

Does stoma site specimen extraction increase postoperative ileostomy complication rates?

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Abstract

Background Minimizing incisions has the potential to decrease hernia formation and wound complications following laparoscopic surgery. It is currently unknown if using the stoma site for specimen extraction affects outcomes. This study aims to evaluate the impact of stoma site extraction on postoperative complication rates in laparoscopic colorectal surgery.

Methods After IRB approval, a retrospective comparative review of 738 consecutive patients (405 M) who underwent laparoscopic colorectal surgery with ileostomy between January 2008 and December 2014 was performed. Patients who had a minimally invasive surgery that required an ileostomy were included. Patients were classified into two groups: stoma site extraction (SSE) or non-stoma site extraction (NSSE) and compared by body mass index (BMI), age, comorbidities, American Society of Anesthesiologists score, length of stay, estimated blood loss, parastomal complications, and hernia rate.

Results The parastomal hernia rate was 10.1% for the SSE group ($n = 14$) and 4.2% for the NSSE group ($n = 25$) ($p = 0.007$). The need for additional surgeries was 7/139 (5.0%) for the SSE group and 27/599 (4.5%) for the NSSE group ($p = 0.79$). There was no difference in the hernia rate after stoma closure in either group. There was no

difference in single incision laparoscopic surgery versus conventional laparoscopy or robotic-assisted laparoscopy on stoma site complications in patients with SSE. SSE, transfusion, and BMI >30 were found to be independent factors associated with increased stoma site complications. **Conclusion** SSE does increase stoma site complications. SSE should be used with caution, or in conjunction with other techniques to reduce hernias in patients requiring a permanent stoma or with an elevated BMI. The increase in stoma site complications does not translate into additional surgeries or postoperative sequelae following stoma reversal and is a reasonable option in patients requiring a temporary stoma.

Keywords Laparoscopy · Parastomal hernia · Colorectal surgery · Colectomy · Ileostomy · Colostomy · Postoperative complications · Single incision laparoscopy · Specimen extraction

Laparoscopic colorectal surgery is associated with a number of postoperative recovery benefits [1–3]. Many techniques have been employed to further minimize surgical trauma including reduced port and single incision laparoscopy. A common technique utilized to minimize incisions when a stoma is required is to enlarge the stoma aperture to extract the specimen, sparing a separate extraction incision. The literature suggests that 46% of patients with a stoma, created either open or laparoscopically, experience postoperative morbidity directly attributable to the stoma. Some studies also suggest that laparoscopic surgery may increase the incidence of parastomal hernia [4]. Many factors affect hernia rates including BMI, wound infection, hand-assisted or conventional laparoscopic approach, and medical comorbidities [5].

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The impact of specimen extraction sites on wound complications, including surgical site infections and incisional hernia rates, has been evaluated in a number of studies assessing colorectal surgery procedures [5–7]. However, there are limited data on whether specimen extraction specifically through the stoma site is associated with increased morbidity particularly with stoma site complications including hernia, stenosis, prolapse, or retraction. The aim of this study is to assess whether clinically significant stoma-related complications are influenced by specimen extraction through the stoma site.

Patients and methods

A retrospective comparative review of 738 patients who underwent minimally invasive colorectal surgery with ileostomy creation between January 2008 and December 2014 was performed following institutional review board approval. This single institution study included patients who underwent a minimally invasive colorectal procedure performed by a colorectal-trained surgeon that required a stoma and a specimen to be extracted through the abdominal wall. Patients were excluded if the specimen was extracted through the perineum.

A wound protector was used in all cases at the specimen extraction site. The stoma site aperture creation involved vertical division of the anterior and posterior sheaths with blunt spreading of the rectus muscle layers. After specimen extraction, the anterior rectus sheath was tightened around the stoma using one or more interrupted figure of eight absorbable sutures. The stoma was matured as previously described [8]. The anterior rectus sheath of the separate specimen extraction incisions was also closed using absorbable suture. The SILS procedures all involved SSE. The NSSE extraction sites included midline, Pfannenstiel, umbilical and left lower quadrant (LLQ) sites. All data were obtained from a prospectively maintained institutional colorectal surgery outcome database corroborated by patient chart review as necessary. BMI, age, comorbidities, preoperative steroids, biologics, and chemotherapy use, ASA, LOS, EBL, parastomal complications, and parastomal hernia rate were compared between the two groups. All stoma site complications were obtained from clinical documentation obtained through chart review. If there was no documentation of hernia in the postoperative visits or the stoma nurse documentation, it was assumed no clinically evident hernia was present. CT scans were not routinely performed. The charts were also reviewed for all operations after the surgery to ensure that no clinically significant complications requiring surgery were omitted.

Statistical significance was assumed when the *p* value (two-sided) was less than 0.05. Categorical variables were

reported as frequency (%), and quantitative variables were reported as mean \pm standard deviation or as median (25th–75th%). Categorical variables were analyzed with Chi-square or Fisher's exact test. Parastomal hernia, separate site hernia, stoma site hernia, and all stomal complications were also described using the Kaplan–Meier method and were compared by log-rank test. Quantitative variables were analyzed with a Wilcoxon rank-sum test. Subsequently, multivariate Cox regression analyses were conducted to assess the associations between each of parastomal hernia, separate site hernia, stoma site hernia, and all stoma site complications, and stoma site extraction, with covariates selected in a stepwise fashion using Akaike's information criterion (AIC).

Results

738 charts were reviewed which included 333 women (45.1%) and 405 men (54.9%). 23 (3.1%) cases were converted to open and these cases were included in the NSSE group as intention to treat. 139 cases were included in the SSE group (18.8%), while 599 patients had a separate incision NSSE (81.2%). The NSSE sites included 127 midline, 429 Pfannenstiel, 35 umbilical, and 8 left lower quadrant (LLQ) incisions. 736 patients included had a temporary ileostomy created, and only 2 patients in the NSSE group had permanent stomas created. 337 patients had a loop ileostomy created, while 401 patients had an end ileostomy created. 10 surgeries were performed on an emergent basis, while the remainder were performed electively. The method of surgery was based on the surgeon's comfort. The procedures performed, type of surgery, and diagnoses are summarized in Table 1.

There were no statistically significant differences in BMI, age, comorbidities, or ASA score between the SSE and NSSE groups (Table 2). EBL and operative time (OP) were both significantly decreased in the SSE group (Table 3). The median time to stoma closure interval was 4.7 (3.0–9.0) months for the SSE group ($n = 139$) and 5.4 (3.1–7.4) months for the NSSE group ($n = 597$) ($p = 0.94$). The postoperative outcomes of LOS, ileus, time to stoma function, SBO, anastomotic leak, wound infection rates, and venous thromboembolism rates were similar between the groups (Table 3).

The parastomal hernia rate for the entire series was 5.3%. The parastomal hernia rate was 10.1% for the SSE group ($n = 14$) and 4.2% for the NSSE group ($n = 25$) ($p = 0.007$). The estimated 2-year parastomal hernia rate for the entire series was 5.0%. The 2-year parastomal hernia rate was 9.8% for the SSE group and 3.9% for the NSSE group ($p = 0.002$). The parastomal hernia detection time was 4.1 (3.5–5.5) months for the SSE group and 6.9

Table 1 Comparison of the type of surgical procedure, diagnosis, and technique between the groups

	SSE (<i>n</i> = 139)	NSSE (<i>n</i> = 599)	<i>p</i> value
Procedure <i>n</i> (%)			0.06
CP/IPAA	14 (10.1)	109 (18.2)	
TPC/IPAA	13 (9.4)	68 (11.4)	
TAC/EI	88 (63.3)	313 (52.3)	
LAR/DLI	24 (17.3)	109 (18.2)	
Diagnosis <i>n</i> (%)			0.47
Cancer	23 (16.5)	119 (19.9)	
IBD	106 (76.3)	449 (75.0)	
Other benign diseases	10 (7.2)	31 (5.2)	
Technique <i>n</i> (%)			<0.001
Conventional laparoscopy (CL)	37 (26.6)	589 (98.3)	
Robotic-assisted laparoscopic surgery (RAL)	17 (12.2)	10 (1.7)	
Single incision laparoscopy (SILS)	85 (61.2)	0 (0)	

CP/IPAA completion proctectomy with ileal pouch–anal anastomosis; LAR/DLI low anterior resection/diverting loop ileostomy; TAC/EI total abdominal colectomy with end ileostomy; TP/IPAA total protocolectomy with ileal pouch–anal anastomosis; IBD inflammatory bowel disease

Table 2 Comparison of demographics, preoperative characteristics between the groups

	SSE (<i>n</i> = 139)	NSSE (<i>n</i> = 599)	<i>p</i> value
Gender (F/M)	79/60	253/346	0.002
BMI, kg/m ²	25.5 ± 5.6	25.9 ± 5.9	0.52
Age, year	40.7 ± 13.4	42.8 ± 15.9	0.27
ASA score <i>n</i> (%)			0.21
I	2 (1.4)	16 (2.7)	
II	76 (54.7)	371 (61.9)	
III	59 (42.4)	207 (34.6)	
III	2 (1.4)	5 (0.83)	
COPD	1 (0.7)	4 (0.7)	1
DM	4 (2.8)	32 (5.3)	0.23
Steroid use	58 (41.7)	212 (35.4)	0.16
Biologic use	24 (17.3)	89 (14.9)	0.48
Chemotherapy	4 (2.9)	16 (2.7)	0.78
Follow-up time 1	23.2 (14.7–36.2)	32.7 (18.5–48.6)	<0.001
Follow-up time 2	16.4 (7.7–30.6)	25.6 (12.3–41.8)	<0.001

Data were given as mean ± standard deviation, or median (25th–75th%)

BMI body mass index; ASA American Society of Anesthesiologists; COPD chronic obstructive pulmonary disease; DM diabetes mellitus; Follow-up time 1 follow up from ileostomy creation; Follow-up time 2 follow up from ileostomy closure

(4.2–13.9) months for the NSSE group. The stoma prolapse rate was 1.4% for the SSE group (*n* = 2) and 0.3% for the NSSE group (*n* = 2). One patient experienced stoma retraction from the SSE group. The stoma stenosis rate was

1.4% for the SSE group (*n* = 2) and 0.2% for the NSSE group (*n* = 1). One patient from both the SSE and the NSSE suffered stoma strangulation. The parastomal abscess rate was 1.4% for the SSE group (*n* = 2) and 0.2% for the NSSE group (*n* = 1) (Table 4). The incidence of all stomal complications combined was higher in SSE group rather than the NSSE group (Table 5).

Prior to ileostomy closure, 21 non-stoma site incisional hernias were noted: 4/139 (2.8%) cases in the SSE group (one LLQ incision hernia, one midline incisional hernia, and two umbilical hernias), and 17/599 (2.8%) cases in NSSE group (7 Pfannenstiel, 6 midline, and 4 umbilical incisional hernias).

The number of patients who required additional surgeries related to stoma site complications was 7/139 (5.0%) for the SSE group and 27/599 (4.5%) for the NSSE group (*p* = 0.79) (Table 3). 7 patients that had the specimen removed from the stoma site required a second surgery, including: 3 related to stoma site complications, 2 for bleeding, 1 for small bowel obstruction (SBO), and 1 for bowel perforation. 27 patients from the NSSE group required a second operation, including: 3 for stoma site complications, 6 for rectal stump complications, 2 for SBO, 8 for anastomotic leak, 2 for bleeding, 3 for dehiscence, and 3 for hematoma/abscess. The 2-year non-stoma site incisional hernia rate was 4.2% for the SSE group and 3.1% for the NSSE (*p* = 0.91). The non-stoma site incisional hernia rate for the total series was 3.3% (24/738). The non-stoma site incisional hernia rate was 1.4% (2/139) for the SSE group and 3.7% (22/599) for the NSSE (*p* = 0.29). The stoma site hernia following closure of the stoma was 2/139 for SSE group and 11/597 for NSSE

Table 3 Comparison of intra- and postoperative outcomes between the groups

	SSE (<i>n</i> = 139)	NSSE (<i>n</i> = 599)	<i>p</i> value
Operative time (min)	186.47 ± 81.34	224.22 ± 75.73	<0.001
EBL (cc)	100 (50–150)	150 (55–225)	<0.001
Transfusion	6	27	0.92
LOS (days)	5 (3–8)	5 (4–9)	0.2
Time to stoma function (days)	2 (1–3)	2 (1–3)	0.86
Reoperation	7 (5)	27 (4.8)	0.79
Stoma closure interval	4.7 (3.0–9.0)	5.4 (3.1–7.4)	0.94
Anastomotic leak	0 (0)	12 (5.8)	0.23
Wound infection	4 (2.9)	20 (3.3)	>0.99
Intraabdominal abscess	3 (2.2)	9 (1.5)	0.48
Ileus	14 (10.1)	76 (12.7)	0.4
SBO	4 (2.9)	36 (6.0)	0.15
DVT	3 (2.2)	12 (2.0)	1.00
Dehydration	4 (2.9)	15 (2.5)	0.77

Summaries of continuous data were given as mean ± standard deviation, or median (25th–75th%)

EBL estimated blood loss; LOS length of stay; SBO small bowel obstruction; DVT deep venous thrombosis

Table 4 Descriptive frequencies of postoperative stoma site complications between the groups

	SSE (<i>n</i> = 139)	NSSE (<i>n</i> = 599)
Stoma complications		
Hernia	14 (10.1)	25 (4.2)
Prolapse	2 (1.4)	2 (0.33)
Retraction	1 (0.72)	0 (0)
Stenosis	2 (1.4)	1 (0.17)
Strangulation	1 (0.72)	1 (0.17)
Abscess	2 (1.4)	1 (0.17)
All stomal complications	18 (12.9)	28 (4.7)
	SILS	CL/robotic
Stoma hernia detection (mo)	4.1 (3.5–5.5)	6.9 (4.2–13.9)
Non-stoma incisional hernia	4 (2.9)	17 (2.8)
Non-stoma hernia detection (mo)	14.5 (8.9–19.4)	8.9 (4.6–13.5)
Stoma site hernia after closure	2 (1.4)	11 (1.8)
Post stoma closure hernia detection (mo)	16.5 (15.6–17.2)	25.2 (17.7–43.2)

Summaries of continuous data were given as median (25th–75th%)

group ($p = 0.75$) (Table 4). 11/85 (12.9%) patients who underwent a SILS procedure and had SSE suffered stoma site complications, while 7/54 (12.9%) of patients who had a CL or RAL procedure with SSE had stoma site complications indicating that the SILS port itself does not increase the risk for parastomal hernia ($p = 1.0$) (Table 4).

Multivariate Cox regression analysis was conducted for factors associated with any stoma-related complication including parastomal hernia, prolapse, retraction, stenosis, strangulation, or abscess. The same analysis was performed

for parastomal hernia alone. The following variables were used to construct the model: stoma extraction, steroid use, biologics use, chemotherapy, diagnosis, BMI, transfusion, COPD, age, and gender. SSE (HR: 3.14, 95% CI: 1.74–5.67, $p < 0.001$), transfusion (HR: 3.26, 95% CI: 1.28–8.28, $p = 0.03$), and BMI >30 (HR: 4.27, 95% CI: 2.40–7.60, $p < 0.001$) were found to be independent risk factors associated with all stoma-related complications (Table 6). SSE (HR: 2.93, 95% CI: 1.52–5.66, $p = 0.003$), BMI >30 (HR: 6.65, 95% CI: 3.47–12.74, $p < 0.001$) and

Table 5 Kaplan–Meier estimated 2-year cumulative rate of stomal complications

	SSE (<i>n</i> = 139)	NSSE (<i>n</i> = 599)	<i>p</i> value*
Parastomal hernia	9.8	3.9	0.002
All stomal complications	12.7	4.6	<0.001
Non-stoma incisional hernia	4.2	3.1	0.91
Stomal site hernia after closure	2.7	1.5	0.87

* Log rank test

transfusion (HR: 3.37, 95% CI: 1.19–9.58, *p* = 0.05) were found to be independent risk factors associated with parastomal hernia (Table 7).

Discussion

Laparoscopy was first described for colorectal operations in the early 1990s [9]. Since that time, the benefits of laparoscopic colorectal surgery are clear and include earlier return of bowel function, decreased postoperative pain, and lower complication rates [10, 11]. As surgeons have become more proficient in laparoscopy and technology has advanced, more complex operations are being performed with less incisions. Remzi et al. described the first single incision laparoscopic surgery (SILS) colectomy in 2008 [12]. Since that time, SILS has become a common platform

for colorectal resection, which has resulted in using the stoma site not only as a port site, but also for specimen extraction.

Colorectal operations can include the formation of either an end stoma or a defunctioning stoma to reduce complications of an anastomosis. A large portion of these patients, created open or laparoscopically, experience postoperative morbidity directly attributable to the stoma [1]. Patients suffer from difficulties with stoma pouching, cosmetic concerns, pain, limited mobility, incarceration, retraction, stenosis, and the need for additional surgeries. Many laparoscopic and SILS surgeons are using the stoma site as a port site as well as for specimen extraction in an attempt to minimize incisions. Often the stoma site requires stitches to tighten down the fascia aperture around the bowel. As technology has advanced, it is possible to perform more advanced surgeries with less incisions theoretically decreasing pain, improving cosmetic outcomes, and minimizing wound complications. There are few studies that have examined the effects of enlargement of the stoma site to facilitate specimen extraction on stoma site complications.

Studies regarding parastomal hernias are difficult, as no standardized definition for parastomal hernia exists. Differing definitions of parastomal hernia may explain the wide range of incidences quoted in the literature, from 1 to close to 50% [13]. The use of CT scans is helpful and increases detection of asymptomatic hernias, but still can miss parastomal hernias that reduce in the supine position.

Table 6 Cox regression model for any type of stoma-related complication (parastomal hernia, prolapse, retraction, stenosis, strangulation, or abscess) (*n* = 723, 47 events)

Variable	Parameter estimate (SE)	Hazard ratio (95% CI)	<i>p</i> value
SSE	1.14 (0.30)	3.14 (1.74–5.67)	<0.001
Transfusion	1.18 (0.48)	3.26 (1.28–8.28)	0.03
BMI >30	1.45 (0.29)	4.27 (2.40–7.60)	<0.001

This is a multivariable model for any complication using the following candidate covariates: stoma extraction (SSE), steroid use, biologics use, chemotherapy, diagnosis, BMI, transfusion, COPD, age, and gender

Variables entered the model based on greatest improvement in Akaike's information criterion (AIC)

A likelihood ratio *p* value is given for the variable

Table 7 Cox regression model for parastomal hernia (*n* = 723, 39 events)

Variable	Parameter estimate (SE)	Hazard ratio (95% CI)	<i>p</i> value
SSE	1.07 (0.34)	2.93 (1.52–5.66)	0.003
Transfusion	1.22 (0.53)	3.37 (1.19–9.58)	0.05
BMI >30	1.90 (0.33)	6.65 (3.47–12.74)	<0.001

This is a multivariable model for parastomal hernia using the following candidate covariates: stoma extraction (SSE), steroid use, biologics use, chemotherapy, diagnosis, BMI, transfusion, COPD, age, and gender

Variables entered the model based on greatest improvement in Akaike's information criterion (AIC)

This study looked at clinically significant hernias and more importantly stoma site complications that required additional interventions. In this study, prolapse was defined as eversion of the stoma through the abdominal wall, whereas parastomal hernia was defined as a clinically evident bulging around the stoma whether symptomatic or not [1, 14]. Other authors have described parastomal prolapse as a subgroup of parastomal hernia, but it is considered a separate entity in this study [15].

The overall parastomal hernia rate in this series was 5.3%, which is low compared with the reported rates for laparoscopic surgery. In this series, many of the patients had surgery for inflammatory bowel disease or rectal cancer resulting in 99% of the stomas being temporary. All Hartmann's procedures at this institution were performed open and therefore excluded, and all abdominoperineal resection patients and total proctocolectomy with end ileostomy patients were excluded due to a perineal extraction site. A lower parastomal hernia rate was expected in this study since the average time to parastomal hernia detection was 6 months and the average time to stoma closure was 5 months. The use of clinical exam for diagnosis also falsely lowers the hernia detection rate, though that should be equally biased for both groups.

Patient-specific factors that could play a role in the formation of parastomal hernias including age, gender, diabetes, COPD, steroid use, biologic use, chemotherapy, wound infection, and BMI were evaluated. There were no differences in the patient-related factors between the SSE and NSSE groups (Table 2). We found that both operative time and EBL were both decreased in the SSE group. These findings are consistent with the author's previous studies looking at SILS compared with conventional laparoscopy (CL) [16, 17]. Since 85/139 patients in the SSE groups were performed using the SILS method, this is likely the reason for the differences noted in the EBL and operative time.

We also found that 8 patients of the 139 from the SSE group experienced stomal prolapse, retraction, stenosis, strangulation, or abscess, while 5 patients of the 599 patients with NSSE suffered these complications. Since the individual complication rates were very low, all stoma site complications, including hernia, were combined and there was a statistically significant increase in complications in the SSE group ($p < 0.05$). The clinically relevant information in the proposed study is whether the patient suffered consequences of these complications and required an additional operation prior to stoma closure.

The rate of reoperation for stoma site complications was evaluated and was equivalent between the groups. The authors feel that if the patient does not need additional operations prior to stoma closure, the effects of the stoma site complications are temporary and corrected with the

stoma closure. Therefore, the statistically significant increase in parastomal hernia rates associated with the SSE group has a much less substantial clinical significance. That does not mean that some patients did suffer adverse effects on quality of life in the interim. In this study, most of patients underwent surgery for IBD or cancer whose stomas were temporary. The increase in parastomal hernias in the patients who had SSE did not increase the need for added operations. The next concern is if the increased parastomal hernia rate led to an increase in stoma site hernias after closure of the stoma. The follow-up data demonstrate no difference in the rate of hernia at the stoma site after closure of the stoma (Table 4).

The follow-up time for both groups is greater than 2 years, which should be adequate to detect postoperative hernias due to the fact that the majority of stomas were temporary. The NSSE follow-up time is longer than SSE due to the fact that SSE has been performed more recently; therefore, the SSE naturally has a shorter follow-up time. If this was to affect the stoma complications data, it would mean that fewer parastomal hernias were detected than truly exist in the SSE group.

Specific independent risk factors for parastomal hernia have previously been described. These predisposing conditions include respiratory comorbidities, cancer, diabetes mellitus, smoking, and elevated body mass index [1, 18, 19]. Multivariate analyses were performed to evaluate multiple patient-specific factors (Tables 6, 7). Factors that increased the risk of parastomal hernia as well as all stoma complications were SSE, BMI, and transfusion.

Using the stoma aperture as the specimen extraction site does increase the clinically detectable parastomal hernia rate. The increase in parastomal hernia rates in the SSE group is likely due to enlargement of the stoma site for extraction. The possibility exists that the SILS technique could increase the risk of stoma site hernia due to constant tension on the fascia from the SILS port and traction from the instruments. Studies have shown that SILS increases the overall hernia rate [20]. This study shows that the use of the stoma site as a port (SILS) did not increase the risk of stoma site complications versus conventional laparoscopy or robotics (Table 4).

The retrospective nature of this study is a clear weakness. The use of clinical documentation to detect parastomal hernias is also a weakness and leads to a falsely low hernia rates, though this weakness should have affected both the SSE and the NSSE groups equally. All operative reports of the patients were reviewed, so no additional operations were missed in either group. The large sample size is a positive attribute to the study. As well as the fact that few patients were lost to follow-up as the majority had temporary stomas and returned for stoma closure.

Conclusions

Stoma site specimen extraction increases the parastomal hernia rate as well as stoma site complications. This increase did not translate into additional surgeries before or after stoma reversal. The increase in parastomal hernias is likely related to enlargement of the stoma site rather than the SILS technique. Though SSE increases the parastomal hernia rate, there was no need for added intervention or increase in the hernia after stoma closure; therefore, it is reasonable in patients with an acceptable BMI in which the stoma will be temporary. Patients with an elevated BMI or requiring a permanent stoma should have a separate extraction incision created.

Compliance with ethical standards

Disclosures Wanglin Li, Cigdem Benlice, Luca Stocchi, Hermann Kessler, Emre Gorgun, Meagan Costedio have no conflicts of interest including relevant financial interests, activities, relationships, and affiliations.

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