite side are divided and ligated. The right gastroepiploic vessels are preferred because they are larger and have more epiploic branches than the left. A window can be fashioned through the transverse mesocolon to allow a more direct route to the pelvis.

**Vertical rectus abdominis myocutaneous (VRAM) flap** The VRAM flap provides a well-vascularized, bulky tissue paddle that can be transposed to the pelvis to fill dead space and reconstruct the perineum. This flap has become our primary choice for soft tissue reconstruction following exenteration. Chessin and colleagues studied 59 patients who underwent a VRAM or primary closure following abdominoperineal resection for anorectal cancer treated with preoperative radiation. The patients who were reconstructed with a VRAM flap had significantly lower rates of perineal wound complications (15.8% versus 44.1%). Moreover, patients had no abdominal wall hernias or infections associated with the flap harvest site. Radice and colleagues compared primary closure with pedicled omentum and VRAM flap and found that the VRAM flap significantly reduced wound infections and length of stay compared with the other types of closure.

The VRAM flap is mobilized by raising a supraumbilical skin paddle with underlying fat and rectus muscle. The anterior rectus sheath is taken with the flap, and the posterior rectus sheath is left for abdominal wall closure. The
perforating vessels through the anterior rectus sheath are carefully dissected to minimize the fascial resection. The blood supply to the VRAM is the deep inferior epigastric artery and vein, which are mobilized as a pedicle. Transabdominal passage of the VRAM flap, sized to reconstruct the perineal wound, is done by rotating the pedicle into the pelvis with the skin of the pedicle facing the perineum. It is important to avoid significant twisting and tension when securing the flap to the perineum [see Figure 11].

**Gluteus maximus myocutaneous flap** The gluteus maximus myocutaneous flap is based on the inferior gluteal artery pedicle. The gluteus maximus flap can be constructed as a

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**Figure 9** Posterior sacral osteotomy (a), laminectomy (b), and dural sac ligation (c). Dashed lines outline margins of bony resection. Reproduced with permission from the Mayo Clinic.

**Figure 10** Transperineal delivery of pedicled myocutaneous rectus flap for perineal reconstruction. Inset shows flap reconstruction site after healing takes place. Reproduced with permission from the Mayo Clinic.

**Figure 11** Harvest of a vertical rectus abdominis myocutaneous flap (VRAM) on a long pedicle to reach the pelvis for reconstruction. Reproduced with permission from the Mayo Clinic.
local advancement or a V-Y advancement myocutaneous flap. The technique involves elevation and advancement of the superior half of the muscle and overlying skin. Two myocutaneous gluteus maximus flaps are prepared, leaving the lower 50% of the underlying muscle intact. Both flaps are dissected free and raised. After deepithelialization of its media part, one of the two flaps is then advanced into the pelvic defect. After partial sacrectomy, even large cavities can be filled completely. The second flap is advanced toward the midline and sutured in layers to the first flap, resulting in a solid midline reconstruction. Both donor defects are closed using a V-Y technique. For very large perineal defects following sacrectomy, the combination of an inferiorly based VRAM and bilateral fasciocutaneous V-Y advancement flaps may be necessary for adequate closure.

Gracilis flap When a VRAM flap is not available, the gracilis muscle may be used to partially fill a pelvic defect. The gracilis flap has an inconsistent blood supply and limited arc of rotation; additionally, the lack of bulk may be insufficient for obliteration of a large pelvic dead space. The gracilis flap is harvested by making a longitudinal incision over the muscle of the medial thigh. Its blood supply is centered on the proximal pedicle of the profunda femoris artery, and the distal pedicle originating from the saphenous artery is ligated. The muscle and skin paddle, if constructed, are mobilized and rotated into the perineal wound [see Figure 12].

Total thigh fillet flap Thigh fillet flaps can be constructed following hemipelvectomy using soft tissue from the amputated limb [see Figure 13]. The posterior hemipelvectomy flap is designed as a myocutaneous flap based on the superior and inferior gluteal vessels. By preserving the gluteal vessels, large posterior flaps incorporating the gluteal muscle can be rotated for coverage of the pelvic defect after the bony pelvis has been removed. If oncologically appropriate, preservation of the internal iliac vessels will increase posterior flap blood supply and decrease flap necrosis. Limited resection of the bony pelvis allows for preservation of the sacral perforators.

Long anterior hemipelvectomy flaps are myocutaneous flaps of the anterior compartment musculature. These flaps are elevated based on the vascular muscle distribution supplied by the superficial femoral artery. This axial-pattern myocutaneous flap is based on branches of the femoral vessels, including lateral and medial circumflex arteries, which arise from branches of the profunda femoris artery. The long myocutaneous flap includes the bulk of the quadriceps femoris and can provide significant coverage of pelvic defects.

The total fillet hemipelvectomy flap uses the majority of the thigh musculature. The blood supply to this large flap is based on preservation of the superficial and profunda femoris vessels, allowing for a substantial amount of muscle preservation. The circumflex vessels of the profunda femoris artery perforate the adductor magnus muscle to the posterior and lateral compartments of the thigh and play a role in supporting a total thigh fillet flap. The total thigh fillet flap provides the largest amount of vascularized tissue when massive defects require soft tissue reconstruction [see Figure 14].

Urinary reconstruction When bladder resection is required, the construction of a functional urinary outlet must be established. Options include continent procedures (Kock pouch, Indiana pouch) or incontinent urostomies. Because exenteration for malignancies often precludes continent procedures, options for urinary reconstruction include ureterocolostomy or, more commonly, an ileal or colon conduit. If the superior rectal artery is ligated but the inferior mesenteric artery and its sigmoidal branches are preserved to ensure blood supply, then the sigmoid colon becomes an excellent urinary conduit as it can be placed in either upper abdominal quadrant as necessary. This approach additionally avoids a small bowel anastomosis as required with construction of an ileal conduit. If the inferior mesenteric artery (IMA) has been taken, however, we do construct an ileal conduit.

Vaginal reconstruction In women who undergo extended anterior exenteration, a portion of the posterior wall of the vagina may need to be removed to achieve negative margins. A variety of techniques have been described for neovaginal reconstruction after anterior pelvic exenteration. We prefer the rectus abdominis myocutaneous (RAM) flap for neovaginal reconstruction because of its consistent blood
supply and its ability to obliterate pelvic dead space [see Figure 15]. Soper and colleagues reviewed 32 patients who had neovaginal reconstruction with a RAM flap after exenterative surgery (85% received radiation) and found a flap complication rate of 32%, with only one patient developing vaginal stenosis. Neovaginal reconstruction with a RAM flap has decreased perineal complications and maintains preservation of the psychosexual self-image of the patient.

Sacropelvic reconstruction When tumors extend posteriorly into the sacrum or deep into the lateral sidewall and through the sciatic notch, sacropelvic resection, including hemipelvectomy, will be required to achieve negative margins. The type of hemipelvectomy performed depends on the extent of the tumor. The four types of sacropelvic resections include total sacrectomy (type 1), hemisacrectomy (type 2), hemisacrectomy + external hemipelvectomy (type 3), and total sacrectomy + hemipelvectomy (type 4), with types 1 and 3 being most commonly performed [see Figure 16].

Troubleshooting
Pelvic exenterations are technically difficult, and surgeons must be equipped to deal with inevitable problems. In reoperative pelvic surgery, significant danger exists with massive hemorrhage from presacral veins and the major iliac vessels. In the event of massive presacral vein bleeding, strategies used to stop the hemorrhage include packing, muscle patch, argon beam coagulation, thumbtacks, and bone wax. We have observed that packing, occasionally with the use of hemostatic agents such as Surgicel, controls presacral bleeding in the majority of cases. If bleeding continues, our next technique is to harvest a piece of rectus abdominis muscle and then to cauterize the muscle over the bleeding site; the resultant coagulum is remarkably hemostatic. Thumbtacks are reserved for situations when the origin of hemorrhage can be clearly visualized and stopped with point pressure; if inaccurately placed, tacks can make the bleeding much worse.

Iliac artery and vein bleeding can be deadly and must be dealt with in an expeditious but controlled manner. Direct pressure can temporize bleeding while exposure is obtained. Proximal and distal control should be achieved. Vascular sutures and equipment must be readily available from the very beginning of the case to use for suture repair and/or ligation. For extended sacral resections, consideration should be given to controlling and ligation the internal iliac artery early in the procedure. In the previously irradiated pelvis, we think it is also important to collaborate with experienced vascular surgeons given the technical difficulty working with fibrosed vessels.

During dissection in the reoperative pelvis, it is essential to immediately identify normal anatomic structures. The genitourinary, vascular, and osseous structures such as the ureters, distal aorta, and sacral promontory, respectively, can provide landmarks to help guide the descent into the narrow confines of the pelvis. The typical anterior and posterior planes are often obliterated due to scar or fibrosis, and orientation to critical structures is paramount as sharp dissection with a knife, heavy scissors, or osteal elevators may be the only means to make any forward progress. Guidance from the perineum, such as application of vaginal retractors, distention of the bladder, or a rigid proctoscope through the neorectum, can also assist with understanding the spatial relationships in the deep pelvis.

Complications
The mortality in selected series after exenterative pelvic surgery ranges from 0 to 9% overall. Causes of death include uncontrolled hemorrhage at the time of surgery, renal failure, pelvic sepsis, and cardiovascular compromise. Between 24 and 68% of patients developed complications, most of which were related to failure of perineal wound healing. The incidence of complications increases with the extent of resection. Patients undergoing sacrectomy, hemipelvectomy, or IOERT have even higher rates of complications, most of which are related to the posterior wound. The most significant reported side effects of IOERT include dose-dependent peripheral neuropathy (16 to 34%) and ureteral stenosis (6%).

Well-described postoperative complications include pelvic abscesses, small bowel obstructions, fistula formation, perineal wound problems, and ureteral obstruction. In a series by Henry and colleagues, 53% developed complications after resection for pelvic recurrences. Nearly a third of the complications in this series were related to infection.
Among these patients, there were 9.2% pelvic abscesses, 5.7% abdominal wound infections, and 3.4% perineal wound infections. The majority of superficial wound infections can be successfully managed with local drainage and wound care. Percutaneous drainage of pelvic abscesses is commonly performed with catheters placed either anteriorly or posteriorly. Abscesses low in the pelvis, which are not amenable to CT-guided percutaneous drainage, may be addressed through the perineum or transanally in the operating room. Chessin and colleagues noted a decrease in the perineal wound complication rate, from 44 to 16%, with the use of a RAM flap to close the perineum. The increased use of vascularized tissue flaps will continue to decrease infection-related complications.

Urologic complications are also common with ureteral obstruction and leak occurring with construction of urinary conduits. Permanent bladder dysfunction requiring intermittent catheterization or cystectomy may also occur after posterior exenterations. Renal insufficiency resulting from ureteral stenosis secondary to ureterolysis and pelvic irradiation has been described. A CT urogram with delayed contrast imaging of the urinary system can diagnose most urinary complications. Double-J stent placement, if possible, is the best way to address hydronephrosis caused by ureteral obstruction versus nephroureteral stenting if an endoscopic stent is unable to be placed. Finally, percutaneous nephrostomy tubes can be used if a complete urinary diversion is needed to heal a leak.

Outcome Evaluation

Oncologic outcomes after exenteration are difficult to compare because of the lack of consistent classification of these procedures. Moreover, published series often include a heterogeneous patient population. When recurrent disease is confined to the axial and anterior locations (male and female genitourinary organs, including the bladder), an R0 resection is frequently possible and therefore leads to better survival. Moore and colleagues found that 72% of patients with a recurrent axial or anterior recurrence were able to achieve an R0 resection. This finding is in contrast to lateral and posterior recurrences, which have lower rates of R0 resection: 50 and 36%, respectively. Stocchi and colleagues noted a 3-year survival of 45% with en bloc resection involving the urinary tract. Anterior recurrences are less likely to
become fixed to the bony pelvis and are more amenable to complete excision and, therefore, improved survival.

The ability to achieve an R0 resection with lateral and posterior recurrences is more difficult because of the potential for increased points of fixation. Recent series have been able to obtain R0 resections in 51 to 100% of patients, which included lateral and posterior recurrences. The 5-year survival rate for this heterogeneous patient population has ranged from 20 to 39%. An R0 resection was the most important variable in predicting 5-year survival [see Table 3]. Similar results have been reported by our group for recurrent rectal cancers involving the aortoiliac axis. Major vascular reconstructions involving the aorta and iliac arteries and veins were performed to achieve an R0 resection in over 50% of these patients, with reported 4-year survival and disease-free survival rates of 55% and 45%, respectively.

Oncologic outcomes for lower sacral resection have resulted in 5-year survival rates as high as 37% in some patients. These results from lower sacral involvement have prompted questions on whether similar outcomes could be expected in patients with high sacral involvement. Our initial experience with high sacrectomy, defined as above the third sacral body, showed promising results with an R0 resection in all nine patients: 30-day mortality of zero and median survival of 31 months. Wanebo and colleagues reported two series of patients with recurrent rectal cancer who underwent high sacral resection, achieving 5-year survival rates of 31 and 33%, respectively. Our group recently reported survival outcomes in 30 patients with locally recurrent rectal cancer undergoing extended sacral resection and demonstrated a 46% 5-year survival and 43% 5-year disease-free survival with R0 resection, achieved in 93% of patients. Moreover, there were no operative deaths and an acceptable morbidity. Surgery provided excellent local tumor control, with only one patient having re-recurrence in the pelvis.

Improved survival in patients with recurrent rectal cancer is possible when IOERT is added to resection compared with patients who do not receive IOERT. When IOERT is used as part of a multimodality approach, a 15% increase in survival has been demonstrated. Although there are no randomized trials comparing surgery alone and surgery with IOERT, there seems to be a benefit not only for patients with negative margins but also in those with microscopic and grossly positive margins. Haddock and colleagues recently published the Mayo Clinic’s experience with multimodal therapy for locally advanced recurrent colorectal cancer that included the use of IOERT. In our practice, the dose of IOERT given at the time of surgery is dependent on the resection margin [see Table 4]. Survival estimates at 5 years were 46%, 27%, and 16% for R0, R1, and R2 resection, respectively. For carefully selected patients, exenterative resection of pelvic recurrence can provide a 5-year survival of up to 39%, which is similar to that seen after resection of solitary metastasis to the lung, liver, and brain.

For re-recurrent rectal cancer, our experience suggests that an R0 re-resection provides outcomes similar to those of surgery for first-time recurrent rectal cancer. From 47 patients with re-recurrent rectal cancer, we achieved R0, R1, and R2 resection margins in 60%, 32%, and 8% of patients, respectively. Approximately 81% of patients required non-bowel organ resection, including seven sacral resections. Thirty-day mortality was nil, and 5-year overall survival and disease-free survival were 33% and 27%, respectively.

### Table 3  Survival Following Exenteration for Recurrent Rectal Cancer

<table>
<thead>
<tr>
<th>Study, Year</th>
<th>Number of Patients</th>
<th>Type of Exenteration</th>
<th>R0 (%)</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saito et al, 2003</td>
<td>85</td>
<td>Posterior, combined</td>
<td>51</td>
<td>5 yr (39%)</td>
</tr>
<tr>
<td>Moriyam et al, 2004</td>
<td>57</td>
<td>Posterior, combined</td>
<td>84</td>
<td>3 yr (54%); 5 yr (36%)</td>
</tr>
<tr>
<td>Melton et al, 2006</td>
<td>29</td>
<td>Anterior, posterior, combined</td>
<td>62</td>
<td>2 yr (63%); 5 yr (20%)</td>
</tr>
<tr>
<td>Schurr et al, 2008</td>
<td>72; 45 resected</td>
<td>Anterior, posterior, combined</td>
<td>82</td>
<td>Overall median: 54.9 mo</td>
</tr>
<tr>
<td>Colibaseanu et al, 2014</td>
<td>30</td>
<td>High posterior</td>
<td>93</td>
<td>5 yr (46%)</td>
</tr>
</tbody>
</table>
Reoperative pelvic surgery for patients with recurrent or even re-recurrent rectal cancers can therefore provide significant benefit to patients, and situations thought to be nonoperative should be carefully reviewed for the possibility of an R0 resection.

Complications following IPAA

Reoperative pelvic surgery in patients with inflammatory bowel disease typically occurs in patients who have complications following IPAA for ulcerative colitis (UC). Indications for surgery [see Table 5] can be divided into mechanical or infection-related problems. Mechanical complications include anastomotic strictures refractory to anal dilation, long efferent limbs, pouch septa, or a twisted pouch. Infection-related complications from anastomotic dehiscence and pelvic sepsis may occur in approximately 25% of patients following IPAA, leading to fibrosis, chronic fistula, and abscesses. The goals of reoperative surgery in the setting of a failing pouch will vary depending on several factors including underlying pathology (i.e., Crohn disease versus UC) and whether the complication is a mechanical versus an infection-related cause. Patients with a history of pelvic sepsis or those with a delayed diagnosis of Crohn disease often experience minimal success from reoperative pouch surgery.

Although perineal approaches such as ileal pouch advancements are well described, an abdominal approach is typically required to safely free the pouch from the sacrum and pelvic floor, especially in the setting of previous pelvic sepsis. When reoperating in the setting of previous pelvic sepsis, excision of all infected tissue and control of all existing sinuses and fistulas is imperative to prevent recurrence.

Operative Technique

The patient is typically placed in the Lloyd-Davies position with all extremities safely padded to avoid nerve injuries. Bilateral ureteral stents may be placed to ease the identification of the ureters during surgery. A lower midline incision is made, and the abdomen is explored. The incision should be limited if possible to the level of the umbilicus as it allows the small bowel to be packed cephalad under the intact upper abdominal wall. The small bowel is often found to be adhesed to pelvic structures and to the retroperitoneum, which requires tedious and careful lysis. The ureters and gonadal vessels should be identified and looped with Silastic vessel loops. The course of the ureters is typically normal until the level of the pelvic brim and then becomes more medial as it enters a previously operated pelvis; therefore, identification of the ureters in the lower abdomen above the pelvic brim is a good strategy to begin identifying normal anatomy.

The ileal pouch is found deep within the pelvis, often densely adherent to the anterior, lateral, and posterior walls of the pelvis. Additional proximal small bowel often fills the pelvis, and a significant amount of time is inevitably spent lysing adhesions and obtaining orientation to achieve proper exposure. Embryonic fusion planes are nonexistent; therefore, dissection of the pouch is bloody and fraught with risk to injuring nearby structures such as the iliac and gonadal vessels, ureters, pelvic nerves, and presacral veins. It is often helpful to identify anatomic landmarks, including

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Intraoperative Radiotherapy Doses Related to Resection Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td>IOERT Dose (Gy)</td>
</tr>
<tr>
<td>R0 (&lt; 5 mm)</td>
<td>750–1,250</td>
</tr>
<tr>
<td>R1</td>
<td>1,000–1,500</td>
</tr>
<tr>
<td>Localized R2</td>
<td>1,500–2,000</td>
</tr>
</tbody>
</table>

IOERT = intraoperative electron beam radiotherapy.

and guides drainage if indicated. Pelvic MRI can be particularly useful to elucidate fistula tracts and the extent of sepsis. A pouchogram can assess the architecture of the pouch and demonstrate an anastomotic leak. Pouchoscopy provides information about the health of the lining of the pouch and can determine whether Crohn disease is present. An examination under anesthesia may be necessary to complete the assessment of the pouch, ensure control of sepsis, and determine the strategy for pouch salvage. Confirming a diagnosis of Crohn disease is important because biologic therapy, such as infliximab, may convert a patient with Crohn disease to a surgical candidate or suppress the disease enough to allow a pouch revision to be more successful.

Although some minor reconstructive options may be performed transanally, most major pouch reconstruction options require an abdominal approach with pelvic exploration. Reports of reoperative pouch reconstruction success vary from 48 to 93%, with success in large part depending on the patient’s underlying disease (Crohn disease versus UC) and whether the complication is a mechanical versus an infection-related cause. Patients with a history of pelvic sepsis or those with a delayed diagnosis of Crohn disease often experience minimal success from reoperative pouch surgery.

Operative Planning

When patient symptoms suggest complications in the pouch following surgery for UC, a thorough evaluation should be undertaken to clarify the source of the problem. Imaging such as CT and MRI evaluates for pelvic infection and guides drainage if indicated. Pelvic MRI can be particularly useful to elucidate fistula tracts and the extent of sepsis. A pouchogram can assess the architecture of the pouch and demonstrate an anastomotic leak. Pouchoscopy provides information about the health of the lining of the pouch and can determine whether Crohn disease is present. An examination under anesthesia may be necessary to complete the assessment of the pouch, ensure control of sepsis, and determine the strategy for pouch salvage. Confirming a diagnosis of Crohn disease is important because biologic therapy, such as infliximab, may convert a patient with Crohn disease to a surgical candidate or suppress the disease enough to allow a pouch revision to be more successful.

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<table>
<thead>
<tr>
<th>Table 5</th>
<th>Indication for Reoperative Pouch Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>Stricture: neoterminal ileum, pouch, anastomotic</td>
</tr>
<tr>
<td></td>
<td>Long efferent limb with S pouch</td>
</tr>
<tr>
<td></td>
<td>Pouch septum</td>
</tr>
<tr>
<td></td>
<td>Twisted pouch</td>
</tr>
<tr>
<td></td>
<td>Redundant blind limb</td>
</tr>
<tr>
<td>Infection related</td>
<td>Fistula/chronic sinus tract: pouch-vaginal, pouch-sacral, pouch-perirectal, pouch–abdominal wall, pouch–small bowel</td>
</tr>
<tr>
<td></td>
<td>Pelvic abscess</td>
</tr>
<tr>
<td></td>
<td>Anastomotic dehiscence</td>
</tr>
<tr>
<td></td>
<td>Retained rectal mucosa</td>
</tr>
</tbody>
</table>
the normal proximal ureters, distal aorta, and common iliac vessels, before proceeding deeper into the pelvis. Iliac veins such as the left common iliac are at particular risk for injury due to their fragile thin wall, relative immobility, and trajectory across the midline. The dissection plane should remain anterior to the Waldeyer fascia to avoid the presacral veins.

The pouch mesentery is tethered by its main vascular supply, usually from the superior mesenteric artery (SMA), and follows the curvature of the sacrum from the promontory. The surgeon should be able to raise this mesentery off the posterior wall to completely encircle the pouch mesentery. A clear path to the pouch can then be appreciated. Lateral and anterior dissection of the pouch continues to the pelvic floor, with care to preserve the ureters as they approach the bladder neck and genitourinary structures such as the prostate or vagina. Once the pouch is sufficiently exposed, either partial reconstruction is performed, or, in cases of complete reconstruction or pouch excision, the pouch is transected sharply with a knife or scissors at the pelvic floor and delivered out of the abdominal field.

For complete pouch reconstruction, the old pouch is excised and a new J pouch, approximately 12 to 15 cm in length, is constructed using sequential firings of a stapling device. Presuming that tension-free reach is feasible, a hand-sewn IPAA is then constructed using Lone Star retractors for perineal exposure. Circumferential, interrupted, full-thickness bites of absorbable sutures secure the apex of the new ileal pouch to the distal anal canal with a posterior orientation of the pouch mesentery.

For pouch excisions, we perform a mucosectomy of the remaining anal canal from the dentate line to remove any residual mucosa and close the proximal end of the anal canal using several layers of interrupted absorbable sutures placed transanally. The pouch is transected at a healthy-appearing point on the prepouch ileum, and a tension-free end ileostomy is constructed at a premarked stoma site.

Troubleshooting

The loss of normal anatomic planes in cases of pelvic sepsis, with chronic fistulas and abscesses, makes reoperative pouch surgery technically challenging, and dissection may appear to be blind at certain points. The best strategy that the surgeon can employ in these circumstances is to constantly assess where the critical structures such as the ureters, bladder, and gynecologic and neurovascular structures are or may be. It can be helpful to perform an endoscopy through the pouch to better delineate the size and orientation of the pouch and its efferent/afferent limbs, which may aid with pelvic dissection.

When performing complete pouch reconstruction, the neoterminal ileum must have sufficient reach to the pelvis for a tension-free anastomosis. The same technical principles used during index pouch construction to obtain reach should be employed: complete mobilization of the small bowel mesentery off the retroperitoneum to the root of the SMA at the duodenum, sequential scoring of the peritoneum along the axis of the new pouch mesentery, and ligation of mesenteric vessels only if collateral circulation is readily identifiable to the new pouch. The apex of the pouch should once again easily reach the inferior aspect of the pubis symphysis to estimate adequate length. The options available to provide sufficient reach for a new pouch are somewhat limited due to the restricted vascular supply, and if there is sufficient doubt regarding a tension-free reach, then an end ileostomy should be constructed.

Complications

Postoperative complications after reoperative pouch surgery include loss of the ileal pouch if not initially intended, pouch dysfunction, infection, hemorrhage, and/or injury to surrounding structures, such as the ureters and pelvic nerves. The preponderance of complications tends to fall in the same category as the indication for the reoperation. In an early Mayo Clinic study, postoperative infectious complications such as recurrent fistulas or abscesses were observed in up to 59% of patients after reoperative surgery for infection-related pouch problems such as chronic fistulas. For mechanical problems such as anastomotic strictures, stenosis recurred in 52% of patients after the initial reoperation. The need for more than one operation was observed in up to 73% of patients. Approximately 69% of patients who underwent more than one reoperative procedure ultimately lost their pouch compared with a 14% chance of pouch loss in those patients who only underwent one reoperative surgery. Careful initial pouch construction and a single, definitive reoperative surgery for pouch-related complications if they occur are therefore critical to long-term pouch success.

Outcome Evaluation

Many technical approaches to pouch reoperation, with varying success, have been described. Shawki and colleagues reported on 76 patients who underwent reoperation for pouch complications. The most common indication for reoperation was sepsis and sepsis-related complications. Of 23 patients who required reoperative pouch surgery, seven patients underwent complete pouch reconstruction and 16 patients underwent pouch revision. The pouch salvage rate in these patients was 69%. The most common reason for pouch failure was a diagnosis of Crohn disease and pelvic sepsis. MacLean and colleagues described 63 combined abdominoperineal pouch reconstructions in 57 patients, of whom 30% underwent pouch reconstruction and 70% underwent revision. The primary indication for reoperation was pouch-vaginal fistula and pelvic sepsis. Pouch revision success was achieved in 67% of patients.

Mathis and colleagues reported 51 patients with an initial diagnosis of UC, of whom 22 patients were subsequently proved to have Crohn disease. Sixty-five percent underwent pouch reoperation for infectious complications and 35% underwent reoperation for mechanical complications. Complete reconstruction was performed in 43% and partial reconstruction in 57%. Pouch survival following reconstruction was 93% at 1 year and 89% at 5 years. Most failed pouches (75%) occurred in patients with a later diagnosis of Crohn disease. Pouch survival in patients with a mechanical indication was 91% compared with pouch survival of 79% in those with an infectious indication. Although this is often a technically demanding surgery, these results indicate that a significant proportion of pouches may be salvaged with an experienced team.
LOW ANASTOMOTIC COMPLICATIONS

Similar to reoperative pouch surgery, the primary indications for reoperative surgery for low anastomotic complications are for mechanical or infection-related complications. Mechanical problems are usually related to anastomotic strictures secondary to ischemia or surgical technique. Infection-related complications are inevitably related to anastomotic dehiscence. The overall incidence of anastomotic leaks following low anterior resection is reported from 1 to 19%, with significant challenges in management when they occur.65–66 Apart from substantial patient morbidity and the risk of mortality, resultant function is significantly worse and the cost of treatment of the anastomotic leak has been shown to be substantial.67–69 Of even more concern has been the finding that local recurrence is increased and survival is decreased following anastomotic leak in the setting of surgery for colorectal cancer.70–73 Anastomotic leaks may also lead to chronic fibrosis and scarring and thus ultimately lead to chronic complications, including decreased neorectal capacitance, incontinence, or stricture.64,74

Operative Planning

The location, size, and containment of an anastomotic leak typically dictate how a patient clinically presents. Patients with free anastomotic leaks within the peritoneal cavity present with classic signs of hemodynamic compromise and peritonitis; however, patients with very low, well-contained leaks within the pelvis may present subclinically and pose a diagnostic challenge. In general, patients with clinical deterioration, sepsis, or diffuse peritonitis require immediate surgical intervention. Patients who are not systemically ill with subclinical leaks may not require immediate reoperation and can often be managed with CT- or ultrasonography-guided percutaneous drain placement for cavities greater than 3 cm versus aspiration for small cavities less than 3 cm.

Management algorithms have been developed to address anastomotic leaks.75 For leaks with extensive peritoneal contamination, significant breakdown of the anastomosis, or evidence of ischemia, the operative plan requires takedown of the anastomosis with complete diversion in the form of an ileostomy or colostomy. If the anastomotic ring is mostly intact and there are no signs of bowel ischemia, then the strategy includes preserving the anastomosis, draining the region, and placing a proximal diverting loop ileostomy, which may salvage the anastomosis. Local repairs are typically not successful; however, an omental flap in addition to proximal diversion may assist in healing of the pelvic anastomosis. Other novel techniques with limited supporting data include covered stents, vacuum-assisted closure devices, or over-the-scope clips.64–77

The critical goal in reoperative pelvic surgery for infection-related complications is to control sepsis. Salvage or reconstruction of the anastomosis will be most successful 6 to 12 months later. In very low anastomotic leaks with a connecting abscess, transanal drainage may be performed in the operating room under direct vision. In this instance, the anastomosis is opened and the abscess is drained, followed by placement of a catheter in the defect for irrigation. In the management of pelvic abscesses using drains, serial sinograms must reveal no fistula and resolution of the abscess cavity before confidence in the integrity of the anastomosis. If a persistent fistula to bowel remains after months, an eventual operation may be required for anastomotic revision or diversion. A diverting proximal stoma is often required in conjunction with local measures to control sepsis.

When reoperative surgery is performed for a failed anastomosis, it is important to consider the tissue quality of the pelvic floor, sphincter function, and remaining rectum or anus. In motivated patients with intact sphincter function, reoperation with attempted coloanal anastomoses may lead to a successful outcome. In the setting of chronic pelvic sepsis, the remaining rectal stump is often fibrotic and a high risk for a new anastomosis, but the anal canal is typically soft and pliable, providing a point for a coloanal anastomosis. Preoperative manometry is useful to assess sphincter function. Patients must also be aware that bowel length may limit the surgeon’s ability to create a low anastomosis and that a permanent ostomy may be required. In addition, a diverting loop ileostomy is required for at least 3 months if a low pelvic anastomosis can be created.

Operative Technique

The technical strategy of reoperative surgery for low anastomotic complications is similar to the approach used for recurrent pelvic malignancies and reoperative pouch surgery. In brief, the patient is placed in the Lloyd-Davies position to provide access to the perineum, and all extremities are safely padded. Bilateral ureteral stents may be placed to ease the identification of the ureters during surgery. A lower midline incision is made, and the abdomen is explored. The small bowel is packed into the upper abdomen, and the pelvis is exposed. Critical structures, including the ureters, gonadal vessels, and iliac vessels, should be immediately identified and tagged if necessary. The distal bowel should then be mobilized to the level of the anastomosis. It is helpful to know what type of anastomosis was made (hand sewn, stapled, end to end, or end to side) to guide the dissection. The use of a finger or instruments such as a rigid proctoscope or vaginal retractor may also assist with identifying important pelvic structures.

Definitive surgical options depend on the indication for the reoperative surgery. For mechanical problems such as a benign stricture, resection with (1) no reanastomosis versus (2) reanastomosis and possible proximal diversion requires exposure beyond the original anastomosis to allow room for distal transection. This distal margin may be at the level of the pelvic floor. In cases of very low anastomoses, it may be necessary to perform the distal transection from a transanal approach with an intersphincteric dissection to meet the abdominal dissection plane.

For infection-related problems such as an anastomotic leak, the surgical option depends on the extent of contamination, time to reoperation, degree of dehiscence, patient stability, and overall clinical assessment. These options include (1) attempted primary repair/buttressing with wide drainage and possible proximal diversion, (2) resection with reanastomosis and possible proximal diversion, or (3) resection with no reanastomosis. Although fecal diversion may not prevent another postoperative complication, it is important to consider as it may decrease the magnitude of morbidity should another anastomotic dehiscence or deep surgical space infection recur.
Troubleshooting

Reconstruction of gastrointestinal continuity can pose a major challenge after resection of a previous low anastomosis. When bowel length may not seem adequate for a tension-free anastomosis, several maneuvers can be employed before resorting to an end ileostomy or colostomy [see Table 6]. These include (1) primary maneuvers: mobilization of the embryonic fusion planes and detachment of periorgan ligaments such as the splenic and hepatic flexures; (2) secondary maneuvers: directed ligation of vascular pedicles such as the inferior mesenteric artery (IMA) and vein (IMV) that restrict mobility [see Figure 17]; and (3) tertiary maneuvers, such as retroileal colorectal anastomoses or bowel rotations from the proximal transverse or right colon [see Figure 18]. These techniques may have already been performed during the index anastomotic construction, but if not, these principles should be applied to help reestablish gastrointestinal continuity.

Complications

The spectrum of postoperative complications after reoperative pelvic surgery for anastomotic complications is determined by the indication for reoperation and the reoperative procedure. For infection-related indications such as anastomotic leaks, early studies observed high morbidity and mortality (72%) with diverting loop colostomy and drainage versus complete anastomotic resection and end colostomy, which had no reported morbidity and mortality

### Table 6 Mobilization Techniques for Difficult Reconstructions

<table>
<thead>
<tr>
<th>Maneuver</th>
<th>Goals</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Separation of embryonic fusion planes</td>
<td>Cattell and Mattox maneuvers</td>
</tr>
<tr>
<td></td>
<td>Division of peri-organ “ligaments”</td>
<td>Splenic flexure mobilization</td>
</tr>
<tr>
<td>Secondary</td>
<td>Ligation of vascular pedicles</td>
<td>Ligation of the inferior mesenteric vein and artery</td>
</tr>
<tr>
<td></td>
<td>Preservation of collateral blood supply</td>
<td>Preserving the middle colic artery to supply ileal pouch</td>
</tr>
<tr>
<td>Tertiary</td>
<td>Extended resection to mobile proximal bowel</td>
<td>Deloyers procedure and retroileal reconstruction</td>
</tr>
<tr>
<td></td>
<td>Stoma construction</td>
<td>End ileostomy or colostomy</td>
</tr>
</tbody>
</table>

*Figure 17* Increasing colon length with primary and secondary maneuvers. (a) Primary maneuvers such as splenic flexure mobilization provide additional reach for the proximal colon, but maximal reach is restricted by the inferior mesenteric artery (IMA). (b) After high ligation of the IMA, the colon is further restricted by the inferior mesenteric vein (IMV). Transection of the IMV must be performed proximal to the confluence of the left colic vein (LCV). (c) Ligation of the IMV proximal to the LCV provides maximum colon reach to the pelvis for tension-free colorectal or coloanal anastomoses. Reproduced with permission from the Mayo Clinic.
These early findings applied the management principles used in perforated diverticulitis, which is most often treated with an end colostomy (the Hartmann procedure).

More recent studies after reoperative surgery for anastomotic complications have reported higher morbidity, from 26 to 55%.\(^7\) Genser and colleagues looked at 50 consecutive patients who underwent reoperative surgery for anastomotic strictures (40%) and infection-related indications such as chronic pelvic sepsis (28%) and fistula (6%).\(^8\) All patients underwent resection and anastomosis, with 54% and 46% of these patients receiving a new colorectal or coloanal anastomosis, respectively. Mortality was nil, but morbidity approached 26%. Morbidity was generally minor (Dindo grade < 3) and included intraoperative injury to the bladder, prolonged ileus, urinary tract infections, and one readmission for dehydration from a diverting ileostomy. Only one case of presacral hemorrhage (Dindo grade 4) required reoperation.

Other groups have also reported no mortality after reoperative surgery but have shown associated morbidity.\(^7\)\(^8\)\(^\) Lefevre and colleagues studied 34 patients who underwent reoperative surgery for mechanical and infection-related indications.\(^9\) The mean operating time was 279 minutes and morbidity was 55%, with a 12% anastomotic leak rate after reanastomosis. Pitel and colleagues reported on 66 patients comprising 44 colorectal and 22 coloanal anastomoses.\(^9\) Mortality was again nil, and morbidity was 32%, consisting of a 7.7% anastomotic leak rate, 9.3% readmission rate, and 15.4% reintervention rate. Although these studies demonstrate a significant risk of morbidity after reoperative surgery for anastomotic complications, the morbidity appears to be relatively minor and manageable, with no reported mortality.

**Outcome Evaluation**

Reoperative surgery for anastomotic complications can be safe and effective. For mechanical complications such as benign strictures, functional outcomes are excellent. Schlegel and colleagues observed 27 patients who underwent resection and reanastomosis for low anastomotic strictures and found no recurrent strictures and satisfactory functional results up to 28.7 months postoperatively.\(^8\) Other series have reported restenosis rates in up to 4% of patients but similarly acceptable, long-term functional results.\(^8\)\(^\)\(^9\)

In the series by Genser and colleagues that included both mechanical and infection-related anastomotic complications, all patients successfully underwent reoperation and up to 94% of patients ultimately had their intestinal continuity...
reestablished. The median number of bowel movements was two during the day and zero at night, and 70% of patients had less than three stools a day up to 21 months on follow-up. Pitel and colleagues reported a median follow-up of 35.7 months and long-term success rates in 78.8% of their 66 redo colorectal and coloanal patients with a median Wexner score of 8. These studies suggest that although technically demanding, reoperative pelvic surgery for anastomotic complications is associated with resolution of the original complication, acceptable morbidity, and satisfactory long-term functional outcomes.

Palliative Reoperative Pelvic Surgery

Palliative reoperative pelvic surgery may be necessary in select patients to relieve pain from recurrent cancers, malignant bowel obstructions, chronic abscesses, and/or fistulas that negatively affect quality of life. Brophy and colleagues reported on 35 patients who underwent palliative exenteration procedures for recurrent pelvic carcinoma with refractory symptoms including pain, bleeding, obstruction, and fistulas. Operative morbidity and mortality were 47% and 3%, respectively. The median overall survival was 20 months, and improvement in quality of life was reported in 88% of patients. Esnaola and colleagues prospectively assessed pain in 45 patients with unresectable recurrent rectal cancer from which 30 patients (67%) underwent a palliative resection. Patients who did not undergo palliative resection reported significantly more pain beyond the third month of treatment. These studies suggest that reoperative pelvic surgery has a beneficial role for patients even in palliative situations.

Conclusions

Reoperative pelvic surgery is a challenging but important way to address debilitating and potentially life-threatening issues such as recurrent malignancies, ileal pouch complications, low anastomotic problems, and palliative situations. The safety and effectiveness of reoperative surgery are dictated by key technical principles, including early identification of critical structures, ability to control bleeding with a variety of methods, and understanding reconstruction strategies from a gastrointestinal, genitourinary, and musculoskeletal perspective. Multidisciplinary teams may need to be involved in complex cases of reoperative surgery, but when executed properly, a successful outcome with acceptable low morbidity and satisfactory long-term functional results can be produced.

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References


