

Laparoscopic Surgery for Crohn Disease: A Brief Review of the Literature

Cary B. Aarons, MD¹

¹Division of Colon and Rectal Surgery, University of Pennsylvania, Perelman School of Medicine, Philadelphia, Pennsylvania

Address for correspondence Cary B. Aarons, MD, Division of Colon and Rectal Surgery, University of Pennsylvania, Perelman School of Medicine, Philadelphia, PA (e-mail: cary.aarons@uphs.upenn.edu).

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Abstract

Crohn disease remains a challenging clinical entity, both medically and surgically. It frequently presents in early adulthood and imposes a lifetime exposure to chronic inflammation that can affect the entire gastrointestinal tract. Although the mainstay of therapy is treatment with immunomodulating drugs, ~70 to 90% of patients with Crohn disease will ultimately require surgery. Furthermore, there are high rates of symptomatic recurrences that may also require surgical intervention over time. There is no definitive cure for Crohn disease and surgery is reserved for failed medical therapy or the complications of the disease, namely, obstruction, septic complications (abscess, perforation), and fistulas. However, the robust inflammatory environment during these periods is not always conducive to a minimally invasive surgical approach. Despite the inherent technical challenges, the literature has increasingly shown that laparoscopy for Crohn disease, in the appropriate setting, is feasible and safe. In fact, it offers many advantages, which are particularly beneficial to this subset of patients, such as fewer wound complications, a shortened hospital course, less tissue trauma and subsequent adhesion formation, and earlier resumption of oral intake and bowel function.

Keywords

- ▶ laparoscopy
- ▶ Crohn disease
- ▶ minimally invasive surgery

Objectives: Upon completion of this article, the reader should be able to (1) understand the indications for surgical management of Crohn disease, (2) identify the potential challenges of a laparoscopic approach, (3) identify the short- and long-term benefits of laparoscopy in Crohn disease, and (4) identify alternative laparoscopic approaches.

Background

Crohn disease (CD) is an inflammatory condition that can affect the entire gastrointestinal tract from the mouth to the anus. The incidence is ~5 to 15 per 100,000 people per year, with a prevalence of ~50 to 200 per 100,000 people. Globally, the incidence of CD has increased steadily during the last six decades, but has started to stabilize in certain high incidence areas.^{1,2} Histologically, it is characterized by areas of patchy, transmural inflammation of the affected bowel wall. Although the patterns of disease within the intra-abdominal intestinal tract are varied, the most commonly affected area is

the terminal ileum and cecum (55%). Other areas include small bowel disease only (11–48%), colon disease only (19–51%), and combined small and large intestine (26–48%).^{2,3} Despite the incredible advances in the medications for inflammatory bowel disease, surgery remains an important component in the management of CD, but it is generally reserved for failure of medical management or complications. It has been estimated that 70 to 90% of patients, who are typically young adults, will ultimately require surgery over the course of their lifetime.^{2–4} Of these, 30 to 50% will have symptomatic recurrence of disease during the first 5 years and 50 to 80% by 10 years after surgery.⁵ Approximately 40 to 50% of patients undergoing surgery are likely to need further operations within 10 to 15 years.⁴

The advent of laparoscopic surgery has dramatically changed the landscape of colorectal surgery for both benign and malignant disease. When compared with traditional open surgery, laparoscopy offers well-described benefits such as decreased pain, lower wound complication rates,

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improved pulmonary function, earlier resumption of diet and bowel function, better cosmesis, and shorter hospital stays.^{2,6-8} However, widespread use of laparoscopy in inflammatory bowel disease has been more limited due to technical constraints. The inflammation encountered in CD is often multifocal and makes a minimally invasive approach challenging due to a thickened mesentery, as well as the potential for fistulas, abscesses, and large phlegmons.^{2,8-10} The lack of tactile feedback also potentially limits the identification of occult disease.

In 2009, Lesperance et al analyzed national trends for surgical resections in CD from 2000 to 2004 using data collected from the Nationwide Inpatient Sample (NIS), a large inpatient administrative database. Of the 49,609 patients admitted for CD that required surgical treatment, laparoscopic resection was only performed in 6% of cases (2,826 patients) and was associated with fewer complications, shorter length of stay, and lower charges. These short-term benefits of laparoscopy are particularly advantageous in this group of patients that often come to surgery malnourished and on potent immunosuppressive medications. Multivariate analysis for factors that influenced a laparoscopic approach included age less than 35 years, female gender, ileocecal disease location, and performance in a teaching hospital.⁸

While respecting the limitations of laparoscopy, experienced laparoscopists are taking advantage of these benefits in routine and complex cases with good results.

Ileocolic Disease

Ileocolic inflammation is the most common pattern of disease in CD.

There is a large body of data that demonstrates that a laparoscopic approach for resection in this area is as efficacious as conventional open surgery with many added short-term benefits. In 2001, Milsom et al¹¹ published the first prospective, randomized clinical trial comparing these two approaches for ileocolic resections in CD. They randomized 60 patients after initial diagnostic laparoscopy and found that while the laparoscopic approach had longer operative times, it resulted in faster recovery of pulmonary function (measured FEV1 and FVC) and fewer minor complications (wound infection, bowel obstruction, ileus, hernia). There was no statistically significant difference in recovery of bowel function, major complications, or length of stay in the hospital.¹¹

In 2006, Maartense et al¹² reported a multicenter, randomized trial with similar results. Sixty patients were randomized to laparoscopic or open resections for ileocolic disease. Similar to the previous randomized trial, they found that laparoscopy was associated with longer operative times, but resulted in shorter hospital stays, decreased morbidity (minor and major complications within 30 days), and decreased cost. There was no significant difference in morphine requirement, pain scores, or quality of life at 3 months.¹² Both studies reported similar conversion rates. Milsom et al reported two cases of conversion (6.5%) and Maartense et al reported a 10% conversion rate. These groundbreaking stud-

ies provided good initial data to support the utility of laparoscopic surgery in CD, but were limited by their small size.

In a recent review, combing data from these two randomized trials, the authors concluded that laparoscopic surgery for small bowel CD was safe and feasible, but did not impart a definitive advantage over open surgery. Specifically, there were no statistical significant differences in rates of wound infection, pneumonia, urinary tract infection, anastomotic leak, intra-abdominal abscess, duration of hospital stay, or reoperation for disease recurrence. The open group had significantly shorter operative times.²

There have been three meta-analyses in the literature on this topic, which are summarized in **Table 1**. Most recently, Tan et al published a meta-analysis of 14 studies from 1990 to 2006. This included 881 patients undergoing laparoscopic and open surgery for CD, of which ileocolic resection was the most common procedure performed. Consistent with the existing data, they found that the laparoscopic group had longer operative times, faster recovery of bowel function, and shorter length of stay. Overall morbidity was significantly lower in the laparoscopic group (12.8 vs. 20.2%). There was no statistical significance in wound infection, anastomotic leak, intra-abdominal abscess, deep vein thrombosis, pneumonia, or urinary tract infection.⁷

Given these data, surgeons have embraced laparoscopy as the preferred approach for uncomplicated ileocolic disease.

Colonic Disease

There is abundant data that a minimally invasive approach is efficacious for resection of ileocolonic CD. Understandably, in the early years of laparoscopy, surgeons have approached laparoscopic colectomy for CD with a little more trepidation. The handling of a broader, thickened mesentery is challenging, especially in settings where patients present to surgery later, often on multiple immunomodulators and corticosteroids. However, as experience with laparoscopy has grown alongside improving surgical technology over the past decade, the indications for laparoscopic surgery in CD has expanded to include more complex colonic resections.

In a small case-matched series in 2007, da Luz Moreira et al¹³ concluded that laparoscopic colectomy is a safe and acceptable option for patients with Crohn colitis. In this study, the authors compared short-term outcomes in patients with Crohn colitis undergoing either laparoscopic or open colectomy from 1994 to 2005. The study cohort of 54 patients included 27 laparoscopic patients matched with open colectomy patients. There were longer operative times in the laparoscopic group, but no significant differences in the estimated blood loss or postoperative complications. Total length of stay (including 30-day readmissions) was shorter in the laparoscopic group. Recovery of bowel function and recurrence of disease requiring intervention were shorter in the laparoscopic group, but not statistically significant. The conversion rate in this study was slightly higher than that seen in the literature at 26%.¹³

More recently, Holubar et al sought to expand upon the literature by identifying outcomes as well as predictors of

Table 1 Summary of meta-analyses for laparoscopic versus open surgery for Crohn disease

Study	Composition	Op room time	Blood loss	Recovery of bowel function	Duration of hospital stay	Complications	Conversion rate (range)
Rosman et al (2005)	16 Studies (1990–2004): 1 RCT; 13 retrospective; 2 prospective 840 patients (396 lap)	Longer in lap group (26.8 min; 95% CI, 6.4–47.2 min)	No difference between groups	Faster in lap group (time to first flatus –0.82 d; 95% CI, –1.30 to –0.33 d)	Shorter in lap group (–2.62 d; 95% CI, –3.62 to –1.62 d)	Fewer (total and major) ^a in lap group	7% (0–29%)
Tilne et al (2006)	15 Studies (1994–2005): 1 RCT; 8 retrospective; 6 prospective observational 783 patients (338 lap)	Longer in lap group (29.59 min; 95% CI, 11.27–47.90 min)	No difference between groups	Faster in lap group (time to first flatus –0.68 d; 95% CI, –1.20 to –0.17 d)	Shorter in lap group (–2.97 d; 95% CI, –3.89 to –2.04 d)	No difference between groups ^b	6.8% (4.8–22.2%)
Tan et al (2007)	14 Studies (1990–2006): 2 RCT; 10 retrospective; 2 case-matched 881 patients (397 lap)	Longer in lap group (25.54 min; 95% CI, 3.17–47.91 min)	No difference between groups	Faster in lap group (time to bowel function –0.75 d; 95% CI, –1.37 to –0.13 d)	Shorter in lap group (–1.82 d; 95% CI, –3.32 to –0.32 d)	Fewer in lap group ^c	11.2% (4.8–29.2%)

Abbreviations: CI, confidence interval; lap, laparoscopic; OR, odds ratio; RCT, randomized controlled trial.

Note: Meta-analysis performed for each individual complication did not show any difference between laparoscopic and open groups.

^aTotal complications (OR, 0.62; 95% CI, 0.42–0.91) and major complications (OR, 0.50; 95% CI, 0.27–0.96). No statistically significant difference between the two procedures for early reoperation or complications.

^bAnastomotic leak (OR, 1.33; 95% CI, 0.4–4.43; *p* = 0.64); wound infection (OR, 1.25; 95% CI, 0.7–2.77; *p* = 0.57); bowel obstruction (OR, 0.38; 95% CI, 0.13–1.10; *p* = 0.07); intra-abdominal abscess (OR, 0.83; 95% CI, 0.22–3.17; *p* = 0.79).

^cThe morbidity rate for laparoscopic surgery was 12.8% compared with 20.2% for open surgery (OR, 0.57; 95% CI, 0.37–0.87; *p* = 0.01).

Recurrent Disease

As outlined in the review of previous studies, there is ample data to support the safety and feasibility of laparoscopic surgery in primary resections for CD in various anatomic positions. More recently, there has been a growing body of data to also support the role of laparoscopy in resection of recurrent disease, despite the inherent complexity. Authors emphasize the importance of patient selection, but it has been shown that this approach is safe and feasible with acceptable conversion rates and comparable morbidity to primary resections.

conversion and postoperative complications in a larger, single institution study from the Mayo Clinic. They identified 92 patients with Crohn colitis from over an 11-year period (1997–2008) in a prospectively maintained institutional database. The most common procedure performed was a total proctocolectomy with end ileostomy and the most common segmental resection performed was a sigmoid colectomy. Total colectomy was performed in 47% of cases, segmental colectomy in 35%, and subtotal colectomy in 18%. The main indications for surgery were refractory colitis (90%) and neoplasia (10%). Short-term complications occurred in 34% of patients wherein surgical site infection was the most common (42%). Patients undergoing a total colectomy were more likely to develop a complication (42%). Seven patients (7.6%) developed complications requiring reintervention (obstruction, *n* = 3; anastomotic leak, *n* = 2; perineal wound dehiscence, *n* = 1; and recurrent vesiculovaginal fistula, *n* = 1). There was no 30-day mortality. Interestingly, multivariate analysis demonstrated that only perianal disease was associated with an increased risk of postoperative complications. There was a 16% conversion rate without associated increase in length of stay or complications. Small bowel disease was the main predictor of conversion.¹⁴

In the largest series to date, Umansky et al compared the short-term outcomes of patients with Crohn colitis undergoing either laparoscopic or open colectomy from 2002 to 2008. There were 125 consecutive patients identified retrospectively (55 laparoscopic (44%) and 70 open (56%)). The laparoscopic group had a significantly higher body mass index and was less likely to have had previous surgery, but had similar duration of disease as compared with the open cohort. In line with previous studies, the authors found that the laparoscopic group had earlier return of bowel function and shorter hospital stays. However, contrary to previous works they found that laparoscopic surgery was associated with shorter operative times, less estimated blood loss, fewer postoperative complications and decreased disease recurrence. The conversion rate of 10.9% is similar to those found in trials for ileocolic resection. In conjunction with the faster operative times, the data from this series can be viewed as a marker of the considerable accumulated experience that the authors have gained with laparoscopy.¹⁵

These studies suggest that laparoscopic colectomy in Crohn colitis is safe and effective in experienced hands with appropriate patient selection.

Recently, Holubar et al reported a series of 40 patients undergoing laparoscopy for recurrent ileocolic disease from 1998 to 2008. Ninety-five percent of the cohort of patients had previous open resections, with 14 patients (37.5%) having more than one prior bowel resection. Laparoscopic resection was successfully completed in 75% of cases. Moderate to severe adhesions prompted conversion in 80% of the cases and were the only significant risk factor for conversion. Operative time, estimated blood loss, and the time to return of bowel function did not differ significantly between groups. The length of hospital stay was significantly longer in the converted group when compared with the laparoscopic group (7 vs. 4 days, respectively). There was one intraoperative complication in the lap-converted group due to a paraduodenal hematoma. Short-term complications did not differ significantly between groups.⁶ This study elucidates that a laparoscopic approach is safe in patients with CD with recurrent ileocolic disease. Furthermore, the conversion of these cases to a more conventional approach does not confer a poorer short-term outcome.

There have been two recent studies that have compared the short-term outcomes of laparoscopic surgery for recurrent ileocolic CD with those of primary resection. Chaudhary et al identified 59 consecutive patients with ileocolic disease who underwent laparoscopic resection. Thirty patients had recurrent disease and 20 patients had primary resections. Not surprisingly, they found that the operative times were longer in the group with recurrent disease. However, there was no statistically significant difference in length of stay, time to tolerating a diet, and complications (including wound infection, ileus, anastomotic leak, abscess, chest infection, and readmissions). The overall morbidity for the study cohort was 15%, but unlike other studies, this rate increased to 40% for the patients that required conversion. They found an overall conversion rate of 8.5% (6.7% in the recurrent resection group and 10.3% in the primary resection group). Similar to previous studies, the primary indication for conversion in the recurrent resection group was dense adhesions. In the primary resection group, the main indications for conversion were the need for further procedures including strictureplasties and synchronous colon resection.¹⁶

In 2011, Pinto et al reported findings on a larger cohort of patients with a similar study design. They identified 130 patients who had either primary laparoscopy (80 patients) or reoperative laparoscopy (50 patients) for CD from 2001 to 2008. These patients had similar preoperative demographics, including the length and doses of immunosuppressive medications. The indications for surgery were standard and did not differ between groups. These included obstruction, fistulas, unresponsiveness to medical treatment, and toxic colitis. The most common resection performed in both groups was an ileocolic resection with or without an additional resection (73.7% primary laparoscopy vs. 80% reoperative laparoscopy). Surgical outcomes were similar between groups. There were no statistical differences in overall and laparoscopic operative times, estimated blood loss, time to first bowel movement, or length of stay. The overall complication rate was slightly higher in the reoperative laparoscopy group (40 vs. 36.2%

in the primary laparoscopy group), but was not significantly different. Furthermore, there was no difference in the rates of minor or major complications. The conversion rate was higher in the reoperative laparoscopy group (32 vs. 18.7%) and the primary indication for conversion was adhesion formation due to prior surgery. There was one intraoperative complication in each group (a bowel injury in the primary laparoscopy group and a ureteral injury in the reoperative group).

These studies are primarily limited by their small size and retrospective design, but they present congruent findings that support the safety of an initial minimally invasive approach to recurrent disease in patients with CD.

Alternative Laparoscopic Approaches

The learning curve for laparoscopy is relatively steep. There have been several studies comparing laparoscopic and open surgery that have established that at least 20 to 40 cases are necessary to refine the laparoscopic skillset to be able to safely perform complex laparoscopic cases.^{17,18} There have been alternative modalities that have expanded the footprint of laparoscopy such as hand-assisted laparoscopic surgery (HALS) and single-incision laparoscopic surgery (SILS) that maintain the fundamental benefits of minimally invasive surgery.

Hand-Assisted Laparoscopic Surgery

Hand-assisted laparoscopic surgery (HALS) has gained considerable acceptance as a practical alternative to traditional laparoscopic surgery. For routine colectomy procedures, HALS results in similar clinical outcomes as compared with standard laparoscopy¹⁹; however, its routine use in Crohn colitis has not been studied as extensively. With the use of a hand-access device, usually via a lower midline or Pfannenstiel incision, HALS provides tactile feedback and the ability for adequate retraction that may be beneficial in this subset of patients due to the inflammation, thickened mesentery, the potential for abscesses and fistulas, and bulky specimens that may not be appropriate for standard laparoscopy.

Nakajima et al compared open, laparoscopic, and hand-assisted laparoscopy in the management of extensive Crohn colitis in 38 patients undergoing subtotal or total abdominal colectomy. There were 14 open, 6 laparoscopic, and 18 HAL colectomies. They found that the laparoscopic group had significantly longer operative times (median 330 minutes), while that HALS group (median 251 minutes) had only slightly longer times as compared with the open group (median 200 minutes). This difference was not statistically significant. A larger previous study has shown no difference in operative times between laparoscopic and HALS.¹⁴ The HALS and laparoscopic groups had significantly less blood loss. There was no difference between the three groups in postoperative complications. There were no major complications identified and no postoperative deaths. There were no conversions to an open procedure in either laparoscopic approach. Data were not given on length of hospital stay or recovery of bowel function.²⁰

Single-Incision Laparoscopic Surgery

As surgeons become more adept with laparoscopic surgery, SILS has become increasingly used in a variety of colorectal procedures, including inflammatory bowel disease. There have been two recent studies that underscore the safety and feasibility of SILS for CD.

In 2012, Stewart et al published data on their early experience with six patients with CD and with complicated ileocolic disease (paracolic abscess, phlegmon, and a fistula). The mean operative times and estimated blood loss were comparable to standard laparoscopy. One patient required the insertion of an additional trocar for retraction, but there were no conversions to open laparotomy. Mean time to recovery of bowel function was 1.6 days and the mean length of stay was 4.8 days. Thirty-day morbidity was 33.3% (one wound infection and one intra-abdominal abscess) and there were no intraoperative complications. There was no 30-day mortality.²¹

In a slightly larger series, Rijcken et al reported results on 20 patients with ileocolic CD, which were compared with patients undergoing standard laparoscopy in a retrospective match-pair control study. All procedures were performed for medically refractory strictures. Surprisingly, they found that operative times were significantly shorter in the SILS group. There were no statistically different differences in postoperative pain scores or length of stay (SILS group—9 days; laparoscopy group—9.2 days). Each group had a 20% postoperative morbidity rate, which included anastomotic leaks (one in each group), wound infections, ileus, and intra-abdominal abscess. There were no intraoperative complications and conversion rates were similar (SILS group—5%; laparoscopy group—10%).²²

Long-Term Recurrence

Inherently, CD is a chronic, lifelong problem. Although there are several studies showing solid short-term outcomes for laparoscopic surgery in CD, the data on long-term outcomes are sparse. Recently, there have been published reports of long-term follow-up of each randomized trial comparing laparoscopic and open resections of ileocolic disease.

Eshuis et al reported results of 55 patients (26 in the open group and 29 in the laparoscopic group) available for analysis from one previous trial.¹² The median follow-up time was 6.7 years (range 5.7–7.9 years). Overall, 58% of patients had disease in remission, but there were 10 patients (38%) in the open group and 13 patients (44%) in the laparoscopic group that had clinical recurrence. In this study, recurrence was determined by history or as disease evident on endoscopy, or radiographically. Twenty-four percent of patients were on medical management at the time of the study (six patients in the open group and seven patients in the laparoscopic group). There were five patients that required resection of their ileocolic anastomosis (three patients in the open group and two in the laparoscopic group). Additionally, in the open group, two patients required incisional hernia repair and one patient required surgery for adhesiolysis.²³

Stocchi et al reported results on 56 patients (29 in the open group and 27 in the laparoscopic group) previously enrolled in another randomized trial.¹¹ The mean follow-up time was 10.5 years and the overall recurrence rate was 52%. There were similar endoscopic and radiographic recurrences between groups. After the index procedure, 78.5% of patients were maintained on immunosuppressive medications. Eight patients in each group (26% laparoscopic group and 28% open group) underwent reoperative surgery for disease recurrence (primarily at the ileocolic anastomosis). There were four (14%) incisional hernia repairs in the open group compared with 1 (4%) in the laparoscopic group. There were two procedures for adhesiolysis in the laparoscopic group and none in the open group.²⁴

A larger, retrospective study of 113 patients undergoing resection of ileocolic CD from 1987 to 2003 identified similar long-term results. In this study, there were 63 patients who had laparoscopic resections (mean follow-up 62.9 months) that were compared with 50 patients with open resections (mean follow-up 81.5 months). The median time to first recurrence, which was defined in this study as new preanastomotic CD requiring surgery, was 60 months in the laparoscopic group and 62 months in the open group. Six patients in the laparoscopic group (9.5%) had surgical recurrence, which compared favorably with the 12 patients in the open group (24%). This was not statistically significant. Importantly, the rate of chemoprophylaxis was similar between groups.²⁵

Conclusion

CD is a challenging, lifelong medical problem that can affect various parts of the gastrointestinal tract. Patients often have the need for potent immunosuppressive medications and develop complications that require surgery. In fact, because of the relapsing and remitting nature of the disease, a majority of patients will eventually require surgical intervention.

The current body of data suggests that, in properly selected patients, laparoscopy offers excellent short- and long-term outcomes similar to conventional open surgery. Although operative times are generally longer in a laparoscopic approach, there are well-established benefits in improved cosmesis, quicker return of bowel function, and shorter hospital stay. Laparoscopy is also possible in recurrent disease and confers similar benefits to primary resections. Given some of the inherent complexities of surgery for CD, there is a learning curve associated with laparoscopic surgery in this subset of patients. However, as most clinical practices incorporate complex laparoscopy for benign and malignant colorectal disease, these data support adding a minimally invasive surgery as a preferred approach in CD.

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