Totally laparoscopic colectomy with intracorporeal anastomosis achieved using a laparoscopic linear stapler: Experience of a single institute

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Totally laparoscopic colectomy with intracorporeal anastomosis using laparoscopic linear staplers: A single insutitute experience.

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Abstract

Purpose:

Laparoscopic colonic surgery is now widely accepted in the treatment of colorectal disease. The aim of this study was to assess the safety and usefullness of performing intracorporeal functional end-to-end anastomosis with endoscopic linear staplers when using a total intracorporeal surgical strategy for the treatment of colon cancer.

Methods:

Forty three selected patients underwent an elective laparoscopic colon resection for carcinoma. A total intracorporeal colon resection was performed in all of these patients by means of functional end-to-end anastomosis with endoscopic linear staplers.

Results

This technique was used on 43 subjects and the results were successful in all patients. No patient had to be converted to open surgery which thus requires extracorporeal anastomosis. There have been no intra-operative complications related to this technique and no instances of postoperative anastomotic leakage, intra-abdominal abscess, or wound infection.

Conclusion:

Intracorporeal functional end-to-end anastomosis using a linear stapler can therefore be safely and easily performed for any parts of colon resection and it is thus considered to be an effective modality for performing totally laparoscopic colon

resection. This method has also achieved favorable results, particularly in cases demonstrating a small-sized tumor under the present conditions since NOTES remains a challenging method to perform.

Introduction

A laparoscopic colon resection is superior to open surgery in regard to postoperative pain, recovery, and hospital stay. [1–4] With the recent publication of several landmark trials confirming the safety and effectiveness of the laparoscopic approach for both benign and malignant colorectal pathology, [5-8] it is expected that the demand for a laparoscopic colorectal surgery will greatly increase. However, most operations are performed using a laparoscopically assisted technique whereby extracorporeal bowel division and anastomosis are performed after laparoscopic mobilization of the bowel [16, 17]. This technique limits the ability to choose an extraction site. In addition, problems with intestinal alignment after extraction are known to occur. A completely intracorporeal anastomosis may reduce the likelihood of intestinal twisting, while also offering the possibility of using any abdominal location for specimen extraction. However, even though intracorporeal anastomosis with circular stapler methods for left side colon resection and intracorporeal anastomosis methods for right hemicolectomy had been reported [9-14, 24], a method for performing functional end-to-end anastomosis as an open anastomosis method for any parts of a colon resection have not yet been reported. We herein attempt to clarify whether functional end-to-end anastomosis, which has already been proven to be safe and effective for an open colectomy [18, 19], can also be successfully applied when performing totally intracorporeal anastomosis in laparoscopic colectomy.

Methods

Patients:

Between July 2002 and Jun 2010, 43 selected patients (27 males and 16 females: mean age 64.5, range 40 -8 4 years) underwent an elective laparoscopic colon resection for adenocarcinoma. Any patients with a large, fixed tumor (over 6 cm in diameter), a previous history of extensive abdominal surgery, and those who had been, or were still being treated for malignant disease were excluded. The patient characteristics are shown in Table 1.

Technique:

All patients underwent mechanical bowel preparation consisting of an oral sodium picosulfate and magnesium citrate, and glycerin enema preparation. Oral preoperative antibiotics were not used. In addition, all patients received systemic intraoperative and postoperative antibiotics, usually cefotiam hydrochloride (Pansporin, Takeda. Tokyo, Japan), and two postoperative doses were the norm.

All laparoscopic operations were performed by a single surgeon (T.I.) experienced in both laparoscopic and open colorectal surgery. The initial port placement was performed using the open technique and pneumoperitoneum was induced with carbon dioxide. Three or four remaining ports were then made under laparoscopic guidance.

The colon and the vascular pedicles were divided and mobilized together with intracorporeal draining of the lymph nodes. The division of the marginal artery, mesentery, and mesenteric vascular pedicles was also performed intracorporeal. In addition, the proximal and distal margins of the specimen were divided with an intestinal 60-mm Endo-GIA Universal stapler (United States Surgical, Norwalk, CT). Next, the specimens were removed using an Endocatch II (United States Surgical, Norwalk, CT) via a 15 to 18 mm infraumbilical port. A 60-mm Endo-GIA was inserted from the infraumbilical port, and the anastomosis was intracorporeal constructed by two 60-mm Endo-GIA staples in order to perform the functional end-to-end anastomosis.

The method is shown in Figure 1. The antimesenteric borders of the proximal and distal side of the bowel to be anastomosed were apposed using No. 4-0 silk suture. At the edges, 10-mm transverse incisions were made on the antimesenteric borders of both bowels. The 60 mm Endo-GIA was inserted into the abdominal space and each end of the stapler was inserted into each bowel limb and the stapler was then closed along the antimesenteric border of the bowel and fired (Fig. 1A). Thereafter, the center and both ends of the portion where the stapler was inserted were raised using 4-0 silk suture. A reloaded, 60-mm Endo-GIA was then placed across the three raised sutures, and the stapler was then fired (Fig. 1B). Some hand sutures were added for reinforcement purposes corresponding to the conditions of the anastomosis. The mesenteric defect was then closed in the usual manner.

Results

The surgical results and postoperative course are presented in Table 2. The surgical procedures performed included 4 cases of ileocecal resection, 19 of right hemicolectomy, 6 of transverse colectomy, 7 of left colectomy and 7 of sigmoidectomy. The average operation time was 213 minutes. The average time required for anastomosis was 19 minutes. The estimated blood loss was 28 g and no patients recieved blood transfusion. There was no case of conversion to an open surgery. The average length of postoperative ileus was 1.3 days. The average hospital stay was 10 days. Postoperative complications occured in three patients (5%), but no postoperative mortality occured. In terms of major complications, there was no cases of anastomotic leakage, intra-abdominal abscess intraabdominal bleeding. Regarding minor complications, there were two cases of wound infection and one case of paralytic ileus. All of the patients recovered well with conservative management. A fluoroscopic examination (Fig. 2A) of one month after the operation and endoscopy (Fig. 2B) of one year after the operation, show the anastomosis to be of sufficient size while also demonstrating a good passage. The status of the operative wounds at 1 month after undergoing a sigmoidectomy is shown in Figure 3, some slightly visible scars were observed on the abdomen. Three patients had lymph node metastasis, but the number of metastatic nodes was less than three in each. Among them, two patients with stage 3 disease recieved adjuvant chemotherapy. During the median follow-up period of 28 months (range 2 - 94)

months, two patients died of other causes, and no cases of cancer recurrence have so far been observed.

Discussion

When we first began to perform this operation, only the patients whose tumor was small, namely about 1cm in diameter or the patients whose abdominal wall was extremely thick were indicated for this method. Consequently, this method was used to treat 43 cases out of 208 cases of lapaloscopic colectomies for about 8 years. In the last 6 months however, this method was used with 20 out of 22 cases of laparoscopic colectomies, except for two cases that presented with extremely large tumors.

The general method of performing a laparoscopic resection for colon cancer is to pull the portion of the colon including the lesion of the carcinoma out through a small incision and then perform both a resection and reconstruction [16, 17]. According to the method described herein, both the resection and reconstruction were performed intracorporeally. All specimens were removed by a plastic bag via a 15 mm to 18 mm port after cutting the proximal and distal ends with an endoscopic stapler to excise the main site of the disease._ The four main advantages of this method, in comparison to extracorporeal anastomosis are as follows: 1) The thick abdominal wall in accordance with obesity does not affect anastomosis. 2) Because there is no need to extracorporeally position the bowel that needs to be resected, the

extent of bowel isolation can thus be minimized. For example, in a right hemicolectomy, the ileum, which is originally isolated, is sent to the colon, which is hard to move, and then both bowels are anastomosed. 3) It is not necessary to make any new incision for anastomosis, and the abdominal incision size can thus be made even smaller. 4) This method reduces the likelihood of intestinal twisting.

There was some concern that the bowel contents might flow out to abdominal cavity while additional incisions were made for their insertion of the linear stapler. However, almost no such outflow of the bowel contents was observed. Because, during laparoscopic surgery, a manual pressure is not applied to the intestines and the administration of medicines to induce the acceleration of intestinal peristasis, such as epidural analgesia, are originally avoided.

Hellan et al. [12] compared intracorporeal anastomosis with extracorporeal anastomosis for performing a right hemicolectomy. Although, no statistically significant differences in the length of the hospital stay or the duration of the postoperative ileus were found, there appeared to be a trend towards a smaller incision length in the intracorporeal anastomosis group, while there tended to be more anastomosis-related complications in the extracorporeal anastomosis group.

Ikeda et al. [15] compared a totally laparoscopic distal gastrectomy with a laparoscopically assisted distal gastrectomy for gastric cancer and showed a totally laparoscopic distal gastrectomy to have several advantages over a laparoscopically assisted distal gastrectomy, including a small wound size, less invasiveness, and a better feasibility of secure ablation and safe anastomosis independent of the patients' constitution and cancer location.

Most cases that have undergone intracorporeal anastomosis for colorectal resection which have been reported so far were associated wiht methods that used a circular stapler. According to these methods, the anvil head was inserted on the oral side of colon and then was combined with the body of the circular staplar inserted from the anus [9, 11, 12]. Therefore, these methods can be applied only to the anastomosis of a part of the intestine located less than 20 cm far from the anus. There were two reports that intracorporeal anastomosis in which a linear stapler was used according to our search of the pertinent literature. According to both methods, the anastomosis was performed partly using hand-sewn sutures and, as a result, took a longer time to complete in comparison to extracorporeal anastomosis [10, 23]. The method reported herein, namely the anastomosis method itself is not a novel method, since it has already been proven to be safe and effective when performing an open colectomy [18, 19]. The anastomosis is completed after firing two or three linear staplers as necessary.

Recently, natural orifice translumenal endoscopic surgery (NOTES) has gained much interest among minimal invasive surgeons and gastroenterologists. Using the body's natural orifices to perform surgical procedures decreases the bodily injury that occurs with more invasive abdominal wall surgery [20,21]. For humans, various procedures using a hybrid technique that combines the natural orifice approach with standard laparoscopic vision (hybrid NOTES) have been tested [22-24]. In the field of standard laparoscopic surgery, as discussed earlier, some reports describe totally intracorporeal anastomosis combined with extraction of the specimen through natural

orifices. However, difficulty in performing intracorporeal anastomosis has prevented this procedure from so far being widely accepted.

Finally, this intracorporeal stapled reconstruction technique can be applied to NOTES as well.

Conclusion

This report verified that functional end-to-end anastomosis can be safely and easily performed for totally intracorporeal anastomosis during laparoscopic colectomy. Regardless of the physique and the part of the intestine that needs to be excised, this method can be used to successfully perform anastomosis. The future application of this procedure to NOTES is therefore expected.

Legends

Figure 1.

1A) A 60 mm Endo-GIA is intracorporeal inserted into each bowel limb, and then the stapler is closed along the antimesenteric border of the bowel and fired.

1B) Another Endo-GIA is intracorporeal placed across the three raised sutures, and then the stapler is fired.

Figure 2.

The typical follow-up results,from patient No. 9. A fluoroscopic examination (2A) one month after operation and endoscopy (2B) one year thereafter showed the anastomosis to be of sufficient size, while also demonstrating a good passage.

Figure 3.

The status of operative wounds at 1 month in case 10 after undergoing a sigmoidectomy.

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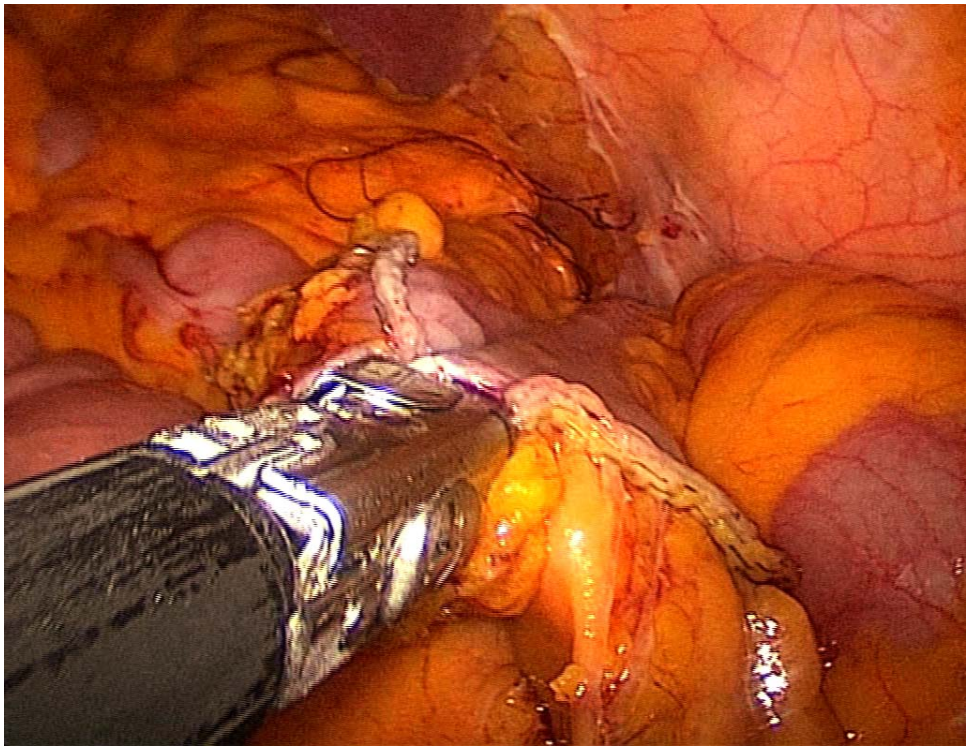
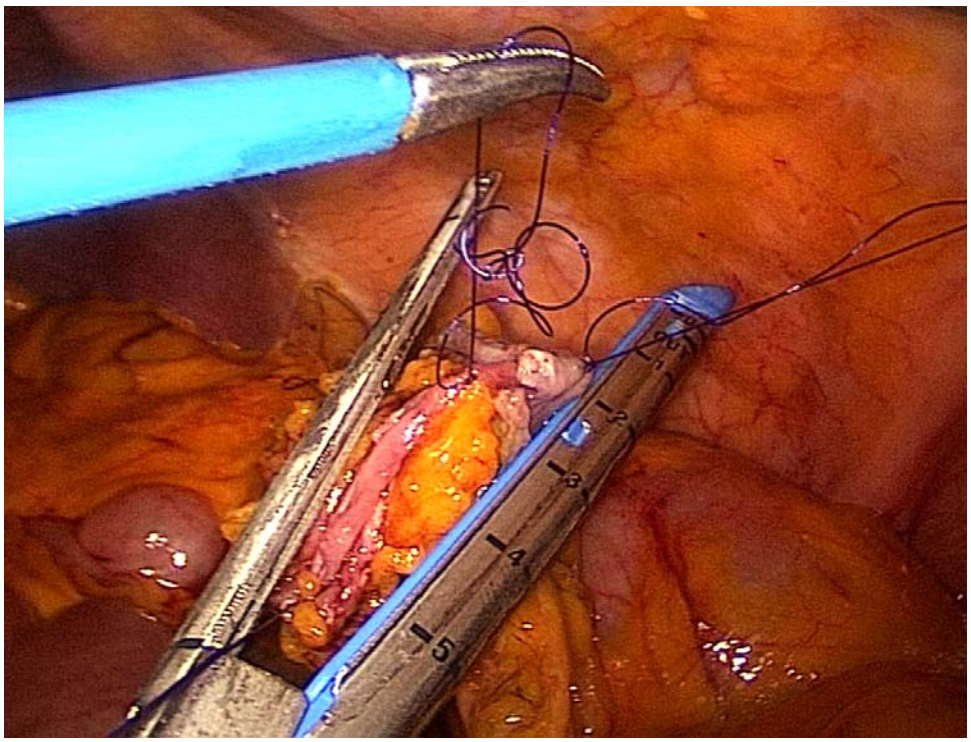
Fig 1.

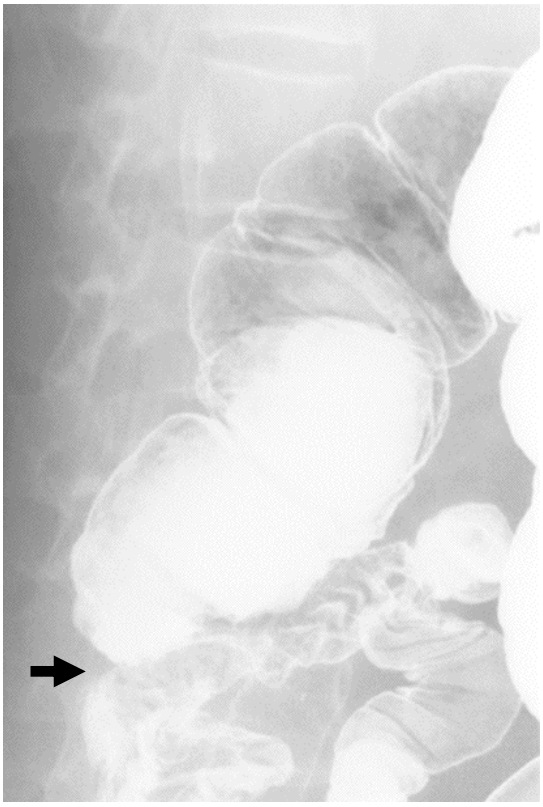


1A)



1B)

Fig. 2.

2A) 

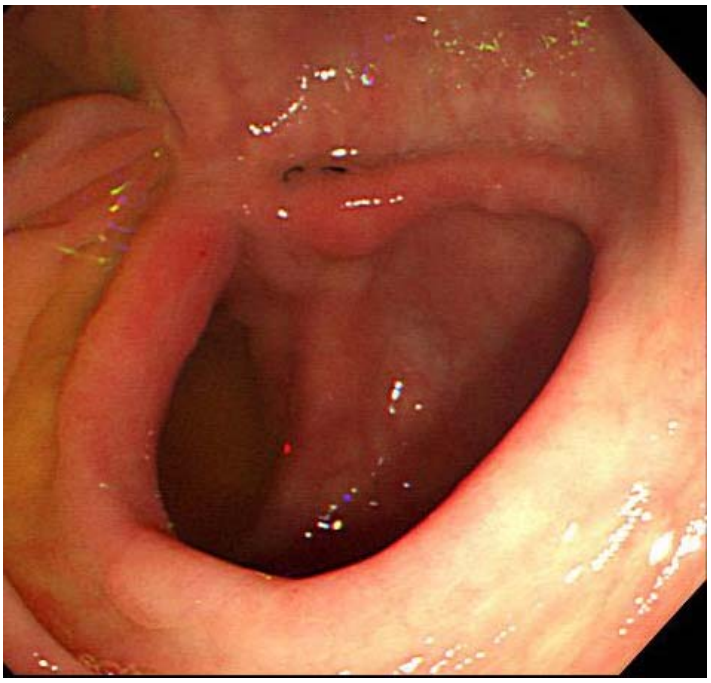
2B) 

Fig. 3.

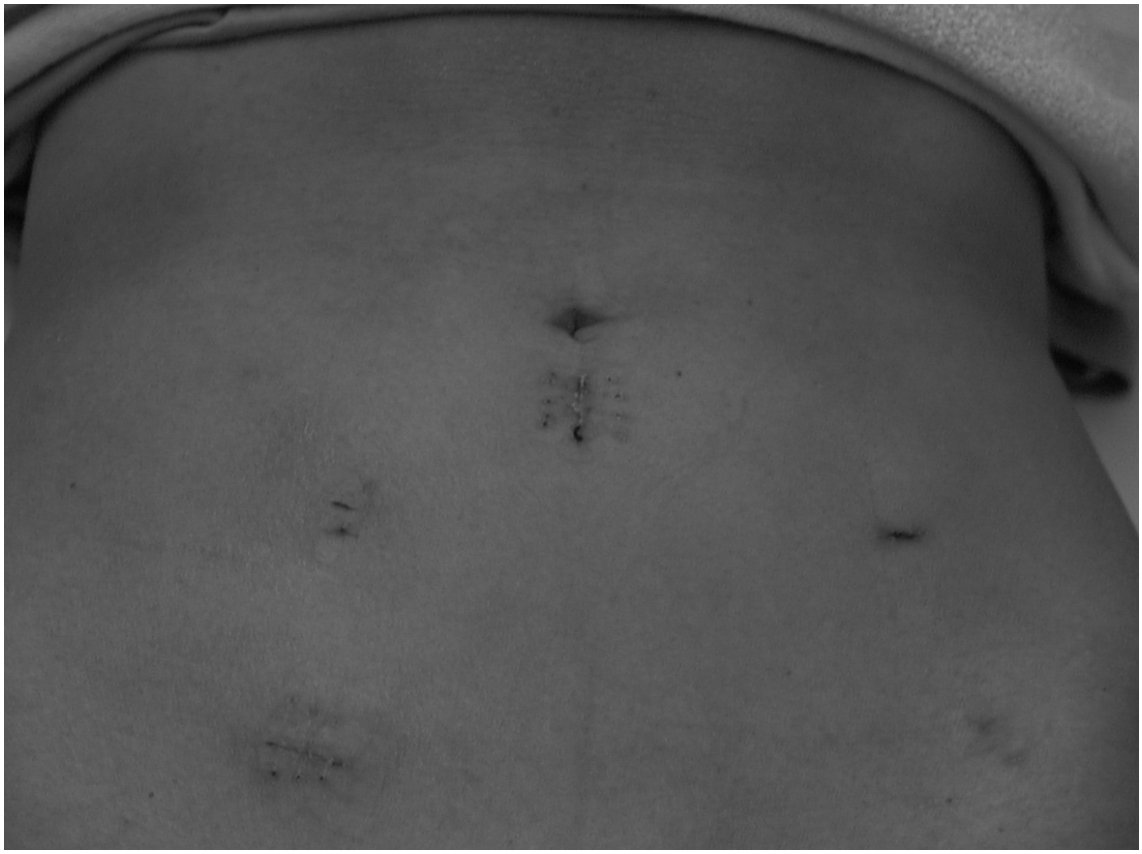


Table 1. The patient characteristics

Age [range (mean)]		40 - 84 (64.5)
Male : Females		27:16
BMI (kg/m^2)		22.1 ± 3.4
Tumor localization [n (%)]	Cecum	4 (9)
	Ascending	19 (44)
	Transverse	6 (14)
	Descending	7 (16)
	Sigmoid	7 (16)

Table 2. The surgical results and the postoperative course

Operation performed [n (%)]	Ileocecal resection	4 (9)
	Right hemicolectomy	19 (44)
	Transverse colectomy	6 (14)
	Left colectomy	7 (16)
	Sigmoidectomy	7 (16)
Operating time (min)		213 ± 84
Anastomotic time (min)		19 ± 8
Estimated blood Loss (g)		28 ± 43
Transfusion [n (%)]		0 (0)
Open conversion [n (%)]		0 (0)
Length of post-operative ileus (day)		1.3 ± 0.9
Complication [n (%)]	Wound infection	2 (5)
	Paralytic ileus	1 (2)
Mortality [n (%)]		0 (0)
Post-operative hospital stay (day)		10 ± 2.3
TNM stage [n (%)]	0	7 (16)
	1	16 (37)
	2	17 (40)
	3	3 (7)
	4	0 (0)
Follow-up period [range (mean)] (month)		2 - 94 (28)