



## Minimally invasive surgery and stoma-related complications after restorative proctocolectomy for ulcerative colitis. A two-centre comparison with open approach

Francesco Colombo<sup>a,\*</sup>, Gianluca Pellino<sup>b</sup>, Francesco Selvaggi<sup>b</sup>, Fabio Corsi<sup>a</sup>, Guido Sciaudone<sup>b</sup>, Gianluca M. Sampietro<sup>a</sup>, Diego Foschi<sup>a</sup>

<sup>a</sup> Luigi Sacco University Hospital, Department of Oncology, Gastroenterology and Surgery-University of Milan, Italy

<sup>b</sup> Unit of Surgery, Department of Medical, Surgical, Neurologic, Metabolic and Ageing Sciences, Università Della Campania "Luigi Vanvitelli", Naples, Italy



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### ABSTRACT

**Background:** Although the creation of a stoma reduces the risk of septic pouch complications following ileal pouch-anal anastomosis (IPAA), the stoma itself and its reversal can give rise to substantial morbidity during the two- or three-stage concept. Aim of study is to compare stoma-related complications in Ulcerative Colitis patients undergoing laparoscopic versus open IPAA.

**Methods:** We collected data on 250 IPAA patients from two Italian Centres between 2005 and 2015. We compared perioperative and postoperative events in 150 open vs 100 laparoscopic IPAA. We performed a case-matched analysis based on baseline differences among groups to compare the rate of mechanical complications.

**Results:** There were no significant differences between open and laparoscopic IPAA in overall stoma complications (complications during ileostomy: 11.3% vs 12%,  $p = 0.8$ ; early complications: 10% vs 8%,  $p = 0.5$ ; late complications: 12.6% vs 6%,  $p = 0.08$ ). The case-matched analysis found a slightly reduced incidence of obstructive complications at any stage with laparoscopy.

**Conclusions:** Overall stoma related complications do not seem to be reduced by minimally-invasive approach itself, but patients might experience less mechanical problems with laparoscopy without conversion.

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### Introduction

Restorative proctocolectomy with ileal pouch-anal anastomosis (IPAA) is the treatment of choice for refractory or complicated Ulcerative Colitis (UC).<sup>1</sup> Laparoscopic IPAA is associated with several short-term benefits, e.g. shorter postoperative stay,<sup>2</sup> and with better cosmesis and increased fecundity in female patients,<sup>3</sup> but it requires advanced surgical skills. Higher costs and longer operative time are additional drawbacks of minimally invasive approaches. IPAA is commonly performed as a staged procedure with a temporary ileostomy.<sup>4</sup>

Small bowel obstructions (SBO) are one of the most common complications after IPAA, occurring in 13–25% of patients, 25% of

whom will eventually require surgery.<sup>5</sup> SBO often occur early and do not seem to be influenced by the surgical approach.<sup>6</sup> Combined with the morbidity of stoma reversal procedures,<sup>7</sup> these observations lead to reconsider one-stage IPAA, with omission of a stoma.<sup>8</sup> However, less than 10% of UC patients may benefit from such an approach, which is ultimately an intraoperative decision.<sup>1,4</sup>

After a first operation performed laparoscopically, frequently, the following procedure is easier because of the presence of less adhesions in the pelvis or in the stoma site. Studies comparing laparoscopy and open IPAA in terms of adhesions and SBO have produced conflicting results, and have several limitations. Hence, it difficult to draw definitive conclusions.<sup>6,9,10</sup> Furthermore, the influence of the surgical approach on stoma-related complications has not been explored in details.

This study aimed to define stoma-related complications after IPAA according to surgical approach.

\* Corresponding author. Via G.B Grassi 74, Ospedale L.Sacco, 20157, Milano, Italy.  
E-mail addresses: [colombo.francesco@hsacco.it](mailto:colombo.francesco@hsacco.it), [francesco.colombo@asst-fbf-sacco.it](mailto:francesco.colombo@asst-fbf-sacco.it) (F. Colombo).

### Abbreviations

IBD	Inflammatory Bowel Disease
CD	Crohn's disease
IPA	Alleal pouch anal anastomosis
UC	Ulcerative Colitis

### Material and methods

We retrospectively collected data of patients receiving staged IPAA for UC between 2005 and 2015 from the prospective databases of two Italian Referral Centres for UC surgery: L.Sacco University Hospital (Milan) and University of Naples. All the operations were performed by experienced colorectal surgeons or supervised colorectal fellows. According to policy of follow-up of the institutions, patients were seen in outpatient clinic at 1, 3, 6 and 12 months after stoma closure. In all cases, data were directly retrieved from patients in the context of normal clinical assessment (history, physical examination, blood analysis, imaging).

#### Definitions and patient groups

IPAA was performed as either 1) subtotal colectomy (STC) with stoma followed by completion proctectomy (CP) and pelvic ileal pouch with pouch anal anastomosis, plus diverting ileostomy, or 2) total procto-colectomy and pelvic ileal pouch with pouch anal anastomosis, plus diverting ileostomy.

Total proctocolectomy was usually performed in all patients undergoing surgery in good general status, with no acute colitis, no megacolon and no recent treatment with steroids.

IPAA was performed either laparoscopically or by open approach. Stoma reversal was performed approximately 3 months later. Two groups of patients were defined according to surgical approach, **open vs laparoscopic** surgery.

**Conventional surgical technique: Open proctocolectomy (OPRC)** consisted of a standard median laparotomy. First, descending, transverse and ascending colon including both flexures were mobilized, removing the greater omentum. Rectal resection was fashioned with a “bad” total mesorectal excision (TME) technique in order to reduce nerve damage. TME was only performed in patients with dysplasia or cancer. The rectum was transected approximately 1 cm above the dentate line with a linear stapler.

If the first operation was an *open subtotal colectomy* (OSTC), the rectum was divided at the recto-sigmoid junction and a terminal ileostomy was performed at right flank.

**Laparoscopic approach during proctocolectomy (LPRC)** was performed with 5 trocars (5 mm, 10–12 mm or 15 mm). Colic and rectal dissection were conducted as described in the open technique. The rectum was transected at the same level with Endo-GIA (endoscopic gastro-intestinal-anastomosis). Specimen extraction and ileal pouch formation were mostly performed through a small Pfannenstiel incision or through the stoma site.

**Laparoscopic subtotal colectomy (LSTC)** was performed using 5 trocars: after complete colon dissection with vascular ligations, terminal ileum was transected at ileocaecal valve and the rectum at the recto-sigmoid junction. A terminal ileostomy was fashioned in the right flank.

**Open completion proctectomy (OCP)** was performed through the midline incision used during the first open approach or through the Pfannenstiel incision after a laparoscopic procedure. Rectal dissection and transection were performed as described in one stage proctocolectomy.

**Laparoscopic completion proctectomy (LCP)** was performed starting from mobilization of the ileostomy and introducing a 15 mm trocar through the stoma site. Then, 3 more trocars were placed, bad TME/TME was performed, and the rectum was transected and removed through the stoma site.

The ileal 15 cm-long J-pouch was constructed using a linear stapler. A transanal circular stapler with a size of 28 or 31 mm was usually used for the pouch-anal anastomosis, depending on the width of the sphincter.

**Conversion to open surgery** was defined as conventional midline laparotomy, due to technical difficulties or anaesthesiologic instability. Patients whose operations were started laparoscopically but ultimately required conversion to laparotomy were considered in the laparoscopic group in an intention-to-treat analysis.

We defined **total open staged surgery** a conventional approach in every single stage of the restorative proctocolectomy independently from the number of surgical steps.

We defined **total laparoscopic staged surgery** minimally-invasive approach in all surgical steps.

**Stoma closure** procedures were performed through a parastomal incision, the loop ileostomy was dissected from the surrounding subcutaneous tissues, fascia recti and peritoneum. An adequate length of small bowel was mobilized from intra-abdominal adhesions and side-to-side anastomoses were performed either using a linear stapler (55 or 75 mm) or with handsewn technique (double layer running absorbable suture).

Prophylactic antibiotics were continued on for 24 h postoperatively.

#### Data of interest

We collected demographic data, extent and severity of UC at the time of surgery, extra-intestinal manifestations and smoking habit, IBD familiarity and ASA scores. Concerning the surgical variables, we included operative approach (laparoscopy vs. open IPAA), indications for surgery (unresponsiveness to medical treatment, megacolon, perforation, bleeding and cancer/dysplasia), number of surgical steps, urgent surgery rate and conversion rate. All patient characteristics are enlisted in [Table 1](#).

Perioperative and postoperative events were classified as 1) complications during ileostomy, 2) early complications after ileostomy closure (within 3 months), and 3) late complications after ileostomy closure (>3 months).

We decided to collect the *complications* occurring during ileostomy only considering the events that occurred after pouch surgery, because otherwise too many factors could have influenced the data, thereby confounding the results. Patients receiving urgent surgery are in usually in poorer health status due to disease severity and prolonged use of medications, eventually increasing stoma-related complications (e.g. dehydration, ileus). We excluded from analysis all data regarding stoma-related complications after subtotal colectomy, namely involving patients not fit to primary IPAA.

We evaluated the rate of: electrolyte imbalance, SBO, stoma prolapse, stomal/parastomal hernia and stoma retraction/stenosis. In details, SBO was defined as abdominal distension/pain, vomiting, or the presence of multiple air-fluid levels on a plain abdominal X rays. Electrolyte imbalance was a dehydrating condition due to increased stoma output with sodium and potassium loss causing fatigue, shortness of breath and cramps.

**Complications after ileostomy closure** were as follows: SBO, dehiscence at stoma closure site, and intra-abdominal septic complications (IASC). IASC were defined as any abdominal or pelvic abscess confirmed on CT scan or clinical signs of peritonitis with or without anastomotic dehiscence.

Early complications<sup>11</sup> after IPAA were defined as all the adverse

**Table 1**  
Patients characteristics.

		OPEN (N° 150)	LAP (N° 100)	p
<b>AGE, yrs</b>		45,9 ± 17,6	46,3 ± 38,2	N.S
<b>DIAGNOSIS</b>	<b>UC</b>	145 (96,5%)	95 (95%)	N.S
	<b>CD</b>	3 (2%)	4 (4%)	N.S
	<b>IC</b>	2 (1,5%)	1 (1%)	N.S
<b>EXTENT of DISEASE</b>	<b>E1</b>	43 (28,6%)	6 (6%)	<0.0001
	<b>E2</b>	50 (33%)	13 (13%)	<0.0005
	<b>E3</b>	57 (38,4%)	81 (81%)	<0.0001
<b>SEVERITY of DISEASE</b>	<b>S0</b>	13 (8,6%)	6 (6%)	N.S
	<b>S1</b>	16 (10,6%)	15 (15%)	N.S
	<b>S2</b>	75 (50%)	11 (11%)	<0.0001
	<b>S3</b>	46 (30,8%)	68 (68%)	<0.0001
<b>IBD FAMILIARITY</b>		14 (9,3%)	7 (7%)	N.S
<b>EXTRAIESTINAL DISEASE</b>		26 (17,3%)	10 (10%)	N.S
<b>SMOKING</b>		34 (22,6%)	11 (11%)	<0.02
<b>ASA SCORE</b>	<b>I</b>	16 (10,6%)	13 (13%)	N.S
	<b>II</b>	124 (82,6%)	78 (78%)	N.S
	<b>III</b>	7 (4,6%)	8 (8%)	N.S
	<b>IV</b>	3 (2,2%)	1 (1%)	N.S
<b>INDICATION for SURGERY</b>	<b>UNRESPONSIVE to MEDICAL TREATMENT</b>	129 (86%)	73 (73%)	<0.01
	<b>MEGACOLON</b>	8 (5,3%)	2 (2%)	N.S
	<b>PERFORATION</b>	4 (2,7%)	1 (1%)	N.S
	<b>BLEEDING</b>	/	1 (1%)	N.S
	<b>CANCER/DYSPLASIA</b>	9 (6%)	23 (23%)	<0.0002
<b>URGENT SURGERY</b>		25 (16,7%)	22 (22%)	N.S
<b>CONVERSION</b>		/	9 (9%)	/
<b>N° STEPS</b>	<b>II</b>	92 (61,3%)	68 (68%)	N.S
	<b>III</b>	58 (38,7%)	32 (32%)	N.S

events occurring within 90 days after stoma reversal. This slightly longer timeframe is reported to assess better all the complications related to this procedure.<sup>11</sup>

Among early complications (<3 months from stoma reversal) we specifically assessed surgical site infections (SSI), which were defined as purulent wound discharge, wound erythema and induration. Incisional hernia at port site, stoma site or at midline incision were specific late complications (>3 months).

### Endpoints

The primary endpoint was the rate of stoma-related complications after IPAA according to the surgical approach (laparoscopy vs. open surgery).

The secondary endpoint was the rate of overall mechanical complications in matched groups.

### Statistical analysis

Continuous data are reported as median (range), and were compared with Mann-Whitney *U* test. Categorical variables are reported as *n* (%), and compared by means of Fisher's exact test.

A case-matched analysis was performed to compare the different surgical approach (laparoscopic IPAA vs open IPAA) in terms of mechanical complications connected with the stoma. Mechanical complications considered were: SBO, hernia, retraction/stenosis. We used the variables that significantly differed in the whole patient cohort between lap and open as described in [Table 1](#): number of steps according to extent/severity of disease, smoking, and indication to surgery.

Statistical analysis was performed with Statistical Package for Social Sciences (SPSS®) 24.0 (SPSS Inc., Chicago, IL) and MedCalc® (Version 14.8.1 MedCalc Software bvba, Ostend, Belgium) software.

### Ethical considerations

This study was authorized by the Ethical Committee of our

Institutions and was conducted following the Guidelines for Good Clinical Practice.

### Results

In the study period (2005–2015), 250 patients underwent IPAA for UC at the two centres.

IPAA was performed in two stages in 92 and 68 patients in the open and laparoscopic group respectively. Three-stage IPAA was carried out in 58 patients with the conventional approach (OSTC + OCP) and in 32 with mini-invasive technique (LSTC + LCP).

Hence, 122 patients underwent a totally-open staged procedure (OPRC or OSTC + OCP) compared with 100 patients who received a completely laparoscopic approach (LPRC or LSTC + LCP).

Baseline characteristics were similar between open and laparoscopic group considering age at operation, diagnosis, IBD familiarity, EIM, ASA scores, urgent surgery rate and extent of resection ([Table 1](#)).

Patients in the laparoscopic group had more extended (E3 81 vs 57;  $p < 0.0001$ ) and severe disease (S3 68 vs 46;  $p < 0.0001$ ) at time of first surgery. In the open group there were more smokers (34 vs 11;  $p < 0.02$ ).

Comparing the groups we found a difference in the main reason for surgery in the two surgical approaches: the indication for surgery was unresponsiveness to medical treatment for a significantly higher number of patients of the open group (129 vs 73;  $p < 0.01$ ), whereas cancer or dysplasia were significantly more frequent in the laparoscopic group (23 vs 9;  $p < 0.0002$ ).

Two “fulminant” ulcerative colitis with intraoperative finding of an impending megacolon were managed laparoscopically, despite technical difficulties. A micro-perforation of the sigmoid colon with a small pericolic abscess found at surgery was managed with a laparoscopy.

We had in total 9 conversions from a mini-invasive approach to open surgery: 4 cases were due to a specific anaesthesiologist request for instability of the patient and 5 cases were caused by technical or anatomical difficulties (adhesions, bulky organs,

bleeding ...). Only for these 5 cases the length of operation was significantly longer than usual and the laparoscopic part of the operation was in average of 145 ± 46 min.

Mean time elapsing between IPAA and ileostomy reversal was 3 months, with mean follow up of 3.3 years.

The overall complication rate **during ileostomy** for all IPAA procedures was 11.6%, including 16 (6.4%) electrolyte imbalance, 7 (2.8%) SBO, 3 (1.2%) stoma prolapse, 1 (0.4%) stoma hernia and 2 (0.8%) stoma retraction/stenosis.

The overall **early (<3 months) complication** rate after ileostomy closure was 8.4%, consisting of 8 (3.2%) SBO, 3 (1.2%) dehiscence at stoma closure site, 5 (2%) IASC and 5 (2%) surgical site infection.

The **late (>3 months) complication** rate after stoma reversal was 9.2%, and included 13 (5.2%) SBO, 1 (0.4%) dehiscence at stoma closure site, 3 (1.2%) IASC and 6 (2.4%) incisional hernia.

The analysis comparing the complications between laparoscopic and open group (100 vs 150 patients) failed to show any significant differences in terms of complications [12 (12%) vs 17 (11.3%)], readmissions [14 (14%) vs 10 (6.7%)] and reoperations [2 (2%) vs 6 (4%)] **during ileostomy, early complications** after ileostomy closure [8 (8%) vs 15 (10%)], readmissions [2 (2%) vs 7 (4.7%)] and reoperations [4 (4%) vs 4 (2.6%)] after stoma reversal.

Only considering the **late onset complications** after stoma closure (SBO, dehiscence, IASC and incisional hernia) all together a statistical significant difference was found, with more adverse events in the open surgery [4 (4%) vs 19 (12.6%); p < 0.03]. The difference was removed by evaluating the single complications between the two groups (Table 2).

The sub-analysis comparing stoma related complications according to the same type of staged surgery (LPRC vs OPRC and LCP vs OCP) did not show significant differences among the minimally-invasive and the conventional group (Table 3).

Finally, comparing the **totally open staged surgery** group (122 patients) with the **totally laparoscopic staged surgery** group (100 patients), the only significant difference in terms of complications was the SSI rate that was higher for the open group (5 vs 0, p < 0.04) as showed in Table 4.

Secondary endpoint

After matching patients to according to the variables described in the methods, we established two groups of 86 patients, receiving either unconverted laparoscopic IPAA or open IPAA. Mechanical complications at any stage were slightly reduced with laparoscopy, even if stoma-related morbidity remained clinically relevant (26.7% vs 12.8%, p = 0.03).

Discussion

Even if the routinely need for a defunctioning ileostomy in UC

patients undergoing IPAA has been recently debated, most surgeons usually prefer to fashion a diverting loop ileostomy during IPAA, as a protective measure to attenuate the consequences of post-operative anastomotic leakage<sup>13,14,15,16</sup>.

Ileostomy closure is associated with a significant morbidity rate (20–33%), including both medical and surgical complications. According to recent reviews<sup>8,15,17</sup> the most common complications after stoma reversal include SBO (5–15%), wound infection (4–20%), anastomotic leak (0–8%) and entero-cutaneous fistula (1–7%), which occur after both open or laparoscopic surgery.

Furthermore, the temporary diversion can frequently cause dehydration or electrolyte imbalance secondary to high stoma output, and it can cause peristomal hernia, retraction and stenosis.

Technical difficulties during stoma reversal are associated with adhesions occurring around the ileostomy site, which can lead to seromyotomies or enterotomies with subsequent potential dehiscence or SBO.

Despite the relevant number of recent studies focused on the surgical approach (laparoscopic vs open) and the subsequent degree of adhesions formation after colorectal surgery, no agreed evidence exists to date to support any differences between the two techniques.<sup>18</sup> According to Benlice et al,<sup>12</sup> the rates of incisional hernia and SBO after IPAA do not seem to be influenced by the surgical approach.

As far as we know, this is the first study specifically comparing stoma-related complications after IPAA for UC between laparoscopic and open approach. Moreover, very few studies considered the complications related to ileostomy status itself (electrolyte imbalance, SBO, stoma prolapse/hernia) only reporting on complications due to stoma reversal. We divided the complications classifying the adverse events based on the time in which they occurred.

Our overall complication rate **during ileostomy** status was 11.6%. The most common complications were dehydration/electrolyte imbalances and SBO. Nevertheless, our findings seem to be similar to those of other authors.<sup>19,20,21</sup> We did not find any significant differences in the rates of interval complications of ileostomy status between patients operated on with minimally invasive approach and open approach.

Our overall complication rate in the **early post-operative** period (within 3 months) after stoma closure was 8.4%, whereas the **late** complication rate (>3 months) was 9.2%. Combining these data we obtain a total complication rate after stoma reversal of 17.6%, in line with data reported in the literature (7–33%)<sup>1,2,3,5</sup>.

The surgical approach did not modify by itself the likeliness of single post-operative complications. We did not collect data on number or quality of abdominal adhesions but apparently the open approach in IPAA has not significantly added potential causes of bowel obstructions.

Only considering together the late onset complications after ileostomy closure (SBO, dehiscence, IASC and incisional hernia) we

Table 2  
Complications according to surgical approach (CLAVIEN-DINDO Classification).

		OPEN N = 150	LAP N = 100	P
<b>COMPLICATIONS during ILEOSTOMY</b>	<b>GRADE I</b>	8 (5,3%)	8 (8%)	N.S
	<b>GRADE II</b>	<b>3 (1,3%)</b>	<b>2 (2%)</b>	<b>N.S</b>
	<b>GRADE III</b>	<b>6 (4%)</b>	<b>2 (2%)</b>	<b>N.S</b>
	<b>GRADE IV</b>	/	/	<b>N.S</b>
	<b>GRADE V</b>	/	/	<b>N.S</b>
<b>EARLY COMPLICATIONS after ILEOSTOMY CLOSURE</b>	<b>GRADE I</b>	<b>8 (5,3%)</b>	<b>3 (3%)</b>	<b>N.S</b>
	<b>GRADE II</b>	<b>3 (2%)</b>	<b>2 (2%)</b>	<b>N.S</b>
	<b>GRADE III</b>	<b>4 (2,6%)</b>	<b>3 (3%)</b>	<b>N.S</b>
	<b>GRADE IV</b>	/	/	<b>N.S</b>
	<b>GRADE V</b>	/	/	<b>N.S</b>

**Table 3**  
Complications according to surgical approach in staged surgery.

		PROCTO-COLECTOMY N° 160			COMPLETION PROCTECTOMY N° 90			p
		LAP N° 68	OPEN N° 92	p	LAP N° 32	OPEN N° 58		
						Previous LAP N° 28	Previous OPEN N° 30	
<b>COMPLICATIONS during ILEOSTOMY</b>	<b>ELECTROLYTE IMBALANCE</b>	5 (7,3%)	9 (9,7%)	N.S	1 (3,1%)	1 (3,5%)	/	N.S
	<b>INTESTINAL OBSTRUCTION</b>	4 (5,8%)	2 (2,1%)	N.S	/	1 (3,5%)	/	N.S
	<b>STOMA PROLAPSE</b>	/	2 (2,1%)	N.S	1 (3,1%)	/	/	N.S
	<b>STOMAL/PARASTOMAL HERNIA</b>	/	/	N.S	1 (3,1%)	/	/	N.S
	<b>STOMA STENOSIS</b>	/	2 (2,1%)	N.S	/	/	/	N.S
<b>READMISSION during ILEOSTOMY</b>		10 (14,7%)	5 (5,4%)	N.S	N.S	4 (14,2%)	1 (3,3%)	N.S
<b>REOPERATION during ILEOSTOMY</b>		1 (1,4%)	4 (4,3%)	N.S	N.S	1 (3,5%)	1 (3,3%)	N.S
<b>EARLY COMPLICATIONS after ILEOSTOMY CLOSURE</b>	<b>ILEUS</b>	1 (1,4%)	5 (5,4%)	N.S	1 (3,1%)	/	1 (3,3%)	N.S
	<b>DEHISCENCE</b>	1 (1,4%)	/	N.S	2 (6,2%)	/	/	N.S
	<b>IASC</b>	/	4 (4,3%)	N.S	1 (3,1%)	/	/	N.S
	<b>SURGICAL SITE INFECTION</b>	/	4 (4,3%)	N.S	/	/	1 (3,3%)	N.S
<b>LATE COMPLICATIONS after ILEOSTOMY CLOSURE</b>	<b>ILEUS</b>	2 (2,9%)	8 (8,6%)	N.S	1 (3,1%)	1 (3,5%)	1 (3,3%)	N.S
	<b>DEHISCENCE</b>	/	1 (1,08%)	N.S	/	/	/	N.S
	<b>IASC</b>	/	2 (2,1%)	N.S	/	/	1 (3,3%)	N.S
	<b>INCISIONAL HERNIA</b>	/	2 (2,1%)	N.S	1 (3,1%)	1 (3,5%)	1 (3,3%)	N.S
<b>READMISSION after ILEOSTOMY CLOSURE</b>		/	3 (3,2%)	N.S	/	/	2 (6,6%)	N.S
<b>REOPERATION after ILEOSTOMY CLOSURE</b>		1 (1,4%)	2 (2,1%)	N.S	3 (9,3%)	/	2 (6,6%)	N.S

found a significant difference ( $p < 0.03$ ) in favour of laparoscopic approach.

Hiranyakas et al.<sup>14</sup> compared in their study the outcomes of ileostomy closure after laparoscopic and open colorectal resections and they found lower complication rates ( $p = 0.028$ ) for minimally-invasive approach. However, they included non-UC patients and other-than-IPAA procedures.

Another original finding of our study is that the number of stages before stoma closure (I or II) did not influence the effects of the surgical approach on stoma-related complications.

Reading between the lines of published papers, a lot of authors considered as “laparoscopic proctocolectomy” patients that received only a first step of laparoscopic surgery (subtotal colectomy) followed by a proctectomy performed via a small suprapubic incision. Consequently, the potential benefits of the laparoscopic approach can be outweighed by the inflammatory response and the adhesion formation in the pelvis.<sup>7,22,23</sup> This was the rationale that led us to perform a sub-analysis considering the patients that received a “truly” complete laparoscopic IPAA in either II or III steps.

We aimed at investigating whether repeated laparoscopic

operations (LSC + LPC) can add some final advantages in term of stoma complications in a complex, staged surgery such as IPAA. However, the only significant advantage of complete laparoscopic IPAA appeared to be a decreased wound infection rate in comparison with the open approach. We would suggest that denser adhesions during stoma reversal after open proctocolectomy resulted in longer and demanding adhesiolysis, sometimes leading to bowel serosal damages or bowel perforation. Contamination of the surgical field could have increased SSI rate. In addition, due to adhesiolysis, stoma reversal had generally longer operative times after previous open approach, and increased SSI.<sup>24</sup> Lastly, adhesiolysis during stoma reversal often required larger peristomal skin incisions, probably leading to a higher frequency of wound contamination and SSI compared to smaller incisions required for easier stoma reversals.

As underlined before, in our study, the indication for surgery was significantly more frequent an unresponsiveness to medical treatment for the open group and a cancer/dysplasia for the laparoscopic group.

Our data confirm the available results in literature that a life-

**Table 4**  
Subanalysis: comparison of ileostomy complications between complete lap approach and complete open approach.

		TOTALLY OPEN STAGED SURGERY N°	TOTALLY LAP STAGED SURGERY N°	P
		122	100	
<b>COMPLICATIONS during ILEOSTOMY</b>	<b>ELECTROLYTE IMBALANCE</b>	9 (7,3%)	6 (6%)	N.S
	<b>INTESTINAL OBSTRUCTION</b>	6 (4,9%)	5 (5%)	N.S
	<b>STOMA PROLAPSE</b>	2 (1,6%)	1 (1%)	N.S
	<b>STOMAL/PARASTOMAL HERNIA</b>	/	1 (1%)	N.S
	<b>STOMA STENOSIS</b>	2 (1,6%)	/	N.S
<b>READMISSION during ILEOSTOMY</b>		6 (4,9%)	10 (10%)	N.S
<b>REOPERATION during ILEOSTOMY</b>		5 (4%)	1 (1%)	N.S
<b>EARLY COMPLICATIONS after ILEOSTOMY CLOSURE</b>	<b>ILEUS</b>	6 (4,9%)	(2%)	N.S
	<b>DEHISCENCE</b>	/	3 (3%)	N.S
	<b>IASC</b>	4 (3,2%)	1 (1%)	N.S
	<b>SURGICAL SITE INFECTION</b>	5 (4%)	/	<0,04
<b>LATE COMPLICATIONS after ILEOSTOMY CLOSURE</b>	<b>ILEUS</b>	9 (7,3%)	3 (3%)	N.S
	<b>DEHISCENCE</b>	1 (0,8%)	/	N.S
	<b>IASC</b>	3 (2,4%)	/	N.S
	<b>INCISIONAL HERNIA</b>	3 (2,4%)	1 (1%)	N.S
<b>READMISSION after ILEOSTOMY CLOSURE</b>		5 (4%)	3 (3%)	N.S
<b>REOPERATION after ILEOSTOMY CLOSURE</b>		4 (3,2%)	3 (3%)	N.S

threatening condition as acute severe colitis or megacolon in immunodepressed and frail patients, frequently need a quicker approach as an open colectomy can be.

In our double-centre study, the IBD tertiary referral Centre of Milan, since 2007, started a clinical protocol where, also in acute setting, the initial approach of the colectomy was a laparoscopic approach.<sup>25</sup> Nevertheless, unifying the data between the two centres, overall, in case of acute colitis the most frequent approach still remained the traditional surgery.

This difference in the reason for surgery, can have slightly altered the comparison of the groups of patients but we still think our study can offer a good evaluation of the main outcomes of the two different surgical approaches of this operation.

After removing the confounding effect of factors that were significantly different between groups, we found that unconverted laparoscopy achieved less mechanical complications. This finding needs to be interpreted with caution, because the study was not designed primarily for this effect and it might result in surgeons being more keen not to convert during a procedure. Rather, we would suggest that procedures that did not need conversion were less technically demanding and resulted in fewer complications. The definition of conversion is still debated, e.g. a small periumbilical incision could be needed to access the root of the mesentery and gain more length, without any significant events justifying a laparotomy.<sup>1,26</sup> It is important not to consider conversion a failure, unnecessarily prolonging an already demanding procedure, and advocate it promptly when needed.

## Conclusions

This study is limited by its retrospective nature and by the lack of additional information that could have been useful for our purposes. Some confounding factors could have played a role, such as objective assessment of the extent and density of the adhesions. Even if the very first years of the IPAA training and learning by the operating surgeons were removed from analysis, the learning curve of IPAA is challenging and may have influenced our results.

A certain degree of variation between the two centres concerning the perioperative management of patients, indications to surgery and technical details of the procedures is another limitation that could not be removed.

We suggest that the putative advantages of laparoscopic surgery in the reduction of incisional hernias, SBO and other stoma-related complications for this specific procedure might require a larger sample size to become statistically detectable. Due to the limited numbers of events observed, further analyses to investigate other factors associated with stoma-related complications could have produced misleading results, even after case-matching.

A prospective study with agreed technical steps during surgery could be useful to obtain more homogeneous results. Lastly, including more centres could help achieving an adequate sample size in an acceptable timeframe, further removing another bias due to changes in devices used. These may also have influenced our results. Nonetheless, our study is the first to be attempted on the topic and to suggest similar outcomes in terms of stoma-related adverse events with either open or minimally-invasive approach to IPAA. We also found that laparoscopic IPAA reduced subsequent SSI.

Although confirming the safety and feasibility of the laparoscopic approach to IPAA, we didn't show a reduced rates of stoma-related complications with the mini-invasive technique. Future prospective, multicentre studies with a larger sample size and standardized patient management and complication assessment might clarify the impact of laparoscopy in patients undergoing IPAA.

## Conflicts of interest

All the authors have no conflict to declare.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.amjsurg.2018.07.028>.

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