

# Minimally Invasive Surgery in Complex Crohn's Disease

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## Abstract

### Keywords

- ▶ robotic completion proctectomy
- ▶ laparoscopic ileocecal resection
- ▶ fistulizing Crohn's disease

Minimally invasive approaches are safe, feasible, and often recommended as the initial choice in the surgical management of Crohn's disease. However, a consensus has not been reached as the ideal approach in the surgical treatment of complex and recurrent Crohn's disease. Laparoscopy may provide advantages such as shorter length of stay and decreased postoperative pain and result in less adhesion formation in patients with complex disease. Robotic techniques may be beneficial in selected patients for completion proctectomy, providing better visualization in the narrow pelvis and increased dexterity. Decision of surgical technique should be made on a case-by-case basis.

## Definitions and History

Management of Crohn's disease begins with medical treatment. However, regardless of the advancements in medical therapy and newly introduced agents, during the course of the disease, surgery may be required in up to 80% of the patients.<sup>1</sup> Besides refractory medical treatment, indications for surgery in Crohn's disease may range from complications due to medical therapy to complications from the disease itself such as abscesses, perforation, and fistulas.

Penetrating disease is described as a behavioral subtype by the Montreal Classification.<sup>2</sup> Description of complex and penetrating Crohn's disease may include perforating disease with fistulas, intra-abdominal abscesses, and even free perforations. Behavioral pattern of disease may progress over time and this may lead to a requirement of surgery. Management of complex Crohn's disease remains to be a challenging topic for the practicing surgeon.

## Guidelines and Recommendations

Practice guidelines from Europe and United States have looked into the surgical management of complex Crohn's disease and discussed the evidence regarding minimally invasive approaches. According to clinical practice guidelines published by American College of Colon and Rectal Surgeons in 2007, laparoscopic surgery was equivalent to open approach.<sup>3</sup> It is also stated that if penetrating ileocolonic disease was not complicated, resection can either be performed with laparoscopic approach or open surgery.

Clinical Practice Guidelines published by ASCRS in 2015 state that laparoscopic approach can be safely used when the adequate surgical expertise and experience is available with a level 1B recommendation (strong recommendation based on moderate-quality evidence).<sup>4</sup>

Additionally, according to 2016 European Crohn's and Colitis Organization, laparoscopy can be preferred for ileocolonic resections in Crohn's disease where appropriate expertise is available; however, the role of laparoscopy can be considered for more complex disease. In more complex cases or for recurrent resection, sufficient evidence does not exist recommending laparoscopic surgery.<sup>5</sup> Thus, consensus is formed for implementing laparoscopy in straightforward Crohn's disease, but application in more complex disease is still debated.

## Laparoscopic Approach

Laparoscopic surgery for Crohn's disease was first described by Milsom et al in 1993 in nine patients.<sup>6</sup> Since that time, laparoscopy has gradually increased in patients with Crohn's disease. Application for complex disease remains a controversial topic because complicated anatomy with fistulas or abscesses might make the laparoscopic approach challenging especially for novice laparoscopist.<sup>7</sup>

Laparoscopic surgery is favored because it provides benefits such as shorter operative time and better cosmetic results when compared with open surgery. Lower degree of adhesion formation after laparoscopic surgery compared with open surgery<sup>8</sup> could be another beneficial property for

complex Crohn's disease patients in the short and long term. It may be possible that as we see further advancements in medical therapy for Crohn's disease, time of surgery could be delayed. Subsequently, this may lead to more and more patients presenting with more complex disease.

Studies looking at feasibility of laparoscopic surgery in patients with complex Crohn's disease are mostly limited by small numbers.<sup>9-13</sup> A summary of literature reporting use of laparoscopic surgery in complex Crohn's disease is given in ►Table 1.<sup>9-23</sup> One of the reported series with large case

**Table 1** Studies reporting results with laparoscopic approach for complex Crohn's disease

Study year	Authors	Number of patient population	Study design	Results
1997	Wu et al <sup>14</sup>	116 (46 lap with 24 complex vs. 70 open)	Prospective	Longer operative time in open ( $p < 0.05$ ), higher blood loss in open ( $p < 0.05$ ) LOS shorter in lap ( $p < 0.01$ )
2003	Hasegawa et al <sup>15</sup>	52 (61 lap, 45 primary vs. 16 recurrent, -7 lap vs. 9 open)	Retrospective	Shorter operative time in open group ( $p = 0.042$ ) Shorter operative time in primary group ( $p = 0.012$ )
2004	Uchikoshi et al <sup>16</sup>	43 for recurrent disease (17 lap vs. 6 HALS vs. 20 open)	Retrospective	Flatus earliest in HALS ( $p < 0.05$ ) LOS shortest in HALS ( $p < 0.01$ )
2004	Moorthy et al <sup>17</sup>	48 (57 lap procedures, 26 recurrent vs. 31 primary)	Retrospective	Conversion higher in recurrent ( $p = 0.02$ ) Days to soft diet shorter in primary ( $p = 0.03$ )
2007	Okabayashi et al <sup>12</sup>	107 (124 procedures, 91 lap, 67 initial, and 24 recurrence vs. 33 open)	Retrospective	Complications comparable Recurrence of CD more in laparoscopy group ( $p = 0.001$ ) Stricture disease more commonly underwent laparoscopy ( $p = 0.035$ )
2009	Goyer et al <sup>11</sup>	124 (all lap, 54 complex vs. 70 simple)	Prospective	Conversion rate higher in complex disease group ( $p < 0.01$ ) Mean operative time longer in complex disease group ( $p < 0.05$ )
2009	Melton et al <sup>13</sup>	104 with ISF (29 lap vs. 75 open)	Retrospective	Lap group had lower rates of stoma creation ( $p = 0.04$ ) LOS, complications comparable
2010	Holubar et al <sup>18</sup>	40 (30 lap-completed vs. 10 lap-converted)	Retrospective	LOS shorter in lap ( $p = 0.002$ ) Days to soft diet shorter in lap ( $p = 0.03$ )
2010	Brouquet et al <sup>19</sup>	57 (62 reoperations, 29 lap vs. 33 open)	Retrospective	Need for associated procedures more often in open ( $p = 0.003$ ) Intraoperative intestinal injuries more in lap ( $p = 0.01$ )
2011	Chaudhary et al <sup>20</sup>	59 lap (30 recurrent vs. 29 primary)	Retrospective	Operative time longer in recurrent ( $p < 0.01$ ) Postoperative complication rates comparable
2011	Pinto et al <sup>21</sup>	130 lap (80 primary resection vs. 50 for recurrent disease)	Retrospective	LOS comparable Postoperative complication rates comparable
2012	Aytac et al <sup>9</sup>	52 with prior midline incisions (26 lap vs. 26 open)	Retrospective Case-match	Operative time, LOS, overall morbidity comparable
2012	Huang et al <sup>22</sup>	130 lap (48 with prior surgery vs. 82 without prior surgery)	Retrospective	Rate of conversion to open surgery comparable Postoperative complication rates comparable
2013	Beyer-Berjot et al <sup>10</sup>	33 lap (11 fistulizing vs. 22 control nonfistulizing)	Retrospective Case-match	LOS, rate of conversion and major complications comparable
2016	Manabe et al <sup>23</sup>	56 lap (25 simple CD vs. 31 complex CD)	Retrospective	Longer incision length in complex CD ( $p = 0.004$ ) Incidence of severe postoperative complications higher in complex CD ( $p = 0.026$ )

Abbreviations: CD, Crohn's disease; HALS, hand-assisted laparoscopic surgery; ISF, ileosigmoid fistula; lap, laparoscopic; LOS, length of stay.

series is by Bellolio et al, reporting a total of 293 patients with perforating disease, 251 of who had a fistula and were included only if it was the initial surgery. Most common site of fistula was sigmoid colon along with fistulas to bladder and enterocutaneous fistulas. The group with the perforating disease reported longer operative times ( $p < 0.001$ ) and higher conversion rates ( $p < 0.001$ ). They also reported higher incidence of temporary ileostomy creation rates ( $p = 0.002$ ).<sup>24</sup>

Another series reported by Goyer et al described laparoscopic ileocolonic resection to be safe and feasible for complex Crohn's disease in 54 patients compared with 70 patients without complex disease. It is advocated that complexity of the disease is not necessarily a contraindication for laparoscopy.<sup>11</sup>

A recent study by Manabe et al compared laparoscopic surgery in simple and complex Crohn's disease patients. Twenty-two patients among the 31 in the complex disease group had penetrating disease. There was no difference between the groups in terms of operative time, estimated blood loss, and length of stay. However, in the complex Crohn's group, Clavien-Dindo grade 3 and 4 complications were seen more often (12.9 vs. 0.0%,  $p = 0.026$ ).<sup>23</sup> Beyer-Berjot et al also reported 11 patients with complex fistulizing disease who underwent laparoscopic surgery and perioperative outcomes were compared with the nonfistulizing disease group and found comparable, supporting use of laparoscopic surgery in fistulizing complex Crohn's disease.<sup>10</sup>

In most patients, Crohn's disease has a progressive course and it is very likely that these patients may develop fibrostenotic or penetrating disease during the course of disease that requires surgery. Patients with complex disease may require reoperation after the initial resection. Preferring the minimally invasive approach with careful patient selection may help decrease adhesions and possible complications and allow easier reoperations in the following operations. These patients may have a midline incision which could affect the outcomes of the second surgery. In a study from our institution by Aytac et al, laparoscopy was compared with open approach in patients with previous midline incisions. A total of 29 patients with penetrating disease were included, 12 in laparoscopy and 17 in open group. Compared with the open surgery group, patients who underwent laparoscopy and had a previous midline incision were comparable in terms of operative time, estimated blood loss, overall morbidity, length of stay, reoperation, and readmission rates.<sup>9</sup> The laparoscopy group had less wound infections, which should be highlighted as an advantage for patients with Crohn's colitis.

Immunologic responses in Crohn's disease are altered<sup>25</sup> due the pathophysiology of the disease itself and also as a result of medical treatment with immunosuppressive and/or biologic agents prior to surgery. This altered response may also negatively affect the physiology of wound healing. Laparoscopic surgery may be beneficial in avoiding morbidity such as wound infections in these patients. Also overall low body mass indexes and poor nutritional status,<sup>26</sup> especially in younger patients, may be associated with delayed wound healing. This population may benefit from minimal tissue trauma as in minimally invasive approaches.

## Laparoscopic Approach in Complex Crohn's Disease

Recent studies report favorable outcomes with laparoscopic approach for complex Crohn's disease. It is important to note that when managing patients with complex disease, their condition should be stabilized before proceeding with laparoscopic surgical resection.<sup>23</sup> This may aid the surgeon in clear visualization of the surgical field and minimize conversions. Studies show that during the course of disease, 70% of patients may fall into the category of complex disease in 10 years of follow-up.<sup>27</sup> As the optimal conditions for surgical treatment are rarely reached in patients with complex disease, decision of surgical method should be done on a case-by-case basis and minimally invasive surgery can be the preferred decision in selected cases. Although published literature shows favorable results comparable with open surgery in complex disease,<sup>10,11,23</sup> the decision to proceed with laparoscopy should be made carefully and the experience of the surgeon should be one of the main factors to consider in addition to the individual characteristics of the patient and the indications for surgery.

Finding the best method of treatment for fistulizing disease is difficult in the sense that it has many variables that need to be considered such as patients' age, nutritional status, and any previous surgery, which will affect the surgical approach. Despite the favorable properties of laparoscopic approach, there are certain limitations such as necessity for a large incision and extensive adhesions that make laparoscopic approach nonapplicable. Although laparoscopic approach is promising, it should be carefully utilized by highly experienced laparoscopists.

## Single Incision Laparoscopic Surgery

Single incision laparoscopic surgery (SILS) can be considered a subtype of laparoscopic surgery in which the laparoscopic instruments are introduced from a single incision site, umbilicus or stoma site.<sup>28</sup> It allows the entire operation to be completed through one incision which is also used as the extraction site.<sup>29</sup> Mizushima et al reported 24 patients with structuring and perforating disease who underwent SILS for ileal resection, ileocecal resection, stoma closure, and stricturoplasty. Perioperative outcomes were found to be comparable besides blood loss, which was higher in the perforating disease group.<sup>28</sup>

According to other studies comparing SILS with conventional laparoscopy, it is safe and feasible in patients with complex Crohn's disease, resulting in less need for pain medication,<sup>29</sup> shorter operative time,<sup>30</sup> and with technical advantages over multiport technique.<sup>31</sup>

Single incision technique can be the procedure of choice especially in pediatric population and adolescent patients who have an indication for diverting ileostomy. Safe use of SILS was advocated with comparable perioperative outcomes with open surgery.<sup>32</sup>

## Role of Robotic Technique

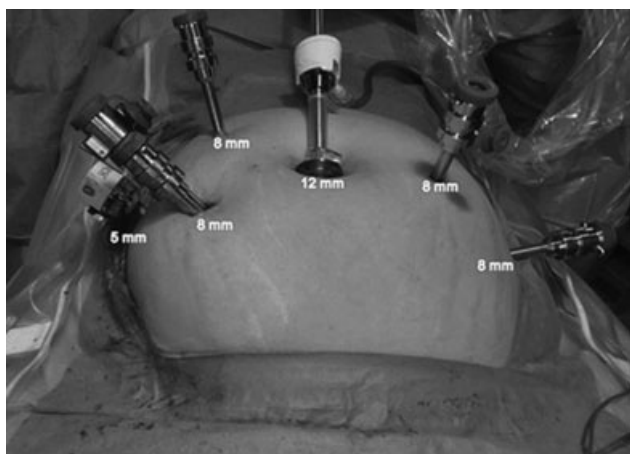
The robotic platform enables the surgeon to have better visualization, enhanced control of the surgical field, and

improved dexterity.<sup>33</sup> These benefits of the robotic approach is highly advantageous for operating in the narrow pelvis, such as proctectomy. Better viewing angles may help, particularly in complex disease, in removing adhesions or resection of fistulizing disease without damaging adjacent anatomical structures. This will help avoid nerve injury and related functional and sexual complications with the close-up visuals provided by the robotic camera. As the robotic approach is gaining popularity, the question of feasibility for patients with complex Crohn's disease remains to be answered.

Robotic platform could be useful in performing proctectomy in patients with complex disease. Completion proctectomy is indicated in Crohn's patients who have resistant perianal disease with penetrating behavior.<sup>33,34</sup> It is a technically challenging procedure requiring expertise. Robotic approach may help overcome the ergonomical and visual shortcomings of laparoscopic surgery especially in the deep and narrow pelvis.<sup>33,35</sup>

Treatment of choice in these patients with anorectal involvement is generally proctocolectomy with permanent ileostomy.<sup>34</sup> Performing robotic completion proctectomy consists of similar steps as the laparoscopic approach. Port placement takes place under direct vision with the robotic camera. Five to six ports are usually inserted that include the camera and the assistant ports (► Fig. 1). Docking from the left side of the patient is performed for the pelvic portion of the surgery. If all steps of the operation are performed with the robotic platform, multiple dockings can be necessary.

Current literature is scant about application of robotic surgery in patients with complex Crohn's disease. In a study comparing 30-day morbidity between robotic and laparoscopic groups in rectal resection, only 2 patients had Crohn's disease among 79 patients of robotic approach group.<sup>36</sup> In a previous study from our institution, 21 patients undergoing laparoscopic proctectomy were matched with robotic proctectomy group and 4 patients in each group had a diagnosis of Crohn's disease. Operative time was longer ( $p = 0.008$ ) and estimated blood loss was higher ( $p = 0.02$ ) in the robotic proctectomy group. Rate of conversion, return of bowel movements, and hospital stay were found to be similar between robotic and laparoscopy groups.<sup>33</sup>



**Fig. 1** Port placement for robotic completion proctectomy.

During completion proctectomy for these patients, intramesorectal or total mesorectal excision can be performed based on existing dysplasia. Another advantage of robotic approach for performing completion proctectomy in these patients could be the possible better preservation of nerves adjacent to the surgical plane when performing intramesorectal or total mesorectal excision.<sup>33</sup>

Certain disadvantages of robotic approach for completion proctectomy are that single docking is usually not sufficient and multiple docking is necessary which can be time consuming. However, it should be noted that these disadvantages should not push the surgeon away from this approach, as new innovations allow multi-quadrant docking and may help overcome some of these issues.<sup>33</sup>

Another disadvantage as shown in our previous study was the longer operative time with the robotic approach. As the learning curve is reached and robotic surgical training becomes more available, this disadvantage may disappear. Using laparoscopy and robot together to compensate for each other's limitations may shorten the operative time by avoiding multiple docking and provide the surgeon with the advantages of robot when working in the narrow pelvis.

## Conclusion

Minimally invasive approach in the management of complex Crohn's disease is gaining popularity. Guidelines and published studies support the use of laparoscopic surgery in Crohn's disease, but full adoption of this technique in complex disease remains to be investigated. Robotic surgery may provide the surgeon and the patient with certain benefits, but extended research is necessary to clearly evaluate the benefits and feasibility of this technique. A multidisciplinary discussion for the patients with complex disease to select the right approach is necessary.

## Conflict of Interest

None declared.

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