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Comparable Perioperative Outcomes, Long-Term Outcomes, and Quality of Life in a Retrospective Analysis of Ulcerative Colitis Patients Following 2-Stage Versus 3-Stage Proctocolectomy with Ileal Pouch-Anal Anastomosis

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Abstract

Purpose: Many surgeons assume 3-stage ileal pouch-anal anastomosis (IPAA) is safer than 2-stage IPAA in patients with active ulcerative colitis (UC), although recent data suggest outcomes are comparable. This study aimed to compare perioperative complications, late complications, and functional outcomes after 2- versus 3-stage IPAA in patients with active UC.

Methods: A retrospective review was conducted of patients who underwent 2- or 3-stage IPAA for active UC from 2000–2015 in a high-volume institution. Patients completed quality of life surveys six months following ileostomy reversal. Perioperative and late complications were recorded. Outcomes were compared with the Fisher Exact test, and multivariable logistic regression was used to adjust for potential confounders.

Results: We identified 212 patients who underwent 2- or 3-stage IPAA for active UC, of whom 157 patients (74.1%) underwent 2-stage procedures and 55 (25.9%) underwent 3-stage procedures. More patients undergoing 2-stage procedures were taking immunomodulators preoperatively (46.3% vs. 23.1%, p=0.01), but there was no difference in use of steroids (p=0.09) or biologic agents (p=0.85). Three-stage procedures were more likely to be urgent (78.6% vs. 30.2%,

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This article does not contain any studies with animals performed by any of the authors.

Informed consent: For the data collection aspect of this study (Protocol #2008P002110), formal consent was waived by the IRB. For the survey portion of the study (Protocol #2011P001407), informed consent was implied by voluntary completion of the survey, as approved by the IRB.

Conflicts of interest: The authors declare that they have no conflicts of interest.

p<0.001). There were no differences in perioperative complications (p=0.50), anastomotic leak (p=0.94), pouchitis (p=0.45), pouch failure (p=0.46), perceived quality of life (p=0.68), number of bowel movements per day (p=0.27), or sexual satisfaction (p=0.21) between the 2- and 3-stage groups.

Conclusions: Patients undergoing 2-stage compared to 3-stage IPAA for active ulcerative colitis have comparable outcomes and quality of life following ileostomy reversal. Two-stage IPAA appears to be safe and appropriate, even in high-risk patients.

Keywords

ulcerative colitis; IPAA; two-stage; three-stage; quality of life

INTRODUCTION

Despite significant advances in medical therapies, approximately 15–25 percent of patients with ulcerative colitis (UC) continue to require surgery.[1, 2] Total proctocolectomy (TPC) with ileal pouch-anal anastomosis (IPAA) has become the restorative procedure of choice for medically refractory UC, offering good long-term bowel function and patient satisfaction, though with high morbidity rates of over 30–50 percent.[3–7]

IPAA is usually performed in two stages (TPC with IPAA and diverting ileostomy, followed by ileostomy closure), though it can also be performed in three stages (first subtotal colectomy, then completion proctectomy with IPAA and diverting ileostomy, then ileostomy closure) or one stage (TPC with IPAA and no fecal diversion). Three-stage procedures have been preferred for patients deemed high-risk for complications, such as those with severe disease, on high-dose steroids or biologics, or with possible Crohn's disease.[8, 9] The decision over when to perform 2- versus 3-stage IPAA is highly controversial, and often influenced by training, anecdotes, and fear of complications.[10]

Our prior work from 2013 demonstrated a possible overuse of 3-stage IPAA for active UC.[11] We found that perioperative morbidity was associated with surgeon experience, not with number of stages, emergent status, or preoperative use of steroids. However, it is unclear if surgical practices have changed. The current literature comparing 2- versus 3-stage operations continues to be limited, with mixed results that provide little guidance to practicing colorectal surgeons. Furthermore, studies comparing long-term bowel function in patients with 2- versus 3-stage operations are even more scarce.

This study aims to use our significantly expanded IPAA patient cohort to determine if a 2-stage operation is appropriate in "high-risk" patients. Our hypothesis is that patients who received 2- and 3-stage IPAA will have similar rates of the primary outcome, any perioperative complication after any stage. This study also aims to determine if number of stages was associated with late complications or long-term bowel function.

METHODS

Study design

We conducted a retrospective study of a cohort of patients who underwent 2- or 3-stage IPAA for UC at the Massachusetts General Hospital from September 2000 to December 2015. Data were collected from a prospectively-maintained institutional database of all patients who underwent IPAA. Patient exclusion criteria included diagnosis of Crohn's disease or indeterminate colitis on postoperative pathology, surgical indication of dysplasia or malignancy, ileo-rectal anastomosis, or single-stage IPAA.

Each patient was invited to complete a survey six months following ileostomy reversal, which contained questions pertaining to basic demographics and five validated patient-reported outcome tools (see *Variable Definitions*, below). Follow-up letters were mailed six weeks after the initial surveys to patients who did not respond to increase response rate. Each patient was offered a contact phone number for help with the survey if they did not speak English. The Institutional Review Board (IRB) approved this study (Protocol #2008P002110 and #2011P001407).

Variable definitions

Basic demographic and clinical characteristics were obtained, including age, sex, race, body mass index (BMI), age-adjusted Charlson Comorbidity Index (CCI),[12] American Society of Anesthesiologists (ASA) score, history of prior abdominal operations, and smoking status. Disease characteristics were recorded, such as use of steroids, anti-tumor necrosis factor (TNF) agents (including adalimumab, infliximab, certolizumab, and golimumab), and other immunomodulators (including azathioprine, 6-mercaptopurine, cyclosporine, tacrolimus, and methotrexate) at the first operation. Use of >40 mg/day of prednisone-equivalent corticoid medication at the time of the first operation was also recorded. Surgical factors included indication for the operation, urgent status (operated on during an unplanned admission), 2- versus 3-stage IPAA, laparoscopic approach, and surgeon experience (high-volume inflammatory bowel disease (IBD) surgeon was defined as anyone who performed ≥50 IPAA during colorectal fellowship or as an attending). All ileo-anal anastomoses were stapled. A board-certified pathologist determined disease severity of the overall specimen and at the anastomosis (using the ring of tissue removed after firing the circular stapler).

Perioperative complications (within 30 days of an operation) were recorded after each stage of surgery and included anastomotic leak, abdominal sepsis or abscess, other infections (pneumonia, urinary tract infection, surgical site infection, line infection), thrombotic complications (deep vein thrombosis, pulmonary embolism, line-associated thrombus), and ileus (more than 3 days between surgery and patient's ability to tolerate a solid diet).[13] Length of stay (LOS), readmission within 30 days, readmission within 90 days, and reoperation within 90 days were also recorded. Late complications (>30 days after surgery) included pouchitis (symptoms of pouchitis confirmed by inflammation on endoscopy and/or biopsy),[14] fistula or abscess, small bowel obstruction (SBO), incisional hernia, anal stricture, and pouch failure (requiring revision or reversal of IPAA).

Surveys collected patient-reported outcomes using five previously-validated tools: Fecal Incontinence Quality of Life scale,[15] International Index of Erectile Function Survey for men[16] or Female Sexual Function Index for women,[17] Memorial Sloan-Kettering Cancer Center (MSKCC) Bowel Function Scale,[18] Fecal Incontinence Severity Index Scale,[19] and the clinical portion of the Pouchitis Disease Activity Index.[20] While originally developed for patients undergoing resection for rectal cancer, the MSKCC scale has been used by our group in patients with benign conditions that may lead to low anterior resection syndrome (LARS) secondary to proctectomies. It was found to correlate well with other validated tools measuring fecal incontinence and urgency, while providing additional quantifiable information on use of medical interventions to treat bowel dysfunction, severity of clustering and fragmentation associated with mild LARS (as seen in resections for diverticulitis) as well as extreme LARS (as seen after IPAAs), while discriminating the impact of variations in surgical technique for IPAA creation, and patients with pouchitis.[21, 22]

Statistical analysis

Power calculations were performed to ensure adequate sample size to detect a difference in our primary outcome, any perioperative complication within 30 days of any operation. To detect a relative risk of 1.3, with an estimated total complication rate of 70% (given that each patient underwent multiple operations), assuming 35% of our patients would undergo a 3-stage operation, would require including 130 patients in the 2-stage group and 46 patients in the 3-stage group. These calculations were based on previously published data,[11] and were performed with a power of 0.80, at an alpha level of 0.05.

Variables were summarized as mean (standard error of the mean (SEM)) or count (percentage) as appropriate. Categorical variables were compared with the Fisher Exact test, continuous variables were compared with the 2-sample t test, and multivariable logistic regression was used to adjust for potential confounders. For analyzing perioperative and late complications, we created multivariable models including the following clinically-relevant variables: CCI; >40 mg/day of prednisone-equivalent corticoid medication use, anti-TNF agent use, and other immunomodulator use at first operation; urgent status; surgeon experience; and severe disease in the specimen. These variables were chosen based on prior literature and the authors' expertise.[11]

Given potential for bias from missing data, univariate analysis was used to assess characteristics of survey responders to non-responders, to confirm similarity between the two groups. Univariate analysis was then used to compare the functional outcomes between survey responders treated with 2- versus 3-stage operations. All statistical analysis was performed using Stata software, version SE 14.0 (StataCorp, College Station, TX, USA). All tests were 2-sided and statistical significance was accepted at the $p<0.05$ level.

RESULTS

We identified 252 patients with UC who underwent 2- or 3-stage IPAA over the study period. Of those patients, 40 (15.8%) underwent the operation for dysplasia or malignancy and were excluded from the analysis.

Overall cohort

Of the 212 patients in our cohort, 41.6% were female and 88.4% were white, with a mean (SEM) age of 35.9 (12.9) years and mean (SEM) BMI of 24.9 (5.3) kg/m^2. Approximately 3.5% of patients were current smokers, 29.1% had a CCI ≥1, 13.6% were ASA ≥3, and 23.7% had prior abdominal surgery. Ninety-one percent of patients were operated on by a high-volume IBD surgeon.

In terms of disease severity, 76.6% of patients were taking steroids at the time of the first operation, 30.3% were taking anti-TNF agents, and 41.1% were taking other immunomodulators. All patients had been weaned off steroids and IBD medications prior to the second operation. Approximately 34.9% of patients underwent urgent operations. A total of 157 (74.1%) patients underwent 2-stage IPAA, while 55 (25.9%) underwent 3-stage IPAA. The mean (SEM) follow-up time was 4.7 (2.8) years.

Patient demographics and disease characteristics by 2-stage versus 3-stage procedures

The two groups were similar in terms of age, sex, race, BMI, smoking status, CCI, and ASA score (Table 1). Rates of steroid use and anti-TNF agent use at the time of the first operation were also statistically similar (p=0.09 and p=0.85, respectively). Patients who received 3-stage IPAA were less likely to be taking other immunomodulators at the time of the first operation (p=0.01), more likely for the surgical indication to be perforation or toxic colitis (p<0.001), and more likely for the procedure to be performed urgently (p<0.001). Nevertheless, there was no difference in rates of severe disease in the specimen (p=1.0) or severe disease at the anastomosis (p=0.14).

Perioperative and late outcomes after 2-stage and 3-stage procedures

On univariate analysis of our primary outcome, risk of any perioperative complication after any stage, there was no significant difference between patients who underwent 2- versus 3-stage procedures (106 (67.5%) vs 42 (76.4%), p=0.24) (Table 2). Specifically, rates of overall anastomotic leak (9.6% vs 5.0%, p=0.53) and overall abdominal sepsis or abscess (19.9% vs 25.0%, p=0.51) were statistically similar. LOS after the IPAA stage was significantly longer for patients who underwent 2-stage procedures (6.6 vs 4.4 days, p=0.003). Despite this, 30- and 90-day readmissions were similar (34.6% vs 42.5%, p=0.36; and 35.8% vs 42.6%, p=0.38). Furthermore, total LOS after all stages was shorter for patients who received 2-stage surgery (10.5 vs 13.0 days, p=0.03). There were no significant differences in rates of reoperation within 90 days of the first operation (p=0.97) or any operation (p=0.87), based on number of stages.

On univariate analysis of late outcomes, rates of pouchitis, fistula or abscess, incisional hernia, anal stricture, and pouch failure were similar between patients who received 2- versus 3-stage operations (all p>0.05) (Table 2). Patients with 2-stage IPAA were more likely to develop an SBO (19.8% vs 5.0%, p=0.03). Of note, mean (SEM) follow-up time was significantly different between patients who received 2- and 3-stage procedures (5.05 (0.23) vs 3.65 (0.42) years, p=0.005). Follow-up time was adjusted for in multivariable analyses of late outcomes.

Multivariable analysis of perioperative and late complications demonstrated nearly no difference in outcomes between the 2- or 3-stage approaches (Table 3). Specifically, there was no difference in the primary outcome, risk of any perioperative complication (odds ratio (OR) 0.71, 95% confidence interval (CI) 0.29–1.73, p=0.45). Surgical approach was also not associated with differences in anastomotic leak or abdominal sepsis (p=0.83), pouchitis (p=0.38), fistula or abscess (p=0.31), anal stricture (p=0.25), or pouch failure (p=0.59). The difference in SBO persisted on multivariable analysis, with 2-stage operations associated with increased rate of later obstruction (OR 7.12, 95% CI 1.39–36.5, p=0.02). Surgeon expertise was significantly protective, as patients of high-volume IBD surgeons were less likely to experience any perioperative complications (OR 0.21, 95% CI 0.04–0.98, p=0.047) or later pouch failure (OR 0.16, 95% CI 0.03–0.89, p=0.04). Of note, number of stages was not associated with anastomotic leak or abdominal sepsis on multivariable analysis (OR 0.90, 95% CI 0.33–2.40, p=0.83).

Quality of life surveys

Of the 212 patients in the cohort, 113 (53.3%) completed the survey. There were no differences in demographics or disease characteristics between responders and non-responders (all p>0.05). Of survey responders, 81 (71.7%) patients underwent 2-stage procedures, while 32 (28.3%) had 3-stage operations. Most demographics did not statistically differ between the 2- versus 3-stage IPAA groups among survey responders (Table 4).

Based on the surveys, there was no difference in proportion of patients undergoing 2- versus 3-stage operations who perceived their quality of life (QOL) as better than before IPAA (82.7% vs 84.4%, p=1.0) or better than expected (50.6% vs 56.3%, p=0.68) (Table 5). Mean (SEM) number of bowel movements per day was similar in both groups (7.4 (0.3) vs 8.2 (0.8), p=0.27). Patients undergoing 2-stage procedures were less likely to have nocturnal seepage (17.3% vs 37.5%, p=0.03), although there was no difference after adjusting for original procedure urgency (OR 0.50, 95% CI 0.18–1.42, p=0.20). There were no statistically significant differences between patients who reported making it to the bathroom in time for a bowel movement (92.4% vs 90.0%, p=0.70), distinguishing between stool and gas (48.7% vs 32.3%, p=0.14), and being able to control gas (58.2% vs 51.6%, 0.67). There were also no differences in depression, treatment for pouchitis, sexual satisfaction, or erectile dysfunction (all p>0.05).

DISCUSSION

This study demonstrates no difference in the primary outcome, risk of any perioperative complication after any stage, between patients who undergo 2- versus 3-stage IPAA for active UC. There was no difference in anastomotic leak or abdominal sepsis, pouchitis, pouch failure, long-term bowel function, or QOL in patients who underwent 2- versus 3-stage IPAA. Even after adjusting for high-risk characteristics such as urgent status, high-dose steroid use, anti-TNF agent use, other immunomodulator use, severe disease, and CCI, number of stages was not associated with worse outcomes. Patients who underwent IPAA creation while on steroids and other immunosuppressants (2-stage approach) had equivalent

outcomes when compared to patients who underwent IPAA creation after being weaned off those medications (3-stage approach). Therefore, steroid use and urgent indication should not be considered automatic contraindications to performing an IPAA at the index operation.

Prior studies comparing 2- versus 3-stage operations have been conducted, however most are retrospective studies based on small cohorts from single-institutions.[23–27] Two studies combined patients with UC and familial adenomatous polyposis,[24, 26] and three were published over 25 years ago.[23–25] More recent data suggests no difference in complications or rates of abdominal sepsis after 2- versus 3-stage IPAA.[6, 27–29] In fact, one large recent study using the American College of Surgeons National Surgical Quality Improvement Program found no difference in overall complications or deep surgical site infections between patients who undergo 2- versus 3-stage IPAA.[30]

The most recent of these studies, which compared 185 patients who underwent 2- or 3-stage laparoscopic IPAA, found equivalent postoperative morbidity and bowel function, even though 3-stage procedures tended to be urgent operations.[27] However, they concluded that 3-stage IPAA is “probably safer for high-risk patients (ie. in acute colitis)”. We would argue that the correct interpretation of these data, which correlate well with our results, is that the 2-stage procedure is *just as safe* in acutely ill patients. In both studies, after adjusting for high risk characteristics, there was no association between number of stages and complications.

An interesting finding in our study was that patients who underwent 2-stage IPAA had a higher risk of later SBO. Though it would seem counterintuitive, as three abdominal operations would likely generate more adhesions than two, this has been found in prior published work.[11, 25] A possible explanation is that average follow-up time for our patients who underwent 2-stage IPAA was significantly longer than those who had 3-stage procedures, though we adjusted for follow-up time in our analysis. It is also possible that unmeasured factors, such as use of anti-adhesion barriers or postoperative use of steroids, affect SBO risk. Operative time of the index procedure may have also contributed to risk of late SBO, particularly because only about 25% of procedures were performed laparoscopically. Nevertheless, ileus and SBO continue to contribute significantly to postoperative morbidity, with other studies finding similarly high rates of approximately 20%.[31, 32]

Our study also contributes crucial data to the sparse body of literature on QOL after IPAA. There were no significant differences in long-term bowel function between patients who underwent 2- versus 3-stage IPAA, suggesting that delaying IPAA creation does not improve functional outcome in high-risk patients, though our results are limited by the small number of survey responders. Nevertheless, our results demonstrate high QOL ratings and comparable functional results to previously published data, with patients having approximately 7–8 bowel movements per day, 20% incidence of seepage, and 15–20% rate of treatment for pouchitis.[4, 7, 33] However, there continues to be significant room for improvement, as only one-third of patients rated their health as good, over 10% of patients experienced depression, only one-half of patients reported sexual satisfaction, and nearly one-quarter of male patients had erectile dysfunction.

Of note, our results suggest that surgical expertise is highly correlated with postoperative outcomes. High-volume IBD surgeons were significantly less likely to have patients with perioperative complications or pouch failure, which is consistent with prior work.[11, 34–36] These findings add to the burgeoning literature comparing volume, specialization, and outcomes after complex surgical procedures,[28, 37–40] and suggest that patients with severe colitis on steroids should be referred to dedicated colorectal surgeons when possible.

The main limitation of our study is that it is a retrospective study based on patients at a single high-volume institution, raising the potential for lack of generalizability. Furthermore, despite our attempts to ensure adequate power to detect a clinically significant difference in our primary outcome, we only ended up finding a 13% difference in perioperative complications between the two groups, making it possible that we were underpowered. Multi-institutional databases of IBD patients would be crucial for increasing power and decreasing the potential for biased data from single institutions. A prospective randomized trial would be ideal and should be strongly considered to provide the most definitive answer to this question. Also, though we did not find any differences in patient demographics or disease characteristics between survey responders and non-responders, it is possible that other confounding factors contributed to who completed the surveys and potentially biased results. An additional limitation is that preoperative bowel function, postoperative clinical exam findings, and anorectal physiology test results were not recorded.

We would like to emphasize that we are not arguing for 2-stage IPAA in unstable patients with peritonitis. In our cohort, all seven patients with bowel perforation appropriately underwent 3-stage IPAA. Instead, we are suggesting thoughtful triage of non-toxic, non-perforated patients with UC.

CONCLUSIONS

This work expands on and strengthens our prior work demonstrating that surgical expertise, not timing of IPAA, use of steroids, or procedure urgency, impacts perioperative complications and long-term outcomes in patients with UC.[11, 34] The 3-stage delayed IPAA approach is likely being over-used, subjecting patients to an additional large operation without any functional benefit. While patients with peritonitis or hemodynamic instability must of course undergo 3-stage IPAA, we are suggesting thoughtful triage of non-toxic and non-perforated patients with medically-refractory UC. In the hands of a high-volume IBD surgeon, the 2-stage technique with IPAA and loop ileostomy creation at the time of colectomy is safe and appropriate, even in high-risk patients with UC.

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Table 1.

Patient demographics and disease characteristics, by IPAA surgical approach.

	Two-Stage IPAA (n=157)	Three-Stage IPAA (n=55)	P-value
Patient Demographics			
Age (years), mean (SEM)	36.6 (1.0)	33.8 (1.8)	0.17
Female sex, N (%)	61 (39.6%)	26 (47.3%)	0.34
Race			0.79
White, N (%)	104 (88.9%)	25 (86.2%)	
Hispanic, N (%)	7 (6.0%)	2 (6.9%)	
Other, N (%)	6 (5.1%)	2 (6.9%)	
Body mass index (kg/m^2), mean (SEM)	25.1 (0.5)	24.3 (1.1)	0.43
Current smoker, N (%)	4 (3.0%)	2 (5.1%)	0.62
Age-adjusted CCI ≥1, N (%)	41 (30.4%)	10 (25.0%)	0.56
ASA ≥3, N (%)	17 (13.6%)	5 (13.5%)	1.00
History of prior abdominal surgery, N (%)	33 (24.6%)	8 (20.5%)	0.67
High-volume IBD surgeon, N (%)	140 (89.7%)	52 (94.6%)	0.41
Disease and Operative Characteristics			
Steroid use at first operation, N (%)	100 (73.5%)	34 (87.2%)	0.09
Anti-TNF agent use at first operation, N (%)	42 (30.9%)	11 (28.2%)	0.85
Other immunomodulator use at first operation, N (%)	63 (46.3%)	9 (23.1%)	0.01
Indication for surgery			<0.001
Failure of medical management, N (%)	155 (98.7%)	40 (72.7%)	
Perforation, N (%)	0 (0.0%)	7 (12.7%)	
Toxic colitis, N (%)	1 (0.6%)	8 (14.6%)	
Stricture, N (%)	1 (0.6%)	0 (0.0%)	
Urgent procedure, N (%)	41 (30.2%)	33 (78.6%)	<0.001
Laparoscopic procedure, N (%)	34 (24.5%)	11 (26.8%)	0.84
Severe disease in specimen, N (%)	113 (83.1%)	33 (82.5%)	1.00
Severe disease at anastomosis, N (%)	74 (56.5%)	16 (42.1%)	0.14
Any disease at anastomosis, N (%)	122 (92.4%)	33 (86.8%)	0.33

IPAA: ileal pouch-anal anastomosis; SEM: standard error of the mean; CCI: Charlson-Comorbidity Index; ASA: American Society of Anesthesiologists; IBD: inflammatory bowel disease; TNF: tumor necrosis factor

Table 2.

Univariate analysis comparing perioperative and late outcomes after 2-stage versus 3-stage IPAA.

	Two-Stage IPAA (n=157)	Three-Stage IPAA (n=55)	P-value
Perioperative Outcomes			
Any perioperative complication after any stage, N (%)	106 (67.5%)	42 (76.4%)	0.24
Total perioperative complications after first operation per patient, mean (SEM)	0.8 (0.1)	0.6 (0.1)	0.15
Anastomotic leak, N (%)	11 (8.1%)	1 (2.6%)	0.47
Abdominal sepsis or abscess, N (%)	25 (18.4%)	7 (17.5%)	1.00
Other infections, N (%)	15 (11.0%)	4 (10.0%)	1.00
Thrombotic complications, N (%)	8 (5.9%)	3 (7.9%)	0.71
Ileus, N (%)	42 (30.9%)	8 (21.1%)	0.31
Any perioperative complication after first operation, N (%)	93 (59.2%)	30 (54.6%)	0.63
Total perioperative complications per patient, after all stages, mean (SEM)	1.1 (0.1)	1.3 (0.2)	0.60
Anastomotic leak, N (%)	13 (9.6%)	2 (5.0%)	0.53
Abdominal sepsis or abscess, N (%)	27 (19.9%)	10 (25.0%)	0.51
Other infections, N (%)	36 (26.5%)	16 (40.0%)	0.12
Thrombotic complications, N (%)	8 (5.9%)	3 (7.5%)	0.71
Ileus, N (%)	55 (40.7%)	18 (45.0%)	0.72
Postoperative length of stay			
After IPAA, mean (SEM)	6.6 (0.4)	4.4 (0.3)	0.003
Total, mean (SEM)	10.5 (0.6)	13.0 (0.9)	0.03
Any readmission within 30 days of any operation, N (%)	47 (34.6%)	17 (42.5%)	0.36
Any readmission within 90 days of first operation, N (%)	41 (27.7%)	15 (27.8%)	0.99
Any readmission within 90 days of any operation, N (%)	53 (35.8%)	23 (42.6%)	0.38
Any reoperation within 90 days of first operation, N (%)	8 (5.4%)	3 (5.6%)	0.97
Any reoperation within 90 days of any operation, N (%)	12 (8.1%)	4 (7.4%)	0.87
Late Outcomes			
Follow-up time (years), mean (SEM)	5.1 (0.2)	3.7 (0.4)	0.01
Pouchitis	59 (47.6%)	16 (40.0%)	0.47
Fistula or abscess	14 (10.3%)	6 (15.0%)	0.40
Small bowel obstruction	25 (19.8%)	2 (5.0%)	0.03
Incisional hernia	5 (4.0%)	1 (2.5%)	1.00
Anal stricture	11 (8.8%)	7 (17.5%)	0.15
Pouch failure	9 (7.2%)	1 (2.5%)	0.45
Total late complications per patient, mean (SEM)	1.1 (0.1)	1.0 (0.2)	0.80

IPAA: ileal pouch-anal anastomosis; SEM: standard error of the mean

Table 3.

Odds of perioperative and late complications after 2-stage (versus 3-stage) ileal pouch-anal anastomosis, based on multivariable analysis.[a]

Complication	Odds Ratio	P-value	95% Confidence Interval	
Any perioperative complication after any stage	0.71	0.45	0.29	1.73
Any anastomotic leak or abdominal sepsis	0.90	0.83	0.33	2.40
Pouchitis	1.53	0.38	0.59	3.93
Fistula or abscess	0.49	0.31	0.12	1.94
Late small bowel obstruction	7.12	0.02	1.39	36.5
Anal stricture	0.46	0.25	0.12	1.71
Pouch failure	1.92	0.59	0.18	21.0

[a]Based on multivariable models of each outcome, adjusting for age-adjusted Charlson Comorbidity Index, use of >40 mg/day of prednisone-equivalent corticoid medication prior to first operation, anti-tumor necrosis factor use, other immunomodulator use, urgent status, surgeon experience, and severe disease in surgical specimen. Models for late complications (pouchitis, fistula or abscess, late small bowel obstruction, anal stricture, and pouch failure) were also adjusted for follow-up time.

Table 4.

Patient demographics and disease characteristics, by IPAA surgical approach, among survey responders.

	Two-Stage IPAA (n=81)	Three-Stage IPAA (n=32)	P-value
Patient Demographics			
Age (years), mean (SEM)	37.3 (1.4)	37.6 (2.6)	0.92
Female sex, N (%)	30 (37.5%)	17 (53.1%)	0.14
Race			0.44
White, N (%)	55 (90.2%)	17 (81.0%)	
Hispanic, N (%)	3 (4.9%)	2 (9.5%)	
Other, N (%)	3 (4.9%)	2 (9.5%)	
Body mass index (kg/m^2), mean (SEM)	25.6 (0.6)	24.7 (1.2)	0.44
Current smoker, N (%)	3 (3.8%)	1 (3.2%)	1.00
Age-adjusted CCI ≥1, N (%)	25 (31.7%)	9 (28.1%)	0.82
ASA ≥3, N (%)	11 (14.1%)	4 (13.3%)	1.00
History of prior abdominal surgery, N (%)	20 (25.6%)	6 (19.4%)	0.62
High-volume IBD surgeon, N (%)	74 (92.5%)	30 (93.8%)	1.00
Disease and Operative Characteristics			
Steroid use at first operation, N (%)	56 (70.0%)	26 (83.9%)	0.16
Anti-TNF agent use at first operation, N (%)	26 (32.5%)	10 (32.3%)	1.00
Other immunomodulator use at first operation, N (%)	34 (42.5%)	6 (19.4%)	0.03
Indication for surgery			<0.001
Failure of medical management, N (%)	80 (98.8%)	22 (68.8%)	
Perforation, N (%)	0 (0.0%)	5 (15.6%)	
Toxic colitis, N (%)	0 (0.0%)	5 (15.6%)	
Stricture, N (%)	1 (1.2%)	0 (0.0%)	
Urgent procedure, N (%)	21 (26.3%)	24 (75.0%)	<0.001
Laparoscopic procedure, N (%)	22 (27.5%)	9 (28.1%)	1.00
Severe disease in specimen, N (%)	67 (83.8%)	27 (84.4%)	1.00
Severe disease at anastomosis, N (%)	42 (56.0%)	13 (43.3%)	0.28
Any disease at anastomosis, N (%)	71 (93.4%)	27 (90.0%)	0.69

IPAA: ileal pouch-anal anastomosis; SEM: standard error of the mean; CCI: Charlson-Comorbidity Index; ASA: American Society of Anesthesiologists; IBD: inflammatory bowel disease; TNF: tumor necrosis factor

Table 5.

Univariate analysis comparing quality of life survey responses after 2-stage vs 3-stage IPAA, among survey responders.

Quality of life outcomes	Two-Stage IPAA (n=81)	Three-Stage IPAA (n=32)	P-value
Overall quality of life			
Better than pre-IPAA, N (%)	67 (82.7%)	27 (84.4%)	1.00
Better than expected, N (%)	41 (50.6%)	18 (56.3%)	0.68
Views health as good, very good, or excellent, N (%)	31 (38.3%)	11 (34.4%)	0.83
Scar better than expected, N (%)	32 (39.5%)	13 (40.6%)	1.00
Treated for pouchitis in last 6 months, N (%)	12 (14.8%)	7 (21.9%)	0.41
Bowel movements per day, mean (SEM)	7.4 (0.3)	8.2 (0.8)	0.27
Seepage			
Day, N (%)	12 (14.8%)	7 (21.9%)	0.41
Night, N (%)	14 (17.3%)	12 (37.5%)	0.03
Makes it to the toilet in time, N (%)	73 (92.4%)	27 (90.0%)	0.70
Can distinguish gas from stool, N (%)	38 (48.7%)	10 (32.3%)	0.14
Able to control gas, N (%)	46 (58.2%)	16 (51.6%)	0.67
Depression, N (%)	9 (11.1%)	4 (12.5%)	1.00
Sexual satisfaction, N (%)	45 (55.6%)	13 (40.6%)	0.21
Not sexually active in past 4 weeks, N (%)	33 (40.7%)	16 (50.0%)	0.41
Erectile dysfunction, N (%)	9 (23.1%)	3 (23.1%)	1.00

IPAA: ileal-pouch anal anastomosis; SEM: standard error of the mean