

Endoscopic Evaluation of Surgically Altered Bowel in Patients with Inflammatory Bowel Diseases

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Abstract: Patients with inflammatory bowel diseases often undergo surgical procedures for medically refractory disease or colitis associated dysplasia. Endoscopic evaluation of the surgically altered bowel is often needed to assess for disease recurrence, its severity, and for therapy. It is important to obtain and review the operative report and abdominal imaging before performing the endoscopy. Diagnostic and therapeutic endoscopy can be safely performed in most patients with inflammatory bowel disease with altered bowel anatomy under conscious sedation without fluoroscopy. Carefully planned stricture therapy with balloon dilation or needle knife stricturotomy can be performed for simple, short, and fibrotic strictures. A multidisciplinary approach involving a team of endoscopist, endoscopy nurse, colorectal surgeon, gastrointestinal pathologist, and gastrointestinal radiologist is important for a safe and effective endoscopy. We attempt to review the aspects that need consideration before the endoscopy, the technique of endoscopy, and briefly the therapies that can be performed during endoscopy of the bowel through an ileostomy, a colostomy, in the diverted large bowel or ileal pouch, and small bowel after stricturoplasty and bowel bypass surgery in patients with inflammatory bowel diseases.

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Key Words: diversion, endoscopy, ileostomy, inflammatory bowel diseases, stricturoplasty, surgery

It is estimated that 25% of patients with ulcerative colitis (UC) eventually require colectomy for medically refractory disease, severe medicine-related side effects, or colitis-associated neoplasia.^{1–5} In contrast, at least 60% of patients with Crohn's disease (CD) undergo surgery over 20 years of disease duration.^{6–10} Various forms of surgery are performed in patients with UC and CD. Restorative proctocolectomy with ileal pouch–anal anastomosis (IPAA) has become the surgical treatment of choice for patients with UC undergoing colectomy. The main surgical approaches for CD are bowel resection with anastomosis, stricturoplasty, and bypass. Surgery with temporary or permanent fecal diversion is often performed in patients with UC or CD as a treatment modality or in preparation for an anticipated complex, more definitive operation, including colostomy or ileostomy for the maturation of anastomosis of distal bowel, large bowel obstruction or stricture, and rectovaginal or perianal fistula. The change in bowel anatomy and recurrent disease in inflammatory bowel diseases (IBD) can be challenging for the clinician.^{11,12} The common surgically altered bowel anatomy in patients with IBD is summarized in Table 1. The goals for endoscopy in patients with IBD after surgery

are several folds: (1) diagnosis and differential diagnosis, (2) monitoring for disease recurrence, (3) surveillance for dysplasia, and (4) delivery of endoscopic therapy (Table 2). There are limited data on these aspects of endoscopy. In this article, we discuss principles and techniques of endoscopy in this patient population based on available literature and our experience at Cleveland Clinic's Center for IBD Endoscopy.

PREPARATION

Before the procedure, the endoscopist should familiarize him/herself with the surgical history and bowel anatomy and ensure that adequate patient preparation, equipment, and supplies are available for anticipated diagnostic and therapeutic maneuvers. Anticipated sedation and bowel preparation should be planned ahead of time (Table 3).

Delineation of Bowel Anatomy Before Endoscopy

It is important for the endoscopist to be familiar with the patient's bowel anatomy before the procedure. He or she should carefully review patient's medical and surgical history, operative reports, abdominal imaging, and reports of previous endoscopies. It is prudent to perform some form of abdominal imaging, such as computed tomography (CT), magnetic resonance imaging, or contrast bowel x-ray, to delineate the bowel anatomy. The abdominal imaging may also show the number, location, degree, and length of stricture, along with the presence of hernia, fistula, and abscess (Fig. 1).

Preparation of Patient

Appropriate bowel preparation for endoscopy for patients with IBD with previous surgery requires a systemic approach. For

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TABLE 1. Surgically Altered Bowel Anatomy in IBD

Type	Bowel Involved	Configuration
Stoma	Ileostomy	Loop
		Loop-end
		End
		Continent ileostomy (Kock, Barnett)
	Jejunostomy	Loop
		End
	Colostomy	End
		Mucus fistula
		Blow hole (loop)
Defunctioned bowel	Diverted colon/rectum	
	Diverted ileal pouch	
Stricturoplasty	Small bowel	Heineke-Mikulicz
		Finney
		Michelassi
Bowel bypass surgery	Duodenum	Gastrojejunostomy
		Roux-en-Y bypass

patients undergoing upper or lower endoscopy with conscious sedation or under general anesthesia, overnight fasting is recommended to avoid aspiration, especially for patients with narrowing of the bowel, or stricturoplasty and for those with anticipated prolonged procedures (such as endoscopic therapy). For routine diagnostic endoscopy through ileostomy or jejunostomy, clear liquid diet, the day before without additional bowel preparation may be sufficient.¹³ For diagnostic colonoscopy through colostomy, therapeutic ileoscopy through ileostomy, and endoscopy in the setting of partial bowel obstruction, polyethylene glycol–based oral preparation is recommended. For patients undergoing endoscopy of diverted or defunctioned bowel, oral or topical preparation is usually not required (Table 3).

Informed consent should include risks and alternatives of the endoscopy, sedation, biopsy, and possible therapy, such as polypectomy and stricture treatment.

TABLE 2. Indications of Endoscopy After IBD Surgery

Diagnosis and disease monitoring:
Recurrent/new onset bowel disease
Stoma complications (hernia, retraction, prolapse, stenosis)
Endoscopic therapy
Stricture
Fistula
Anastomotic leak or sinus
Cancer surveillance
Diverted colon, rectum or ileal pouch

CT enterography or magnetic resonance enterography is often performed to delineate the bowel anatomy before endoscopy, and oral contrast is routinely used. Same day, sequential endoscopic evaluation after abdominal imaging should be avoided because of the risk of aspiration from large-volume intestinal contrast.

The extent and location of the bowel examined and anticipated need for therapeutic intervention determines the type of sedation. Diagnostic endoscopy of the intestine through stoma and defunctioned or diverted bowel may or may not need sedation, depending on patient's preference, anticipated duration of the procedure, and finding of healthy or diseased bowel. Patients undergoing diagnostic ileoscopy, jejunostomy, or colostomy through a stoma with anticipated angulated or strictured bowel are suitable for conscious sedation.¹³ Most therapeutic interventions like stricture dilation by through-the-scope (TTS) balloon or needle knife stricturotomy (NKSt) can be safely performed under conscious sedation.^{14,15} If prolonged procedure time is anticipated in cases of dilation of long and/or multiple strictures or when performing balloon-assisted endoscopy (BAE), monitored anesthesia care may be reasonable for patient comfort. Patients with therapeutic endoscopic procedures may need to be observed in recovery room for an extended period of time and may be recommended to stay in close proximity on the day of the procedure after being discharged.

Room Setting, Endoscopy Equipment and Supplies

Fluoroscopic guidance may be considered when performing a therapeutic procedure, as it may help to delineate the anatomy in real time. However, it may not be readily available in most outpatient endoscopy suites and, its operation may need additional training. Furthermore, there has been concern regarding radiation exposure to the patient and the endoscopist.¹⁶ At our center, we do not routinely use fluoroscopic guidance for diagnostic or therapeutic endoscopy in patients with IBD with or without surgery. Nonetheless, we have been able to successfully perform various forms of endoscopic therapies, including TTS balloon dilation, NKSt, and needle-knife sinusotomy.^{14,17,18}

To reduce the risk for aspiration and postprocedure bloating, the use of carbon dioxide insufflation, rather than room air, is recommended. After a prolonged procedure, a nasogastric tube through stoma or nipple valve (in patients with continent ileostomies) can be placed with suction to facilitate passage of air and minimize patient discomfort and procedure-related aspiration or perforation risk.

When performing endoscopy through a stoma, we position the patient in a supine position, preferably with the ostomy side closer to the endoscopist. A protective chux sheet with an opening created for the stoma site should be placed on the abdomen.

The various diagnostic modalities available to assess the small bowel in CD include capsule enteroscopy (CE), magnetic resonance enterography, CT enterography, and enteroscopy. In a recent meta-analysis, CE was shown to have a better diagnostic

TABLE 3. Patient Preparation

Bowel Anatomy	Bowel Preparation		Sedation	Endoscope	Special Remarks
	Diagnostic Procedure	Therapeutic Procedure			
Ileoscopy/Jejunostomy through stoma	Clear liquid diet	Clear liquid diet	Conscious sedation	Adult gastroscope	Aspiration risk
Colostomy through stoma	Full prep	Full prep	Conscious sedation	Pediatric colonoscope	
Defunctioned bowel	None	None	None	Adult gastroscope	Superficial biopsies
Strictureplasty	Full prep	Full prep	Conscious sedation	Adult gastroscope or pediatric colonoscope	Aspiration risk. Balloon-assisted enteroscopy
Bypass surgery	None	None	Conscious sedation	Adult gastroscope or pediatric colonoscope	

Full prep, PEG-based full colonoscopy preparation.

yield in suspected and established CD than CT enterography. Magnetic resonance enterography appears to be superior to CE in the assessment of established CD. However, the CE studies in this meta-analysis excluded patients with strictures or suspected obstruction due to risk of capsule retention; and hence, these results cannot be extrapolated to the postsurgical patients with IBD in whom capsule retention is a concern.^{19,20} Another drawback of CE and imaging modalities is inability to obtain tissue biopsy and perform therapy.

For the direct visualization of the bowel in postsurgical patients with IBD, various endoscopic techniques can be used for diagnosis and therapy. Because of its flexibility and smaller caliber, a gastroscope is the preferred tool for evaluation of the

small intestine through ileostomy or jejunostomy, ileal pouches, diverted or defunctioned large bowel or ileal pouch, and bypassed small bowel. For patients with colostomy, a pediatric colonoscope is often used because it provides a longer insertion length. Flexible sigmoidoscope has a larger diameter than the gastroscope but it can provide an additional degree of angulation with better visualization of structures with retroflexion close to the anus or the nipple valve in the continent ileostomy.

In patients with history of stricturoplasty and bypass surgery when deeper insertion is required, enteroscopy can be performed by push enteroscope or BAE. The latter include single balloon enteroscope, double balloon enteroscope (DBE), and spiral enteroscope.^{21,22} Single balloon enteroscope (Olympus,



FIGURE 1. CT before the procedure helps delineate the bowel anatomy. Imaging showing (A) proximal small bowel stricture and upstream dilation. B, stricture (green arrow) at previous stricturoplasty site.

Tokyo, Japan) and DBE (EN-450T5; Fujinon, Saitama, Japan) have a 200-cm tube length with 2.8-cm working channel and 140-cm overtube. The DBE has an inflatable balloon in addition to the balloon at the tip of the overtube to help stabilize and pleat the small bowel over the scope. A previous CE examination may assist in determining the direction of BAE (antegrade through oral or retrograde through anal approach) and maximize the yield of the procedure.²³

For stricture therapy, TTS balloon can be used through the endoscopy channel of adult gastroscope, pediatric colonoscope, adult colonoscope, push enteroscope, single balloon enteroscope, or DBE. In patients who fail EBD, NKSt can be tried.²⁴

ENDOSCOPY THROUGH STOMA

Surgery for fecal diversion is often performed in patients with IBD, more in CD than UC. Based on the location, ostomy can be classified into ileostomy, jejunostomy, or colostomy. Based on the intention of its creation and duration, ostomy can be categorized as temporary or permanent. Based on the configuration, ileostomy can be of 3 types: loop ileostomy, loop-end ileostomy, and end ileostomy. There can be other variations of ostomy as listed in Table 1. An ostomy is created for various indications in patients with IBD. A permanent-end ileostomy or temporary-loop ileostomy may be created in patients with CD for perianal or medically refractory disease, with or without colectomy.^{6,25,26} A temporary loop ileostomy may also be needed as an interim step of restorative proctocolectomy and IPAA to prevent anastomotic leak and promote maturation of the pouch reservoir. Colostomy may occasionally be created in cases of fulminant colitis or severe colitis in pregnant women. Mucous fistula and blow-hole colostomy for severe colitis are variants of colostomy. Continent ileostomies (Kock pouch and Barnett Continent Intestinal Reservoir [BCIR]) are created in patients with UC with colectomy and poor anal sphincter function or as a rescue operation in cases of failure of IPAA.²⁷

Endoscopic recurrence at the anastomotic site may precede clinical recurrence in CD, and early detection with proper medical treatment may alter the disease course over time.²⁸⁻³⁰ Endoscopic recurrence at the ileocolonic anastomosis can occur in 70% to 80% cases at 1 year after bowel resection surgery in untreated patients.^{6,30,31} Similar rates of recurrence have been reported during retrograde ileoscopy through stoma in patients after CD surgery.¹³ Patients with UC who undergo total colectomy and IPAA can develop pouch failure and may end up with permanent ileostomy for fecal diversion that may require endoscopic evaluation and stricture therapy.³² Hence, given the high rate of recurrence after surgery, endoscopy should be routinely performed in postsurgical patients to evaluate for disease recurrence and perform stricture therapy.

After creation of a new stoma, it is prudent to defer endoscopy through stoma for at least 4 weeks after the surgery. If the patient's history is suggestive of stoma retraction or obstruction, inspecting and assessing the stoma diameter before the procedure will ensure that the correct endoscope is used. Before

intubating the bowel through stoma, a careful inspection of the surrounding area should be performed for stoma prolapse, stoma retraction, fistulous tract, and skin lesions, such as stoma ulcers and pyoderma gangrenosum³³ (Fig. 2C, D).

If there is significant looping of the scope, abdominal pressure applied by an endoscopy assistant around the stoma site facilitates passage of scope. During endoscopy, special attention should be paid to sampling areas of mucosal abnormality. Evaluation of the bowel mucosa should be performed for signs of active disease and strictures with the documentation of degree of inflammation and depth from stoma site. Degree, number, and length of strictures should be noted. Erythema, friability, and ulceration of the small bowel or colonic mucosa just distal to the stoma, which is normally limited to 10 cm or less from stoma site, can be a consequence of ischemic or mechanical effects and may not always represent active CD. Hence, mucosa sampled from this area should be labeled appropriately and interpreted in the light of its location. Sampling of severely strictured area can be performed after dilation to evaluate dysplasia or other lesions.

Loop Ileostomy

A loop ileostomy is usually created as a temporary measure for fecal diversion and has an advantage of easier closure than end ileostomy (Fig. 3A). It can be designed in 2 configurations, either as a double-barrel loop ileostomy with 2 equally sized stoma openings (the afferent and efferent limbs) or as a defunctionalized efferent limb with a smaller second stoma opening (Fig. 4A). The afferent limb leads to the proximal bowel and stomach and the efferent limb towards the diverted distal bowel. The two openings should be cautiously identified and intubated. It should be ensured that the patient does not have a loop-end ileostomy (see section on loop-end ileostomy). Previous knowledge of the surgical anatomy is helpful to avoid inadvertent complications, such as perforation of the blind portion of a loop-end ileostomy.

Loop-end Ileostomy

A loop-end ileostomy is created in situations where end ileostomy is technically difficult. The stoma site will have 2 openings (Fig. 3B). The efferent limb of a loop-end ileostomy is blind and hence should be intubated with extreme caution to prevent inadvertent perforation or should not be intubated at all (Fig. 4B).

End Ileostomy

End ileostomy will have a single stoma opening and is typically performed for the purpose of permanent fecal diversion (Figs. 3C and 4C). Of note, the bowel just proximal to the stoma may be narrow due to extrinsic compression from the surrounding skin or muscle of the abdominal wall. This should not be confused with a bowel stricture. Surgical stoma revision, rather than balloon dilation of a marked stomal stenosis, is recommended.

Continent Ileostomies

Patients with UC may undergo total abdominal colectomy with a continent ileostomy instead of end ileostomy or pelvic



FIGURE 2. Inspection of perianal and peristomal area should be performed before intubation with a scope: (A) peristomal ulcers; (B) ileostomy prolapse; (C) perianal dermatitis in a patient with persistent diversion proctitis; (D) perianal fistula in a patient with diverted ileal pouch for CD.

pouch. Continent ileostomies, such as Kock pouch (Fig. 5A) can be complicated by parastomal hernia, stenosis, fistula at the base of the nipple valve, inlet or afferent limb strictures, and pouchitis. Periodic endoscopic evaluation is needed for diagnosis and therapy. During intubation, the scope traverses the nipple valve that is present at the pouch outlet (distal end of the pouch close to the skin). An average pouch body is about 7 to 10 cm in length and leads to the pouch inlet and afferent limb. A careful retroflexion

should be performed in the pouch body to evaluate the nipple valve, which can have stricture, ulceration, or fistula at the base. If difficulty is encountered in intubating the pouch inlet or afferent limb due to the looping of endoscope, turning the patient to a lateral position facing the endoscopist or applying abdominal pressure by the assistant may help.

BCIR is a variant of the Kock pouch where a loop of small bowel is wrapped around the pouch outlet to augment continence

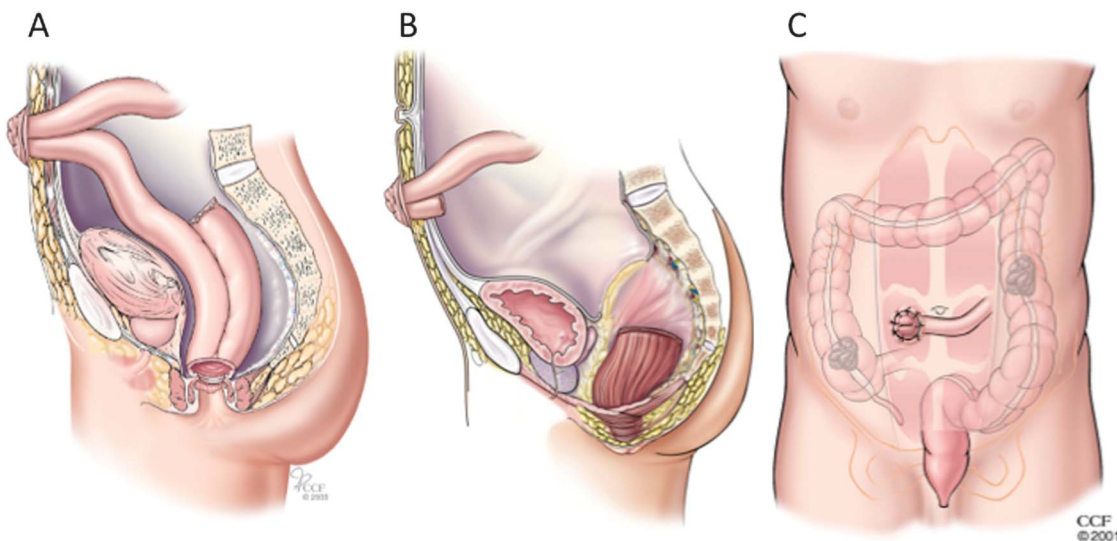


FIGURE 3. Diagrammatic representation of various types of ileostomies: (A) loop ileostomy; (B) loop-end ileostomy; (C) end ileostomy.

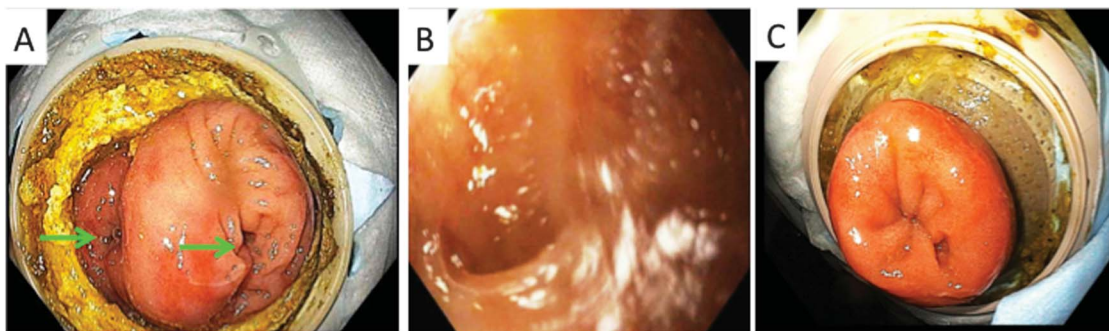


FIGURE 4. Endoscopic views of various ileostomies. A, Loop ileostomy with opening for afferent limb (larger stoma) and efferent limb (smaller stoma) (green arrows). B, Blind efferent limb of loop-end ileostomy. C, Single stoma opening of end ileostomy.

of the ileostomy (Fig. 5B). During endoscopic evaluation on retroflexion, an opening to the loop of small bowel is present adjacent to the pouch inlet. This should not be confused with the pouch inlet and afferent limb. Pouchitis and pouch stricture can occur in BCIR.

End Colostomy

An end colostomy is created for diseased or strictured distal large bowel. The stoma is usually placed on the left side of the abdominal wall and can be intubated with a pediatric colonoscope (Fig. 6A). Mucosa should be examined for disease activity and stricture. A successful colonoscopy through stoma should include intubation and evaluation of the ileocecal valve and terminal ileum.

Mucous Fistula and Ileostomy

When diverting ileostomy is performed in cases of severe colonic inflammation, there is a high chance of leak from the distal rectal stump from the inflamed suture or staple line. Hence, the proximal end of the distal colonic segment is attached to the fascia of the abdominal wall in the midline through a mucous fistula to avoid peritonitis in case of a leak. This is in addition to the ileostomy stoma. The prior evaluation of surgical report is helpful to understand the anatomy (Fig. 6B). The mucus fistula

should not be mistaken for a stoma, and endoscopic intubation should be avoided.

Blow-hole Colostomy

In cases of fulminant colitis or toxic megacolon if the bowel is not healthy enough for colectomy, temporary loop colostomy is created to decompress the bowel and divert the fecal stream. The afferent and efferent limbs will lead in to the proximal and distal large bowels, respectively (Fig. 6C). The patients eventually have a completion colectomy with or without ileal pouch.

ENDOSCOPY FOR DIVERTED AND DEFUNCTED BOWEL

Temporary fecal diversion of the IPAA or large bowel is performed in IBD patients to reduce the risk of anastomotic leak in IPAA or to treat refractory disease of the distal large bowel, perianal disease, strictures, and fistulas. Endoscopic evaluation of the diverted bowel is done for symptoms or for ensuring that there is no stricture or anastomotic leak before stoma closure. For patients with permanent fecal diversion, dysplasia surveillance of the diverted large bowel should be routinely performed.^{34,35}

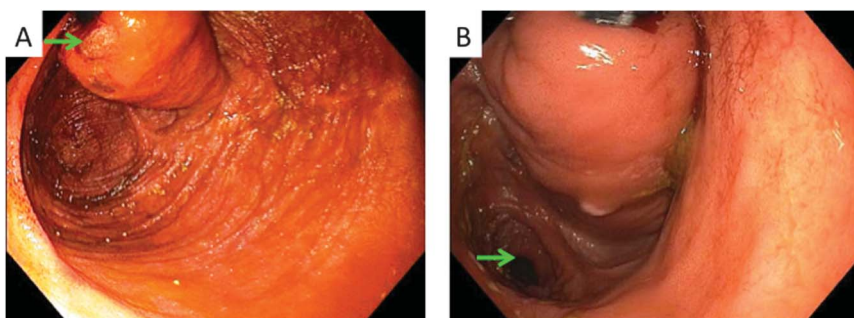


FIGURE 5. Normal endoscopic views of continent ileostomies with retroflexion of the endoscope in the pouch. A, Kock pouch with small ulceration at the nipple valve (green arrow). B, BCIR with opening of a loop of small bowel (green arrow) around the valve that augments continence of the ileostomy.

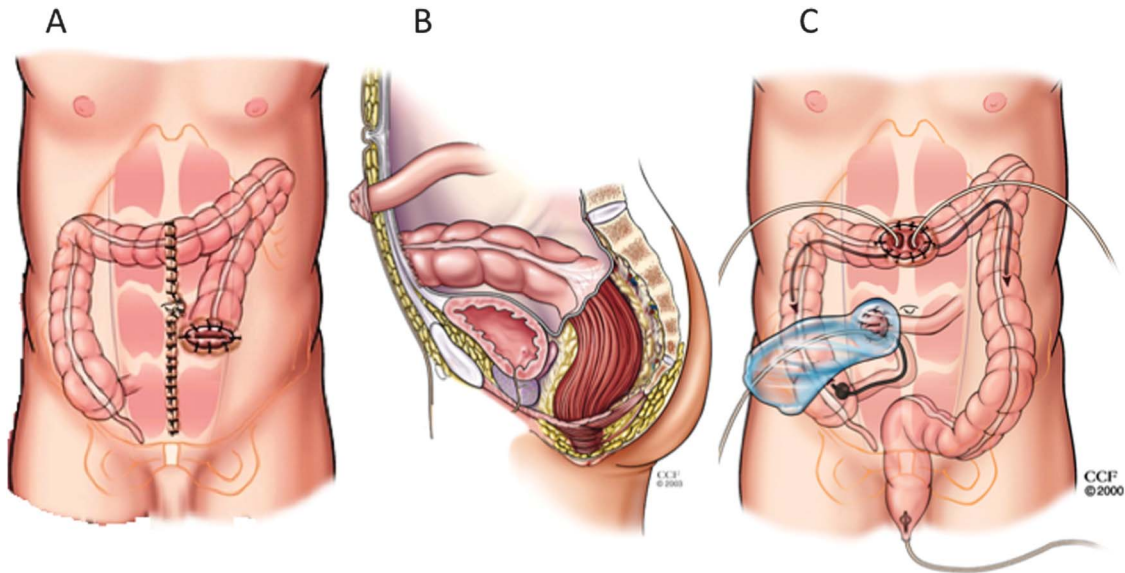


FIGURE 6. Diagrammatic representation of various types of colostomies: (A) end colostomy; (B) mucous fistula with ileostomy; (C) “blow-hole” loop colostomy.

Diverted Large Bowel

The presence of mild erythema, friability, exudate, and ulceration in the diverted large bowel, i.e., diversion colitis or proctitis, is common (Fig. 7A).³⁶ The friable mucosa is prone to spontaneous bleeding, and hence deep or jumbo biopsies should

be avoided. In patients with loop ileostomy, the diverted large bowel may be connected to the efferent limb of the ostomy. When performing endoscopy through anus air insufflation should be minimized and stoma bag left open to avoid over distention of the bowel.

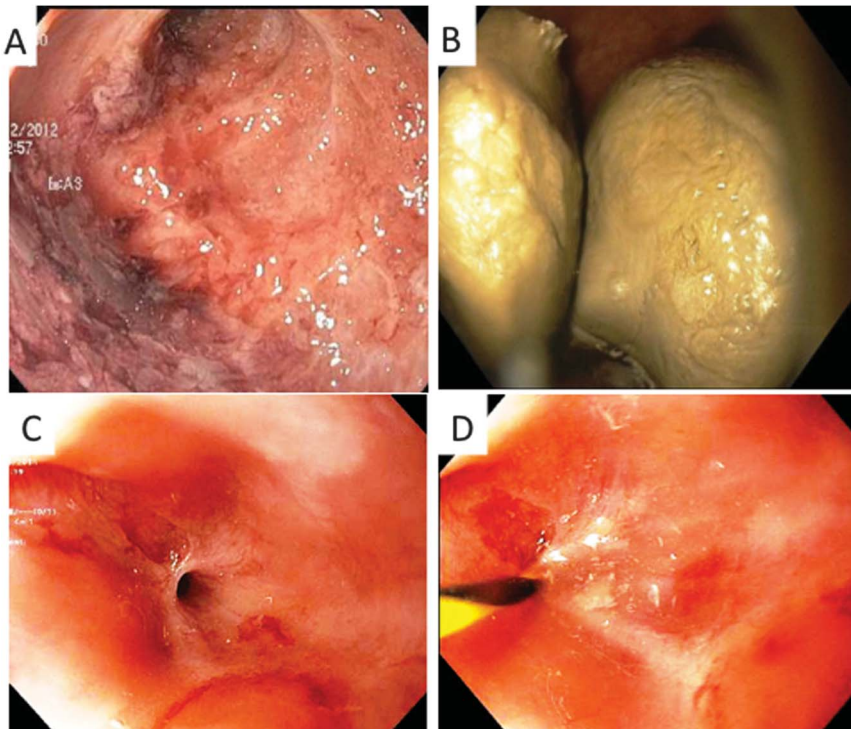


FIGURE 7. Endoscopic evaluation of diverted bowel. A, severe erythema, friability, and edema of diverted colon (diversion colitis). B, Fecal bezoar in a diverted colon. C, Tight stricture in diverted bowel that cannot be traversed with an endoscope. D, A guide wire is used to assess the stricture for depth or fistulous opening.

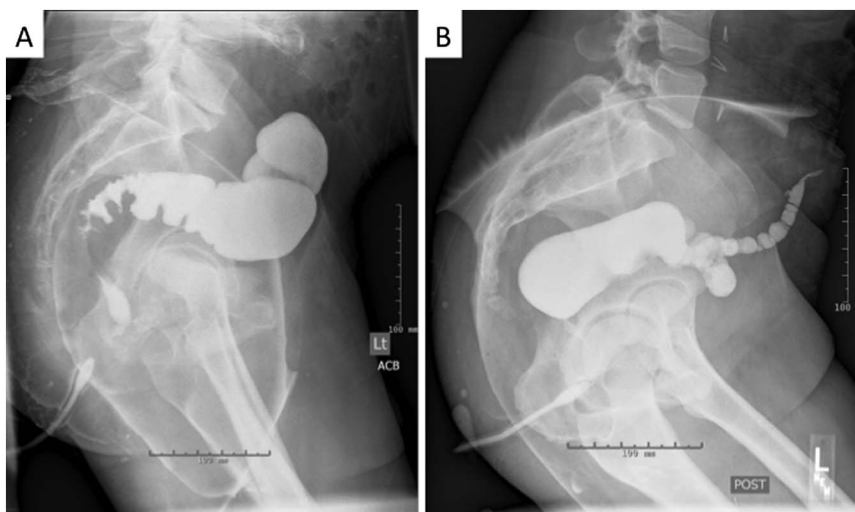


FIGURE 8. Contrasted x-ray imaging (lateral view) of strictures in diverted bowel. A, Diverted colon with distal stricture. B, Diverted J pouch with a loop ileostomy and distal pouch stricture.

Inflammation or long term non-use can lead to mild-to-severe stricture of the diverted bowel. A moderate-to-severe stricture, even if asymptomatic, should be treated before establishing continuity of the bowel as it can predispose to outlet obstruction and fecal bezoar (Fig. 7B). A severe stricture can sometimes be mistaken for an orifice of a fistula. A pre-endoscopy pelvic imaging study, such as magnetic resonance imaging or water-contrasted enema, may be helpful in such a setting. During endoscopy, a soft guide-wire may be used to

delineate the anatomy on the other side of a tight stricture (Fig. 7C, D). A retrograde (through anus) or antegrade (through stoma) contrast x-ray may help delineate anatomy of the diverted bowel (Fig. 8A). In cases where endoscopic balloon dilation (EBD) is unsuccessful, NKSt can be attempted (Fig. 9).

Diverted Ileal Pouch

After the creation of IPAA, temporary fecal diversion is often needed as part of the staged restorative proctocolectomy or as

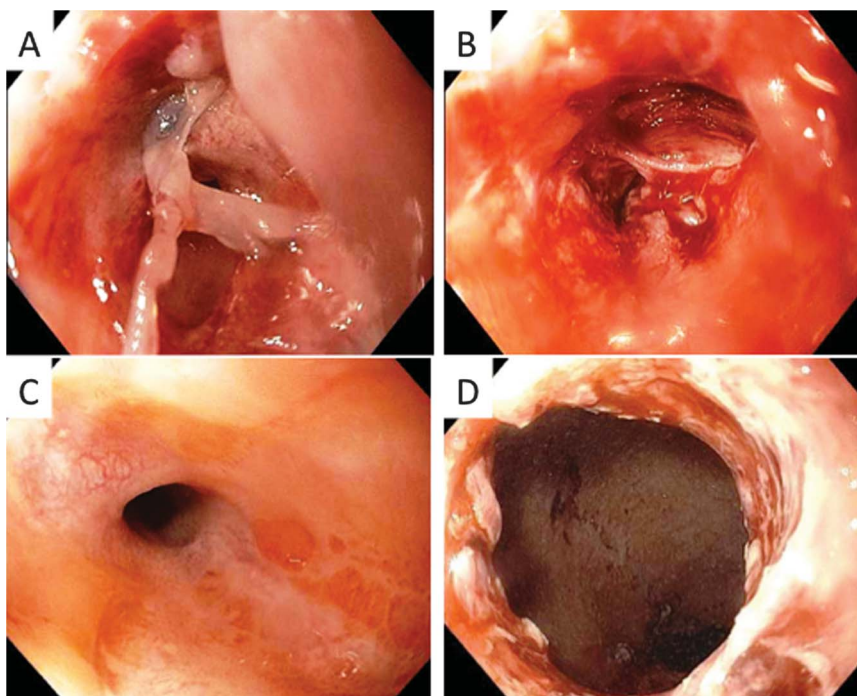


FIGURE 9. Therapy for tight strictures in diverted bowel. A, Tight anastomotic stricture before balloon dilation. B, Post-balloon dilation. C, Tight anastomotic stricture before needle-knife therapy. D, Post-needle-knife therapy.

a treatment approach for those with refractory pouchitis, CD of the pouch, pouch sinus, or perianal disease. Endoscopic evaluation of the diverted ileal pouch is needed to assess for disease activity or for therapy of stricture, anastomotic sinus, or pouch-vaginal fistula.

Attention should be paid to the perianal area for skin infection, fistula opening, induration, and abscess (Fig. 2C, D). A digital rectal examination will assess pouch outlet or anal stricture. Orientation during endoscopic examination is important. When the patient is in the left lateral decubitus position, the anterior wall of the pouch is at the 4 or 5 o'clock location, while the posterior wall is at the 10 or 11 o'clock location at the anal transitional zone. The orifice of pouch-vaginal fistula is often identified anteriorly, whereas the presacral sinus is seen posteriorly, at the opposite wall. Special attention should be given to the pouch size, presence and degree of inflammation, and location, length, number, degree, and traversability of stricture. Endoscopic treatment may be performed if necessary. Contrast enema x-ray through stoma or anus may be needed to reveal the anatomy of the diverted pouch (Fig. 8B).

ENDOSCOPY AFTER STRICTUROPLASTY

The main surgical options for small bowel CD include resection and anastomosis, stricturoplasty, and bypass of diseased bowel. Stricturoplasty is performed in patients with CD at risk for short bowel syndrome or those with multiple and/or long strictures, which are not amenable to endoscopic therapy. The main purpose of stricturoplasty in patients with CD is to preserve bowel length while maximizing the patency of bowel lumen.³⁷ Stricturoplasty is generally avoided in patients with malnutrition, suspicion of cancer at the

stricturoplasty site, multiple strictures in a short segment, and in cases of perforation, fistula, or abscess.³⁸ However, disease recurrence and obstruction are often encountered after stricturoplasty, similar to that in bowel resection, with a 5-year recurrence rate of 28%, although most are not at the stricturoplasty site.³⁷ There are no randomized controlled trials comparing resection and stricturoplasty in CD. The meta-analysis by Reese et al³⁹ showed that patients treated with stricturoplasty alone might have fewer postoperative complications but have a higher surgical recurrence than those undergoing concomitant resection and anastomosis. In duodenal CD, there are limited data regarding surgical outcomes, and results are more controversial.⁴⁰ The study by Worsley et al⁴¹ from the Cleveland Clinic comparing stricturoplasty (13 patients) and bypass surgery (21 patients) found no differences in the surgical outcomes. In contrast, a study by Yamamoto et al⁴² comparing the 2 modalities with 13 patients in each group and longer follow-up duration had poorer outcomes with stricturoplasty with early complication rates and restructuring. The results of a recent study from Italy of 10 patients with duodenal CD suggested that stricturoplasty was a good option for less than 2 strictures that are present in the second or third part of the duodenum, but resection might be better for multiple strictures in proximal and distal duodenum.⁴³ Diffuse jejunoileal CD can be difficult to treat. However, judicious selection of surgical modality including stricturoplasty can give durable outcomes.^{38,44,45} Stricturoplasty provides a bowel preserving option for patients without the complications of blind loop, marginal ulcers, and bile reflux associated with bypass surgery.⁴¹

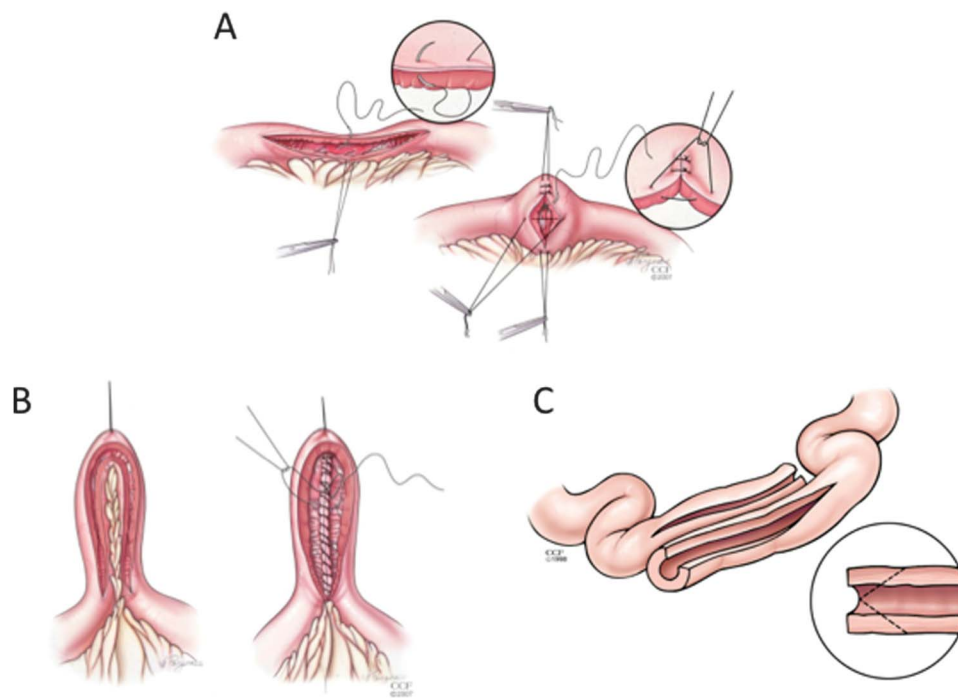


FIGURE 10. Diagrammatic representation of common forms of stricturoplasty: (A) Heineke-Mikulicz stricturoplasty, (B) Fenney stricturoplasty; (C) Michelassi stricturoplasty.

There are various types of stricturoplasty techniques for CD or non-CD strictures. Heineke-Mikulicz stricturoplasty is performed for strictures that are <10 cm in length (Fig. 10A). Fenney stricturoplasty is usually performed for 10- to 20-cm strictures (Fig. 10B), and longer strictures (>20 cm) may be treated with Michelassi stricturoplasty (Fig. 10C). The dilated bowel in the area of stricturoplasty may create a blind loop and predispose the patient to small intestinal bacterial overgrowth, which is less likely in Heineke-Mikulicz stricturoplasty.

Various types of stricturoplasties can be difficult to differentiate endoscopically (Fig. 11A–C). Recurrence of stricture at the stricturoplasty site often requires therapeutic intervention. The inlet (proximal end) and outlet (distal end) can sometimes be difficult to identify due to altered anatomy and tight strictures (Fig. 11B). Endoscopic inspection with cautious retroflexion of the scope in the dilated segment of the bowel can help identify the bowel lumen. TTS balloon dilation up to 20 mm can be attempted for the strictures at stricturoplasty sites.

There is an increased risk of aspiration in patients after stricturoplasty, and hence good bowel preparation, clear liquid diet the day before, and strict fasting after midnight is important.

ENDOSCOPY AFTER BYPASS SURGERY FOR CD

Duodenal or gastric bypass surgeries are performed in patients with upper gastrointestinal CD that are refractory to

medical and endoscopic therapy. The commonly performed bypass surgeries for duodenal CD include gastrojejunostomy with or without Roux-en-Y (Fig. 12A–D). As mentioned above, the choice of surgical modality depends on various factors including the location and length of the strictures.⁴³ Shapiro et al⁴⁶ retrospectively analyzed 30 patients who underwent stricturoplasty (2 patients) and bypass surgery (11 open bypass and 13 laparoscopic bypass patients) for duodenal CD and suggested that laparoscopic bypass was a viable option with lower complication rates and similar recurrence rates as compared with open bypass. In patients with gastrojejunostomy, bile acid reflux gastritis from loss of pylorus (Fig. 12A) and anastomotic strictures are common. Biopsy may help differentiate CD from surgery-associated changes. Both afferent and efferent limbs of gastrojejunostomy and Roux-en-Y should be intubated (Fig. 12B, D). Stricture can occur at the Roux-en-Y anastomosis (Fig. 12C) and can be treated with EBD.

Postsurgery endoscopic evaluation is routinely needed to assess disease activity, obtain information for early escalation of medical management, and deliver endoscopic therapy for strictures. Patients with upper gastrointestinal CD, regardless of phenotype, may present with an aggressive form of the disease. The lack of fecal diversion as a treatment option and the risk of short gut syndrome in refractory cases make early detection and proper treatment of disease recurrence of greater importance in these patients.

Endoscopy with an adult gastroscope is feasible in most cases. A pediatric colonoscope provides deeper insertion length.

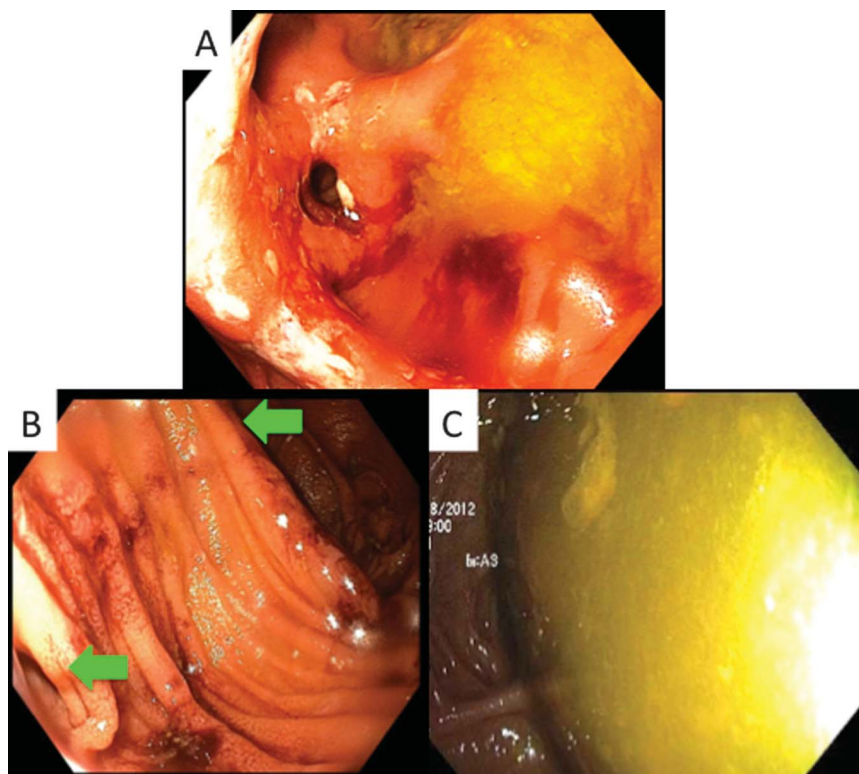


FIGURE 11. Endoscopy of bowel with previous stricturoplasty. A, Endoscopic appearance after Heineke-Mikulicz stricturoplasty; (B) Tight strictures at stricturoplasty site after Fenney stricturoplasty (green arrows). C, Significantly dilated bowel segment after Michelassi stricturoplasty.

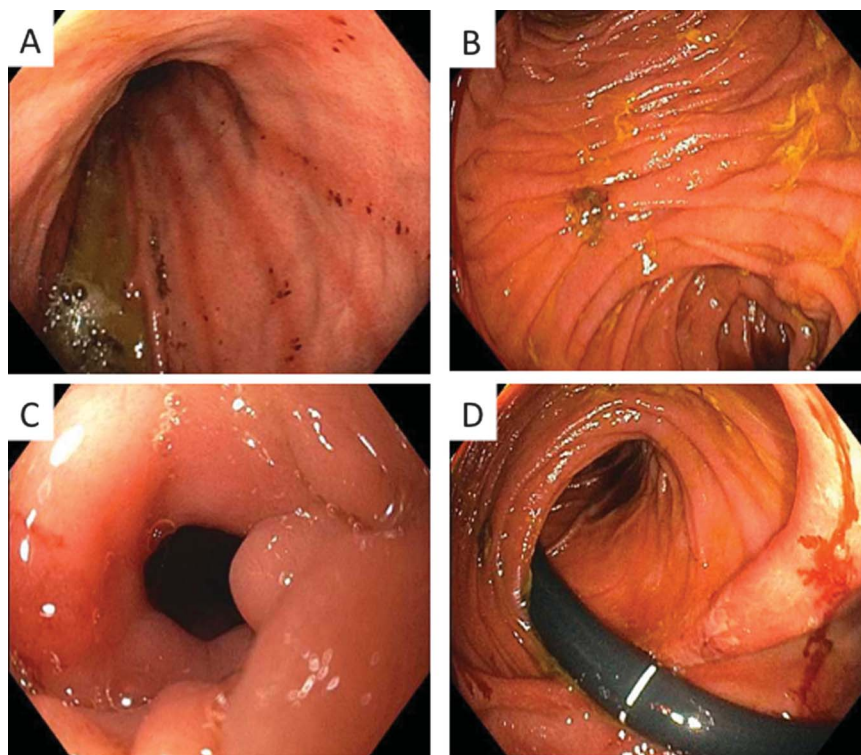


FIGURE 12. Endoscopy after bypass surgery for CD. A, Mild gastric erythema can be due to bile acid reflux. B, Openings of afferent and efferent limbs at the gastrojejunostomy. C, Mild Roux-en-Y anastomotic stricture. D, View in retroflexion showing area of gastrojejunostomy anastomosis.

EBD of CD disease-related primary stricture or secondary/anastomotic stricture can be performed if necessary. BAE may also be used to perform endoscopic therapy including endoscopic retrograde cholangiogram for stone removal, sphincterotomy, biliary stricture dilation, and stent placement.^{47,48}

ENDOSCOPIC THERAPY

Therapeutic endoscopy has been increasingly used in patients with IBD. The main application is endoscopic stricture therapy, which is exemplified by EBD of stricture.⁴⁹ A systematic review by Hassan et al¹⁵ evaluating the utility of DBE for strictures in patients with CD, including patients with previous surgery, showed that short strictures (<4 cm) can be successfully treated with TTS balloon dilation. There are emerging data from case series pertaining to the role of BAE for diagnosis of CD and stricture therapy.^{21,50-54} Although these studies did not specifically address outcomes of patients with strictures after surgical resection or stricturoplasty, they included postsurgical patients and showed that BAE can be used for establishing diagnosis and performing EBD in CD.^{54,55}

Endoscopic Balloon Dilation of Stricture

The TTS balloon dilation has shown good long-term outcomes for short (<4 cm) CD-related strictures in patients without stoma.¹⁵ TTS balloon can be used for dilation of strictures

through the working channel of all regular endoscopes. However, there are no standardized technical guidelines for size and duration of balloon dilation in patients with IBD with or without stoma. At the Center for IBD Endoscopy at the Cleveland Clinic, we routinely perform graded dilation with 18 to 20 mm of balloons for both primary CD and secondary or anastomotic strictures. Caution should be exercised in anastomotic strictures with deep ulceration.⁵⁴ A retrograde dilation technique has been used for most strictures keeping the waist of the balloon at the center of the stricture to prevent inadvertent proximal repositioning. For pinhole and angulated strictures that cannot be safely traversed with a gastroscope or pediatric colonoscope, antegrade TTS balloon dilation with guidewire exchange technique can be performed.^{49,56}

Balloon dilation can be performed for strictures at the previous loop ileostomy site, pouch inlet, and anastomosis in patients with IPAA.^{14,57} Anastomotic strictures in male pouch patients can be dilated up to 20-mm balloon size. In contrast, outlet strictures in female patients should be cautiously dilated to 18 mm to minimize iatrogenic trauma and risk of creating an anterior pouch-vaginal fistula.¹⁴ In patients with Kock pouch strictures, which are often located at the pouch inlet or nipple valve, a careful endoscopic dilation can be performed with satisfactory outcomes.¹⁸

Patients with ileostomy may develop CD-related or non-CD-related stricture at the neosmall intestine. Those strictures can also be managed safely with EBD in experienced hands.¹⁸

Needle-knife Stricturectomy

We developed endoscopic needle-knife stricturectomy (NKSt) for tight fibrotic strictures or strictures refractory to EBD. A needle knife with the setting of maximum coagulation power and minimum cutting power can be used to dissect fibrotic tissue.⁵⁸ Doppler ultrasound guidance may be used when possible to avoid areas of significant vascularity. NKSt has been shown previously to be effective for treatment of esophagogastric anastomotic strictures.⁵⁹ We have shown promising results of needle-knife therapy for treating ileal pouch sinuses and small bowel strictures.²⁴ In patients with prolonged fecal diversion, friable, fibrotic strictures often develop at the anal canal, anastomosis, or distal rectum or pouch. EBD for these strictures may be too traumatic (Fig. 9A, B). We have safely performed NKSt with good outcome (Fig. 9C, D).

Fecal Bezoar and Foreign Body Removal

Tight strictures in a diverted bowel can lead to “sealed” distal bowel and predispose to fecal bezoar (Fig. 7B).⁴⁹ In cases of retained capsule endoscope, DBE can be used to extract the capsule, thus averting the need for surgical intervention.⁶⁰

Patients with Kock pouch are at risk for having foreign body or bezoar, which are amenable to endoscopic retrieval therapy in most cases.^{61,62}

SUMMARY AND RECOMMENDATIONS

Various surgeries are performed in patients with IBD, and endoscopic evaluation is often needed for diagnosis, monitoring of disease recurrence, dysplasia surveillance, and strictures therapy. It is important to be prepared for the procedure by familiarizing oneself with the anatomy by review of operative and endoscopic reports and in most cases performing abdominal imaging studies. Proper bowel preparation, informed consent, sedation, personnel, equipment, and supplies are important for safe and effective diagnostic and therapeutic endoscopy in these patients. Mucosal inflammation and bowel strictures may be related to change in bowel anatomy or recurrent CD. The distinction between these conditions, although challenging, is imperative for proper treatment. Endoscopic treatment can be delivered in most cases in experienced hands.

REFERENCES

- Cosnes J, Gower-Rousseau C, Seksik P, et al. Epidemiology and natural history of inflammatory bowel diseases. *Gastroenterology*. 2011;140:1785–1794.
- Henriksen M, Jahnsen J, Lygren I, et al. Ulcerative colitis and clinical course: results of a 5-year population-based follow-up study (the IBSEN study). *Inflamm Bowel Dis*. 2006;12:543–550.
- Langholz E, Munkholm P, Davidsen M, et al. Colorectal cancer risk and mortality in patients with ulcerative colitis. *Gastroenterology*. 1992;103:1444–1451.
- Leijonmarck CE, Persson PG, Hellers G. Factors affecting colectomy rate in ulcerative colitis: an epidemiologic study. *Gut*. 1990;31:329–333.
- Liu ZX, Kiran RP, Bennett AE, et al. Diagnosis and management of dysplasia and cancer of the ileal pouch in patients with underlying inflammatory bowel disease. *Cancer*. 2011;117:3081–3092.
- Peyrin-Biroulet L, Harnsen WS, Tremaine WJ, et al. Surgery in a population-based cohort of Crohn's disease from Olmsted County, Minnesota. *Am J Gastroenterol*. 2012;107:1693–1701.
- Bernell O, Lapidus A, Hellers G. Risk factors for surgery and postoperative recurrence in Crohn's disease. *Ann Surg*. 2000;231:38–45.
- Farmer RG, Whelan G, Fazio VW. Long-term follow-up of patients with Crohn's disease. Relationship between the clinical pattern and prognosis. *Gastroenterology*. 1985;88:1818–1825.
- Michelassi F, Balestracci T, Chappell R, et al. Primary and recurrent Crohn's disease. Experience with 1379 patients. *Ann Surg*. 1991;214:238–240; discussion 230–238.
- Louis E, Collard A, Oger AF, et al. Behaviour of Crohn's disease according to the Vienna classification: changing pattern over the course of the disease. *Gut*. 2001;49:777–782.
- Rutgeerts P, Geboes K, Vantrappen G, et al. Natural history of recurrent Crohn's disease at the ileocolonic anastomosis after curative surgery. *Gut*. 1984;25:665–672.
- Olaison G, Smedh K, Sjdahl R. Natural course of Crohn's disease after ileocolic resection: endoscopically visualised ileal ulcers preceding symptoms. *Gut*. 1992;33:331–335.
- Vadlamudi N, Alkhoury N, Mahajan L, et al. Ileostomy via stoma after diverting ileostomy: a safe and effective tool to evaluate for Crohn's recurrence of neoterminal ileum. *Dig Dis Sci*. 2011;56:866–870.
- Shen B, Fazio VW, Remzi FH, et al. Endoscopic balloon dilation of ileal pouch strictures. *Am J Gastroenterol*. 2004;99:2340–2347.
- Hassan C, Zullo A, De Francesco V, et al. Systematic review: endoscopic dilatation in Crohn's disease. *Aliment Pharmacol Ther*. 2007;26:1457–1464.
- Ho IK, Cash BD, Cohen H, et al. Radiation exposure in gastroenterology: improving patient and staff protection. *Am J Gastroenterol*. 2014;109:1180–1194.
- Atreja A, Aggarwal A, Dwivedi S, et al. Safety and efficacy of endoscopic dilation for primary and anastomotic Crohn's disease strictures. *J Crohns Colitis*. 2014;8:392–400.
- Chen M, Shen B. Comparable short- and long-term outcomes of colonoscopic balloon dilation of Crohn's Disease and benign non-Crohn's Disease strictures. *Inflamm Bowel Dis*. 2014;20:1739–1746.
- Dionisio PM, Gurudu SR, Leighton JA, et al. Capsule endoscopy has a significantly higher diagnostic yield in patients with suspected and established small-bowel Crohn's disease: a meta-analysis. *Am J Gastroenterol*. 2010;105:1240–1248; quiz 1249.
- Wiarda BM, Mensink PB, Heine DG, et al. Small bowel Crohn's disease: MR enteroclysis and capsule endoscopy compared to balloon-assisted enteroscopy. *Abdom Imaging*. 2012;37:397–403.
- Tharian B, Caddy G, Tham TC. Enteroscopy in small bowel Crohn's disease: a review. *World J Gastrointest Endosc*. 2013;5:476–486.
- Mensink PB. Spiral enteroscopy: from “new kid on the block” to established deep small-bowel enteroscopy tool. *Endoscopy*. 2010;42:955–956.
- Manes G, Imbesi V, Ardizzone S, et al. Use of double-balloon enteroscopy in the management of patients with Crohn's disease: feasibility and diagnostic yield in a high-volume centre for inflammatory bowel disease. *Surg Endosc*. 2009;23:2790–2795.
- Wu XR, Wong RC, Shen B. Endoscopic needle-knife therapy for ileal pouch sinus: a novel approach for the surgical adverse event (with video). *Gastrointest Endosc*. 2013;78:875–885.
- Wexner SD, Taranow DA, Johansen OB, et al. Loop ileostomy is a safe option for fecal diversion. *Dis Colon Rectum*. 1993;36:349–354.
- Winslet MC, Allan A, Poxon V, et al. Faecal diversion for Crohn's colitis: a model to study the role of the faecal stream in the inflammatory process. *Gut*. 1994;35:236–242.
- Lian L, Fazio VW, Remzi FH, et al. Outcomes for patients undergoing continent ileostomy after a failed ileal pouch-anal anastomosis. *Dis Colon Rectum*. 2009;52:1409–1414; discussion 4414–1406.
- Regueiro M, Schraut W, Baidoo L, et al. Infliximab prevents Crohn's disease recurrence after ileal resection. *Gastroenterology*. 2009;136:441–450 e441; quiz 716.
- Regueiro M, Kip KE, Baidoo L, et al. Postoperative therapy with infliximab prevents long-term Crohn's disease recurrence. *Clin Gastroenterol Hepatol*. 2014;12:1494–1502 e1491.
- Rutgeerts P, Geboes K, Vantrappen G, et al. Predictability of the postoperative course of Crohn's disease. *Gastroenterology*. 1990;99:956–963.

31. Orlando A, Mocchiari F, Renna S, et al. Early post-operative endoscopic recurrence in Crohn's disease patients: data from an Italian Group for the study of inflammatory bowel disease (IG-IBD) study on a large prospective multicenter cohort. *J Crohns Colitis*. 2014;8:1217–1221.
32. Du P, Sun C, Ashburn J, et al. Risk factors for Crohn's disease of the neosmall intestine in ulcerative colitis patients with total proctocolectomy and primary or secondary ileostomies. *J Crohns Colitis*. [published online ahead of print December 5, 2014]. doi: 10.1093/ecco-jcc/jju014.
33. Wu XR, Shen B. Diagnosis and management of parastomal pyoderma gangrenosum. *Gastroenterol Rep*. 2013;1:1–8.
34. Xie J, Itzkowitz SH. Cancer in inflammatory bowel disease. *World J Gastroenterol*. 2008;14:378–389.
35. Klarskov L, Mogensen AM, Jespersen N, et al. Filiform serrated adenomatous polyposis arising in a diverted rectum of an inflammatory bowel disease patient. *APMIS*. 2011;119:393–398.
36. Ma CK, Gottlieb C, Haas PA. Diversion colitis: a clinicopathologic study of 21 cases. *Hum Pathol*. 1990;21:429–436.
37. Yamamoto T, Fazio VW, Tekkis PP. Safety and efficacy of strictureplasty for Crohn's disease: a systematic review and meta-analysis. *Dis Colon Rectum*. 2007;50:1968–1986.
38. Yamamoto T, Watanabe T. Surgery for luminal Crohn's disease. *World J Gastroenterol*. 2014;20:78–90.
39. Reese GE, Purkayastha S, Tilney HS, et al. Strictureplasty vs resection in small bowel Crohn's disease: an evaluation of short-term outcomes and recurrence. *Colorectal Dis*. 2007;9:686–694.
40. Bellolio F, Cohen Z, MacRae HM, et al. Strictureplasty in selected Crohn's disease patients results in acceptable long-term outcome. *Dis Colon Rectum*. 2012;55:864–869.
41. Worsey MJ, Hull T, Ryland L, et al. Strictureplasty is an effective option in the operative management of duodenal Crohn's disease. *Dis Colon Rectum*. 1999;42:596–600.
42. Yamamoto T, Bain IM, Connolly AB, et al. Outcome of strictureplasty for duodenal Crohn's disease. *Br J Surg*. 1999;86:259–262.
43. Tonelli F, Alemanno G, Bellucci F, et al. Symptomatic duodenal Crohn's disease: is strictureplasty the right choice? *J Crohns Colitis*. 2013;7:791–796.
44. Yamamoto T, Allan RN, Keighley MR. Long-term outcome of surgical management for diffuse jejunoileal Crohn's disease. *Surgery*. 2001;129:96–102.
45. Dietz DW, Fazio VW, Laureti S, et al. Strictureplasty in diffuse Crohn's jejunoileitis: safe and durable. *Dis Colon Rectum*. 2002;45:764–770.
46. Shapiro M, Greenstein AJ, Byrn J, et al. Surgical management and outcomes of patients with duodenal Crohn's disease. *J Am Coll Surg*. 2008;207:36–42.
47. Skinner M, Popa D, Neumann H, et al. ERCP with the overtube-assisted enteroscopy technique: a systematic review. *Endoscopy*. 2014;46:560–572.
48. Parlak E, Cicek B, Disibeyaz S, et al. Endoscopic retrograde cholangiography by double balloon enteroscopy in patients with Roux-en-Y hepaticojejunostomy. *Surg Endosc*. 2010;24:466–470.
49. Paine E, Shen B. Endoscopic therapy in inflammatory bowel diseases (with videos). *Gastrointest Endosc*. 2013;78:819–835.
50. Murphy SJ, Kornbluth A. Double balloon enteroscopy in Crohn's disease: where are we now and where should we go? *Inflamm Bowel Dis*. 2011;17:485–490.
51. Mensink PB, Aktas H, Zelinkova Z, et al. Impact of double-balloon enteroscopy findings on the management of Crohn's disease. *Scand J Gastroenterol*. 2010;45:483–489.
52. Di Nardo G, Oliva S, Aloia M, et al. Usefulness of single-balloon enteroscopy in pediatric Crohn's disease. *Gastrointest Endosc*. 2012;75:80–86.
53. Oshitani N, Yukawa T, Yamagami H, et al. Evaluation of deep small bowel involvement by double-balloon enteroscopy in Crohn's disease. *Am J Gastroenterol*. 2006;101:1484–1489.
54. Gill RS, Kaffes AJ. Small bowel stricture characterization and outcomes of dilatation by double-balloon enteroscopy: a single-centre experience. *Therap Adv Gastroenterol*. 2014;7:108–114.
55. Navaneethan UVJ, Narayanan Menon KV, Sanaka MR, et al. Impact of balloon-assisted enteroscopy on the diagnosis and management of suspected and established small-bowel Crohn's disease. *Endosc Int Open*. 2014;02:E201–E206.
56. Obusez EC, Lian L, Oberc A, et al. Multimedia article. Successful endoscopic wire-guided balloon dilatation of angulated and tight ileal pouch strictures without fluoroscopy. *Surg Endosc*. 2011;25:1306.
57. Wu XR, Mukewar S, Kiran RP, et al. Surgical stricturoplasty in the treatment of ileal pouch strictures. *J Gastrointest Surg*. 2013;17:1452–1461.
58. Saritas U, Ustundag Y, Harmandar F. Precut sphincterotomy: a reliable salvage for difficult biliary cannulation. *World J Gastroenterol*. 2013;19:1–7.
59. Simmons DT, Baron TH. Electroincision of refractory esophagogastric anastomotic strictures. *Dis Esophagus*. 2006;19:410–414.
60. Makipour K, Modiri AN, Ehrlich A, et al. Double balloon enteroscopy: effective and minimally invasive method for removal of retained video capsules. *Dig Endosc*. 2014;26:646–649.
61. Zhang C, Shen B. Ileal pouch bezoars/foreign body: a report of the largest series in the literature. *Am J Gastroenterol*. 2011;106(Suppl 2):S362–S363.
62. Lian L, Fazio V, Shen B. Endoscopic treatment for pill bezoars after continent ileostomy. *Dig Liver Dis*. 2009;41:e26–28.