Enteric Anastomoses in Crohn’s Disease: Enteric Imaging Findings and Postoperative Complications

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Overview and Educational Objectives:

• To review the common surgical interventions and anastomotic techniques utilized in enteric resection for Crohn’s disease, as well as their indications and appearance at CT and MR imaging.

• To review the common postoperative complications following enteric resection and anastomosis in Crohn’s disease.

• To illustrate the spectrum of CT and MRI findings representing complications and disease recurrence relating to enteric anastomoses in postoperative Crohn’s disease, as well as complications unique to ileal pouch-anal anastomosis (j-pouch).

• To summarize medical and surgical treatments relating postoperative Crohn’s disease and complications arising from enteric anastomoses.
Post-Surgical Enteric Imaging of Crohn’s Disease: General Background

- Crohn’s disease (CD) is characterized by chronic and recurrent transmural inflammation which can lead to intestinal strictures.

- Despite dramatic improvement in treatment of CD with the introduction of anti-TNF agents, the majority of patients with Crohn’s disease will undergo a surgical or endoscopic intervention during their lifetime (1-2).

- In our experience, radiologists frequently miss complications and recurrence in and around these sites of intervention.

- Various surgical anastomotic and endoscopic methods are employed to treat Crohn’s disease complications. Radiologist familiarity with the imaging appearance of normal anastomoses and complications at enteric anastomoses will facilitate appropriate imaging techniques, early diagnosis, and appropriate treatment.
Anastomotic Techniques Following Enteric Resection

- Anastomosis Types:
  - Side-to-side
  - End-to-end
  - Side-to-end

- Temporizing measures prior to re-establishment of continuity:
  - Diverting and End Ileostomy

- No enteric resection or excision:
  - Strictureplasty

- Non-surgical options:
  - Endoscopic Balloon Dilation

- Additional:
  - Ileal pouch-anal anastomosis
Anastomotic Techniques following Enteric Resection: 

Background

• The association between anastomosis type and long term outcome of disease recurrence, complication rate, and re-operative rate is sparsely studied and controversial.

• Surgeon preference generally determines anastomosis type.

• Discernment of anastomosis type on imaging alone can be challenging, but familiarity of general characteristics and techniques may enhance radiologist understanding of potential complications around each anastomosis type.
Surgical Techniques: Anastomosis

Side-to-Side (functional end-to-end)

Case: 55 y/o M with double-stapled, normal appearing capacious side-to-side ileotransverse colostomy performed for penetrating Crohn’s disease with phlegmon formation.

Scant evidence to strongly favor any given anastomosis type, though small studies have demonstrated reduced overall postoperative complications including anastomotic leak and a decreased recurrence and reoperation rate with stapled side-to-side versus hand sewn end-to-end anastomosis (3).

Technique: The end of each segment is closed and an incision is made longitudinally along both segments. These are brought together and typically stapled to form a new connection between the lumens. This typically results in a large cavity where two bowel segments are conjoined.
Surgical Techniques: Anastomosis

End-to-End

Case: 50 y/o F 3 years s/p ileocolic resection with end-ileostomy and eventual end-to-end anastomosis depicted here on Cor FIESTA imaging. No complications following procedure. Ongoing minimal non-specific anastomotic inflammation found at endoscopy.

Technique: End-to-end anastomoses are typically hand sewn and join the ends of two segments directly together, simulating normal anatomic luminal and mesenteric orientation. Possible trend toward decreasing incidence of end-to-end anastomoses, as the hand sewn nature typically takes longer than stapled methods.

End-to-Side

Case: 67y F 19 years s/p ileocolic resection with end-to-side anastomosis. Red arrow indicated site of anastomosis with minimal stricturing. May be employed when one end of the gut is much larger than the other. Uncommonly cited in Crohn’s literature.

Technique: Closure of the end of the larger segment with new incision made longitudinally near the end. The smaller caliber segment is handsewn directly to the newly made longitudinal incision of the larger segment.
Surgical Techniques: No Bowel Resection: 

**Strictureplasty**

**Case:** 36yo F w/ CD pre-strictureplasty: Axial CTE demonstrates a short segment stricture in the neoterminal ileum with proximal small bowel dilation.

**Technique:** The Heineke–Mikulicz technique for strictureplasty is depicted here: Stricture segments are opened along the antimesenteric border and then closed transversely, increasingly lumen diameter. Additional approaches, such as side-to-side isoperistaltic strictureplasty have shown excellent short and long-term results (4).

**Post-Strictureplasty:** Improved patency at site of previous stricture at 6-month CTE followup.
Surgical Techniques: No Bowel Resection: 

*Endoscopic Balloon Dilation*

**Case:** 57 y/o F 19 years s/p end-to-end ileoascending colon anastomosis. Pre-endoscopic balloon dilation, red arrows, indicates area of stenosis at the anastomosis site.

**Background:** Often used to delay or eliminate the need for surgical intervention (5). Endoscopic dilation is considered with short (<5 cm) fibrotic strictures in straight segments of bowel without associated abscesses.

Post-endoscopic balloon dilation, yellow arrow indicates increased patency at stenotic segment.
Surgical Techniques:
*Diverting and End-Ileostomy*

**Diverting and End Ileostomy**
Diverting ostomies are usually intended to be temporary to allow for maturation of a distal anastomosis. End stomas are typically used when the anorectal sphincter mechanism has been removed.

**Case:** 50y/o F 1 year s/p IPAA excision and permanent ileostomy for J-pouch dysfunction (incontinence). Sagittal and axial CTE depicting typical ileostomy appearance. No complications.

An estimated 10% of CD patients eventually undergo permanent ileostomy stoma formation (6).
Surgical Techniques:

Ileal Pouch-Anal Anastomosis (IPAA or J-pouch)

**Background:** Typically avoided in Crohn’s, though not infrequently performed for presumed UC, with Crohn’s manifestations occurring after surgery. Mortellaro et al. found 13% of pediatric patients with IPAA for UC to later be diagnosed with Crohn’s (7). Normally, two loops of small bowel are sutured or stapled together to form a fecal reservoir (pouch). One of these loops is contiguous with the neo-terminal ileum, and the other is oversewn, with variable lengths to this “blind end.” The nadir of the reservoir is then attached to the anus for reestablishment of anal fecal flow.
Anastomosis Complications and Differential Diagnosis

- Recurrent Crohn’s vs. Non-specific anastomotic inflammation
- Stricture vs. Inflammation vs. Neoplasm
- Penetrating Crohn’s fistula vs. Surgical fistula/leak
- Bacterial overgrowth Syndrome
- Enterolith formation
- J pouch complications
Anastomosis complications and differential diagnosis: 

Recurrent Crohn’s vs. Anastomotic Inflammation

Nearly all ileocolonic anastomoses will have non-specific inflammation, and this is a common cause of false positive CT and MR enterography exams in our experience. Anastomotic inflammation is usually mild and symmetric with respect to the bowel lumen. CD recurrence is characterized by asymmetry, ulcers, intramural edema and proximal extension.

**Case 1: Nonspecific Inflammation.** 49yo F Crohn’s s/p re-establishment of bowel continuity in 2013, asymptomatic despite symmetric-appearing neo-terminal ileal hyperenhancement on MRI. Finding was unchanged from prior exam, unaccompanied by abnormal DWI signal, and correlative endoscopy was normal. Symmetric hyperenhancement on both sides of the anastomosis with mild wall thickening is non-specific and should not be labeled as recurrent Crohn’s inflammation.

**Case 2: Recurrent CD.** 60M 10 years s/p 2nd bowel resection for recurrent Crohn’s of neoterminal ileum. MRE (left images): moderate circumferential wall thickening, mild mural hyperenhancement with Comb sign involving the distal 5 cm of neoterminal ileum to the level of the ileo-ascending colonic anastomosis. Findings are consistent with recurrent Crohn’s inflammation. Endoscopy (inset) showed erythema, ulceration, and narrowing, involving the terminal ileum.
Anastomosis complications and differential diagnosis: Inflammation, Stricture, Recurrent Crohn’s, Vascular Complications

Case 1: Mild inflammation or ischemic change. 43 y/o F s/p end-to-side ileocolic anastomosis (white arrow) with symmetrical and short-segment mural edema in the TI (left) and hyperenhancement (right). Ileoscopy was normal. Clinical f/u demonstrated absence of recurrent disease. Mild, short-segment hyperenhancement and wall thickening is non-specific and is not recurrent Crohn’s disease.

Case 2: Chronic PSBO at side-to-side anastomosis due to chronic inflammation. Ongoing dilation at site of side-to-side anastomosis, feces sign indicating stasis, and down stream focal narrowing and inflammation suggests partial obstruction secondary to chronic inflammation. Treated conservatively thus far. Chronic inflammation can lead to fibrostenotic disease, which is more likely to require surgical management.

Case 3: Obstruction secondary to active CD. Axial LAVA (left) and axial FS FIESTA (right) with 5cm segment of active inflammation. (red arrows) proximal to anastomosis. Bowel dilatation proximal to stricture (blue arrows). Usually found at pre-anastomotic site.

Case 4: Vascular sequelae of anastomoses. Vascular sequelae, such as the perianastomotic varices demonstrated in this 32 y/o M s/p jejunojejunal side-to-side anastomosis with chronic mesenteric vein thrombus (not shown), are not infrequently seen. Ischemia is the most common vascular complication and often leads to stricture.
Anastomosis complications and differential diagnosis:

**Fistulas: Surgical vs. Penetrating Crohn’s**

Surgical fistulas generally originate in the peri-operative period. Crohn’s fistulas are almost always associated with the development of an inflammatory stricture, often at the efferent limb of a side-to-side anastomosis.

**Case 1: Penetrating Crohn’s Fistula.** 57yo M with prior segmental small bowel resection and ileorectostomy (left). Multiple exams demonstrated a small fistulous tract extending from just proximal to the ileosigmoid anastomosis to an adjacent loop of ileum (red arrow).

**Case 2: Surgical Fistula.** CT shows ileocolostomy (white arrow) in pelvis without inflammation, with leak from anastomosis and long fistulous tract (red arrows) from the anastomosis to cutaneous opening in the left lower abdomen. Fistulogram from same day with redemontstration of fistulous tract.
Anastomosis complications and differential diagnosis: Fistulas: Surgical vs. Penetrating Crohn’s

Case 3: Penetrating Crohn’s Fistula. 69 y/o M s/p jejunocolic anastomosis for CD (white arrows) with ileal bypass. Diseased loop of distal ileum with marked mural hyperenhancement and thickening, with perienteric fat stranding, indicating severe ileal inflammation. Penetrating complications are seen with a large (blue arrow) and small (red arrow) enteroenteric fistulas arising from the stenotic and inflamed ileum just proximal to the anastomosis. There is an enterolith (yellow arrow) proximal to the inflamed and stenotic distal ileum.
Bacterial Overgrowth Syndrome (BOS)
Colonization of the small bowel with a high concentration of bacteria. Commonly occurs in capacious enterointerostomies, thought to be secondary to stasis of bowel contents. Can cause excessive fermentation, inflammation, or malabsorption.

Risk factors: intestinal surgery or dysmotility, elderly, loss of gastric acidity

Symptoms: bloating, diarrhea, B12 deficiency, weight loss

Diagnosis: carbohydrate breath test or positive jejunal culture

Treatment: 7-10 day course of antibiotics; some patients require longer duration of rotating antibiotics

Case 1: Bacterial Overgrowth Syndrome. 57y/o M s/p side-to-side ileocolic anastomosis diagnosed clinically with BOS. Cor CTE shows fecalization of small bowel contents in a capacious anastomotic lumen. Fecalization of small bowel contents may suggest bacterial overgrowth.

Case 2: Bacterial Overgrowth Syndrome. 28y/o F with BOS. S/p side-to-side ileocolic anastomosis with capacious lumen (left) and fecalization of small bowel contents.
Anastomosis complications: Miscellaneous

Enteroliths

Intraluminal gastrointestinal concretions that develop in the setting of intestinal stasis from substances found in normal succus entericus. Usually found in an effected segment of bowel.

**Risk factors:** Patients with CD are predisposed to enterolith formation due to bowel stenosis from inflammatory strictures.

**Symptoms:** Enteroliths in CD are intraluminal and may become impacted causing acute intestinal obstruction, mucosal erosions, bleeding, or perforation, typically presenting with abdominal pain.

**Treatment:** Enterolithotomy and segmental resection or endoscopic electrohydraulic lithotripsy.

*Case 1: Enteroliths.* 44 y/o M with CD demonstrating multiple enteroliths proximal to a dilated ileoileostomy

*Case 2: Enteroliths.* 77 y/o M with CD demonstrating two large enteroliths in the jejunum proximal to an inflamed and strictured ileocolonic anastomosis.
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA): Complications

- Leak
- Pouchitis vs. Recurrent Crohn’s
- Fistulizing Disease of the J-Pouch
- J-Pouch Prolapse
- Anastomotic Stricture
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications:

**Leak**

**General:**
Typically occur at the ileoanal anastomosis (case 1 below) or at the oversewn edge of the blind limb (case 2). Fluid from a leak at the ileoanal anastomosis will often track posteriorly along the levator plate into a pre-sacral collection (see red arrows). Similar to other enteric anastomoses, evidence is sparse to suggest whether hand-sewn or stapled anastomoses reduce risk of leak.

**Case 1:** 25 y/o M with ileoanal anastomotic leak. CT detected a resolving hematoma posterior to the pouch with a small locule of air. Fluoroscopy showed a sinus track arising form the ileoanal anastomosis.

**Case 2:** 29 y/o M with blind end leak. Pouch eventually excised because of recurrent presacral abscess.
J-Pouch (Ileal Pouch- Anal Anastomosis or IPAA) Complications:

Leak: Blind End and Anal Anastomosis

Case 2: Blind end leak. 24 y/o F 2 weeks s/p IPAA for ulcerative colitis. Collection of gas bubbles in the presacral space with scant associated fluid and surrounding inflammatory changes. Right: Pouchogram shows a small trickle of contrast into the presacral space, likely coming from the stapled blind end of the pouch appendage.

Case 1: Anal anastomosis leak. 12 y/o M s/p IPAA for ulcerative colitis. Top: MR shows fluid extending from the pouch to the left of the anastomosis (blue arrow), suspicious for leak. Bottom row: Large leak and fistulous tract (green arrow), with stenotic and ulcerated distal pouch (red arrow).
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications: 

**Leak: Continued**

**Blow Out of the Blind Limb**

**Case Example:** 14y/o F with Crohn’s, s/p IPAA for presumed UC, later diagnosed with CD. Presented with increasing back and pelvic pain x6 months and fever x2 weeks. CT demonstrated presacral soft tissue thickening and air (left and center images), which extends from the superior aspect of the ileoanal pouch (B, left) with suggestion of a fistulous tract between the posterior aspect of the pouch and the presacral inflammatory changes. Associated erosion of the anterior aspect of the sacrum (right). Findings most consistent with a small pouch fistula with chronic infection and adjacent osteomyelitis. Retrospectively, these findings were present on separate CT and MRI examinations performed six months prior. 
P=pouch, B=blind end.
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications: *Pouchitis vs. Recurrent Crohn’s*

Discernment of diagnosis often relies upon the distribution of disease, specifically the status of the pre-pouch ileum and perianal disease. Pouchitis occurs in over one-quarter of patients. Pouchoscopy often demonstrates non-specific inflammation. Histology of pouch is often unhelpful.

**Case 1: Pouchitis.** 8 y/o M with IPAA for UC. Increased enhancement of the ileoanal pouch with surrounding inflammatory edema in the adjacent fat. Findings and clinical picture consistent with acute pouchitis, which responded to antibiotic therapy.

**Case 2: Recurrent CD of pouch and pre-pouch ileum.** 28y/o M s/p J-pouch for UC, features of CD later. Mural hyperenhancement of the pouch and inflammatory changes of the pre-pouch ileum (arrow) on CT (left, center). Diffuse inflammation, characterized by congestion, erosions, erythema, friability and confluent ulcerations was found in the ileoanal pouch on pouchoscopy (right).
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications: 
**Fistulizing Disease of the J-Pouch**

Commonly pouch-cutaneous fistulas. Occurs in an estimated 20-30% of Crohn’s patients with J-pouch anastomosis. Seton placement is often employed to promote healing.

**Case 1:** 16y/o M s/p IPAA for presumed UC, later diagnosed with CD. Large recurrent left supra-sphincteric fistula extending inferiorly from the base of the ileal pouch at about the 5 o’clock position (both images).

**Case 2:** Recurrent CD with perianal abscess and fistulas. 21 y/o F s/p IPAA for presumed UC 10 years prior. MR shows circumferential abscess (red arrow) around the lower pouch with large left peri-pouch fistula with granulation tissue and debris (yellow arrow).
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications: Pouch Prolapse

**General:** Prolapse of the J-pouch is a rare and debilitating condition with sparse data to guide management. J-pouch pexy is often employed as a reparative measure.

**Case 1: Full-thickness Pouch Prolapse:** 57y/o F s/p IPAA for UC. Recurrent prolapse of the J-pouch. Dynamic MR proctogram demonstrates initial peritoneocele posterior to the pouch (red arrow), prolapse of the left and posterior aspects of the pouch as well as a peritoneocele containing peri pouch ischioanal fat through the anal canal with defecation (white arrows).
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications:  
**Pouch Prolapse Continued**

**Case 2: Full-thickness Pouch Prolapse.** 29y/o M s/p IPAA for UC. Sequential MR proctogram images demonstrate descent of the posterior wall of the pouch with coaptation the anal canal, which functionally obstructs the outflow of the proximal pouch contents (top row), eventually followed by full thickness prolapse (bottom left). Concurrent endoanal imaging of the sphincters demonstrates thickened internal anal sphincter, which is often seen in rectal prolapse (bottom right). Ultimately treated surgically with J-pouch pexy with no recurrence x5 years.
J-Pouch (Ileal Pouch-Anal Anastomosis or IPAA) Complications:

**Anastomotic Stricture**

Most frequently occur in the anal canal and neoterminal ileum. Usually appreciated as a distended pouch.

*Case: Anastomotic Stricture.* 8y/o M s/p IPAA for presumed UC, later diagnosed with CD. CT and MR imaging demonstrate the ileal pouch to be moderately dilated and contains a large amount of fecal material suggesting distal stricture with poor emptying.
Conclusion & Clinical Implications

• Various methods of anastomosis are employed following enteric resection in Crohn’s disease, each with distinct indications, CT and MRI appearances, and optimal methods for imaging suspected complications.

• CT and MRI often aid in the detection and diagnosis of postoperative complications and disease recurrence.

• Radiologists should be familiar with the normal appearance of enteric anastomoses and the spectrum of complications that can arise in order to guide treatment in these frequently asymptomatic and immunocompromised patients.

• Further analysis is needed to determine whether each anastomotic technique produces specific patterns of postoperative complications and disease recurrence, and further, whether these patterns are demonstrated on CT or MR imaging.
References


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