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Retrospective Comparison of Minilaparotomy ('moving window method') and Laparoscopic-assisted Approaches for Colon Cancer Resection

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***Aims*: Outcome in minilaparotomy and laparoscopic-assisted approaches to colon cancer resection was compared retrospectively.**

***Methods*: The 'minilaparotomy approach', defined as a complete resection performed through a skin incision of 7cm or shorter ('moving window method'), was achieved in 47 patients with colon cancers (Tis/T1/T2/T3/T4) between 1997 and 1998 (minilaparotomy group). A laparoscopic-assisted approach was used in 30 patients with colon cancers (Tis/T1) between 1994 and 1996 (laparoscopic-assisted group).**

***Results*: Age, gender, prior laparotomy, tumor location, weight, height, body mass index, operation time, blood loss, and type of colectomies and anastomosis were similar in both groups. Median incision lengths in the minilaparotomy group were longer than in the laparoscopic-assisted group (7.0 versus 6.0cm). Maximal tumor diameter, number of lymph nodes removed, and proximal and distal margins in the minilaparotomy group were larger than in the laparoscopic-assisted group. The minilaparotomy group had more advanced staged tumors; however, times until initial walking, flatus, fluid and solid food, time with urinary catheter, analgesic usage, postoperative hospital stay, and postoperative complication frequencies were similar. In neither group was there tumor recurrence at the laparotomy wound or port sites.**

***Conclusion*: Minilaparotomy and laparoscopic-assisted approaches to colon cancer resection were similar in terms of early return of function and discharge.**

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Key Words: minilaparotomy approach, laparoscopic-assisted approach, colon cancer

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Introduction

Laparoscopic colorectal surgery has been shown to be feasible and safe[1－3] and is gaining acceptance for benign conditions[4]. The theoretical advantages of laparoscopic colorectal surgery - early return of bowel function, reduction of postoperative pain, shorter hospitalization, decreased disability, and better cosmesis - have been well documented in the treatment of benign diseases[5,6]. However, laparoscopic colorectal surgery cannot yet be considered an established procedure for removal of malignancies[4,7,8]. Crucial issues, including the unresolved problem of port site metastasis and unclear outcome, in oncologic terms, remain unclear[4,7,8].

At the completion of most laparoscopic colectomies, a small incision is made for extracorporeal bowel resection and anastomosis and removal of the specimens after laparoscopic mobilization of the bowel is accomplished[7,9,10]. The small incision used in the laparoscopic-assisted colectomy for colorectal cancers is typically from 2 to 12 cm[10－21]. It has been suggested that one of the reasons for early recovery after laparoscopic-assisted colorectal surgery is the small abdominal incision used[22]. When Fleshman et al. compared the minilaparotomy approach with laparoscopic-assisted surgery for colorectal diseases, they found no significant difference in time to return of bowel function, transfusion requirement, or postoperative complications between the two methods[22,23]. The conclusion was reached that early return of function and discharge was dependent on the use of small incisions, whether by minilaparotomy or laparoscopy[22,23].

Laparoscopic-assisted colectomy involves intra-abdominal mobilization of the intestine and vascular ligation (if possible), followed by resection and reanastomosis of the bowel through a small incision at skin level[10,21,22]. A minimally invasive, minilaparotomy approach simply reduces the size of the abdominal incision to the minimum needed to conduct the

operative procedure[22]. To date, comparison of outcomes after minilaparotomy and laparoscopic-assisted approaches has not been fully discussed[10,22,23].

Between 1994 and 1996, we performed laparoscopic-assisted colectomies on selected patients with Tis/T1 (American Joint Committee on Cancer [AJCC] Cancer Staging[24]) colon cancers. However, at that time, there were many problems in performing laparoscopic-assisted colectomy, including that the laparoscopic-assisted procedure was more difficult and complicated than the conventional approach to treat more advanced T2/T3/T4 colon cancers, port site recurrence was reported in several studies[25-27], and it required new and complex surgical techniques, a long operation time, and the operation itself had a high cost[17,28].

In order to establish any true benefit of the laparoscopic-assisted approach, a formal comparison of the two approaches, minilaparotomy and laparoscopic-assisted, should be conducted. As a result, we sought to compare the surgical outcomes of the minilaparotomy and laparoscopic-assisted approaches.

Patients and Methods

Patient selection for the minilaparotomy approach

Our definition of the minilaparotomy approach for resection of colon cancer implies that complete resection can be performed through a skin incision shorter than 7cm. This was achieved in 47 patients operated on for colon cancers (Tis/T1/T2/T3/T4)24) between January 1997 and December 1998 at Nagasaki University Hospital, Nagasaki, Japan. We excluded patients from the minilaparotomy approach for the following reasons: patients who did not consent to the procedure, patients with tumors larger than 6cm or with a tumor infiltrating adjacent organs, patients with intestinal obstruction or perforation, patients who had more than one carcinoma of the colon or polyposis coli, and patients with distant metastases to the liver, para-aortic lymph node, or other distant organs, which were definitely diagnosed by preoperative examinations, including barium enema study, colonoscopy, or computed tomography. No patient had been treated preoperatively with anticancer drugs or irradiation.

Patients selection for the laparoscopic-assisted approach

A laparoscopic-assisted approach was used in 30 patients operated on for early colon cancer between January 1994 and December 1996 at our hospital. This option was indicated for patients with Tis or T1 colon cancer who gave written informed consent. We were not performing the minilaparotomy approach at that time.

Preoperative management

All patients underwent preoperative colonoscopy and biopsy of the tumor. Barium enemas were also conducted to confirm the site of the lesion. Ultrasonography was used to gauge the size of the tumor and to look for evidence of local infiltration, distant metastasis, or both. Computed tomography was performed if patients had locally advanced or bulky disease. Bowel preparation was with 2-3 liters of polyethylene glycol electrolyte solution the day before the operation. Urinary catheters and nasogastric tubes were routinely used. Epidural catheters were also placed before induction of anesthesia; epidural anesthesia was used intraoperatively and postoperatively.

Operative techniques

Each operation using the minilaparotomy or laparoscopic-assisted approaches consisted of (1) mobilization of the relevant segment of bowel loop, (2) division of the lymphovascular pedicle, (3) division of the associated mesentery, (4) division of the distal and proximal bowel ends, and (5) re-anastomosis.

Minilaparotomy approach for colon cancer: The patient was placed on the operating room table in the supine or lithotomy position. During the operation, the table was not moved. A right trans-rectal, left trans-rectal, or lower midline skin incision was used for cancer of the right colon, left colon, or distal sigmoid colon, respectively. The length of skin incision was 7cm or less. All steps of the minilaparotomy approach were performed via the small incision, using conventional surgical techniques and instruments. Interrupted sutures between the peritoneum and skin were added to protect the wound from bacterial infection and tumor cell contamination. A couple of large gauzes were inserted into abdominal cavity. This allowed the small bowel and omentum to be kept out of the operative field, and the small bowel was never exposed to the operating room environment. In order to maintain a good visualization of the operative field, the OMNI-TRACT® retractor system (Omni-Tract Surgical, Minnesota Scientific, Inc., Minneapolis, MN) was also used; this system is locked by a supporting device. In order to maintain optimal visualization of the operative field, we move the wound, and then lock it in place. We adjust the wound, and push down the

abdominal wall, which facilitates performing the operative procedures for deep tissues and lesions. We have named this technique the 'moving window method' (Fig. 1), because we can move the 7cm small incision as if it was a 'window'. With the minilaparotomy technique, the mesenteric lymph nodes could be exposed clearly (Fig. 2). The following steps were performed for complete resection of the cancer via the small incision: careful mobilization for colon and its mesentery,

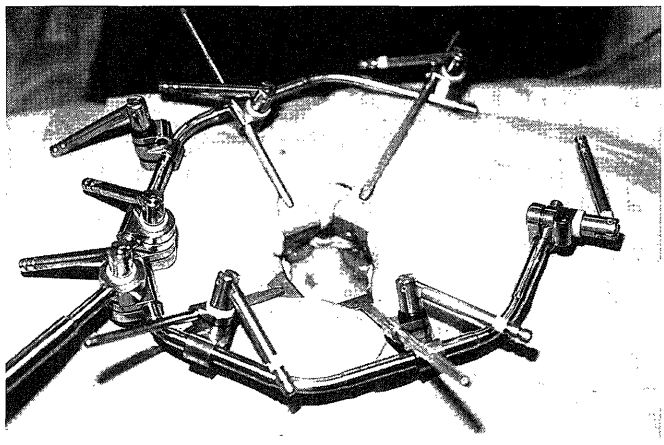

Figure 1. Right hemicolectomy using the minilaparotomy technique in a female patient with ascending colon cancer. The OMNI-TRACT® retractor system was locked by a supporting device in order to maintain optimal visualization of the operative field.

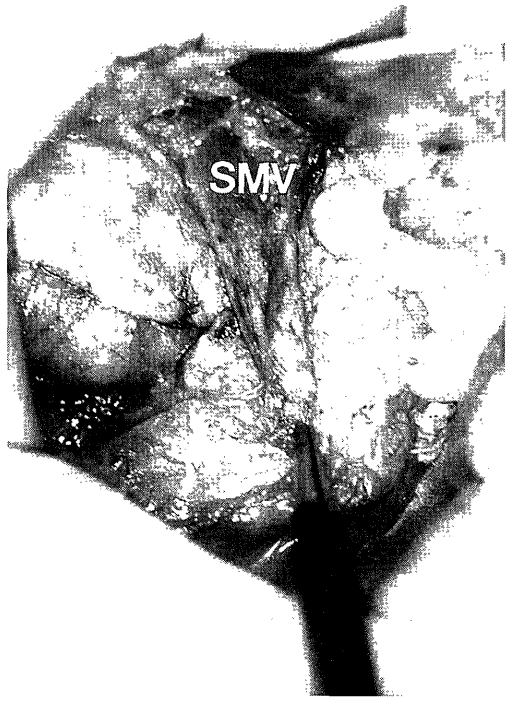

Figure 2. Right hemicolectomy using the minilaparotomy technique in a female patient with ascending colon cancer. Superior mesenteric vein (SMV) is clearly exposed.

division of the central vessels at their origin (the ileocecal and/or the right colic artery for ileocecal resection and right hemicolectomy, the middle colic artery for transverse colectomy, the left colic artery for left partial resection, the inferior mesenteric artery for sigmoid colectomy), removal of the entire lymph node-bearing mesentery, transection of the bowel with adequate proximal and distal margins, and reestablishment of bowel continuity using hand-sewn or stapled anastomosis.

Laparoscopic-assisted approach: The patient was placed on the operating room table in the supine or lithotomy position. During operation, the table was moved so as to use gravity in obtaining exposure. The carbon dioxide pneumoperitoneum was established, and 4 or 5 trocars were inserted. The videolaparoscope was introduced through the umbilical trocar. For ileocecal resection, right hemicolectomy, left partial colectomy, and sigmoid colectomy (when the tumor was not located in the distal portion of the sigmoid colon), bowel loop mobilization, and division of the lymphovascular pedicle and associated mesentery were achieved by laparoscopic-guided dissection. A small incision was also made to bring out the mobilized colon. The bowel ends were divided outside the wound, and an anastomosis was created extracorporeally with hand-sewn sutures. For sigmoid colectomy (when the tumor was located in the distal portion of the sigmoid colon), the operative steps from mobilization of the sigmoid colon and division of the sigmoid mesenteric vessels and associated mesentery were all achieved under laparoscopic guidance. The distal bowel division was performed using endoGIA 30, applied one or more times (Autosuture, U.S. Surgical Corp., Norwalk, CT), and the proximal cut end of the bowel was then exteriorized through a small incision and the proximal division of the bowel was made extracorporeally. The anvil of the premium CEEA (Autosuture) was then inserted into the proximal bowel end and secured with a 2-0 prolene purse-string suture. The bowel was then internalized and the small incision was closed. Pneumoperitoneum was again induced and a stapled anastomosis was fashioned intracorporeally under laparoscopic guidance, using the double-stapled technique.

Postoperative care and data collection

Diet was resumed postoperatively as soon as bowel function returned clinically. Analgesic (pentazocine, 15mg/body) was given intramuscularly on demand. The patients were discharged when fully ambulatory.

Data for each patient group, in terms of age, gender, weight, height, body mass index (BMI), prior laparotomy, procedure performed, disease process, operative time and blood loss, incision length, and postoperative events and complications, were reviewed retrospectively. BMI was used as an objective measure of obesity[29]; BMI is defined as weight in kilograms divided by (height in meters). All patients were followed up regularly at three-month intervals for clinical examination and carcinoembryonic antigen testing. All patients of both groups were completely followed after surgery. The median length of follow-up in the minilaparotomy and laparoscopic-assisted groups was 27.8 months (range, 17.4 to 45.2 months) and 59.8 months (range, 20.7 to 77.9 months), respectively.

All surgically resected specimens were placed immediately in a 10% formalin solution and examined under light microscopy, following hematoxylin and eosin staining. The pathologist was not informed of the surgical technique used. The American Joint Committee on Cancer Classification and Stage grouping was used to classify the tumors[24]. Each tumor was histopathologically classified, using the World Health Organization criteria[30].

The surgical outcomes in the minilaparotomy group were compared with those in the laparoscopic-assisted group.

Statistical analysis

Statistical analyses were performed using Statistica® software (Statsoft, Tulsa, OK). Continuous data were expressed as medians (lower quartile and upper quartile), and statistical analyses were conducted using the Mann-Whitney test. Categorical data were analyzed by the χ^2 test or Fisher's exact test. These tests were two-tailed and a P value of less than 0.05 was considered significant.

Results

Patient populations

Patients undergoing the minilaparotomy and laparoscopic-assisted approaches were similar with regard to age, gender, body weight, height, and BMI. There was also no difference in frequency of prior laparotomy between the groups. The indication for operation in each group was colon cancer. Tumor location (right or left colon) was similar (Table 1).

Table 1. Characteristics of patients.

Variables	Minilaparotomy approach (n=47)	Laparoscopic-assisted approach (n=30)	*P* value
Age (years)*	67.0 [59.0, 72.0]	64.0 [60.0, 70.0]	0.39
Gender†			0.65
Female	23 (48.9)	13 (43.3)	
Male	24 (51.1)	17 (56.7)	
Body weight (kg)*	54.5 [46.7, 61.5]	57.0 [52.5, 61.0]	0.40
Height (cm)*	157.3 [149.9, 164.7]	158.0 [153.5, 165.0]	0.78
BMI (kg/m^2)*	22.1 [20.1, 24.3]	22.3 [20.9, 23.6]	0.46
Prior laparotomy†	25 (34.7)	5 (20.0)	0.20
Tumor location†			0.13
Right colon	18 (38.3)	6 (20.0)	
Left colon	29 (61.7)	24 (80.0)	

* Values are expressed as median [lower quartile, upper quartile] and statistical analyses were conducted using the Mann-Whitney test.
† Values are expressed as number of patients (%), and statistical analyses were conducted using Fisher's exact test.

Table 2. Operative procedures.

Variables	Minilaparotomy approach (n=47)	Laparoscopic-assisted approach (n=30)	*P* value
Length of laparotomy wound (cm)*	7.0 [7.0, 7.0]	6.0 [5.0, 7.5]	0.036
Operation time (min.)*	179 [155, 210]	199 [150, 245]	0.13
Operative blood loss (ml)*	45 [25, 90]	40 [22, 70]	0.65
Operation†			0.080
Ileocecal resection	9 (19.1)	2 (6.7)	
Right hemicolectomy	5 (10.6)	4 (13.3)	
Transverse colectomy	4 (8.5)	0 (0)	
Left partial colectomy	1 (2.1)	4 (13.3)	
Sigmoid colectomy	28 (59.6)	20 (66.7)	
Anastomosis†			1.00
Hand-sewn	36 (76.6)	23 (76.7)	
Stapled	11 (23.4)	7 (23.3)	

* Values are expressed as median [lower quartile, upper quartile] and statistical analyses were conducted using the Mann-Whitney test.
† Values are expressed as number of patients (%), and statistical analyses were conducted using the χ^2 or Fisher's exact test.

Operative procedures

The length of the laparotomy wound in the laparoscopic-assisted approach group was significantly shorter than that in the minilaparotomy approach group: median lengths were 6.0 (lower quartile, 5.0; upper quartile, 7.5) and 7.0 cm (lower quartile, 7.0; upper quartile, 7.0), respectively (P=0.036). There was no difference in the operation time or blood loss between the groups. Types of colectomies performed and anastomosis methods in each group were similar (Table 2).

Histopathological parameters of tumors

Maximal tumor diameter, number of lymph nodes removed, and proximal and distal margins in the minilaparotomy group were significantly larger than those in laparoscopic-assisted group (P=0.026, P<0.0001, P<0.0001, and P=0.010, respectively). The proportion of histologic types in the groups were significantly different. Specifically, patients in the laparoscopic-assisted group had a high proportion of well differentiated adenocarcinoma and a low proportion of moderately differentiated adenocarcinoma, compared to patients in the minilaparotomy group. Stage distribution in the two groups also differed significantly: many patients in the laparoscopic-assisted group (93.3%) had stage I tumors, while 23 (48.9%) patients in the minilaparotomy group had stage I tumors, 14 (29.8%) had stage II tumors, and 10 (21.3%) had stage III tumors in the minilaparotomy group (Table 3).

Table 3. Histopathological parameters and stage of tumors

Variables	Minilaparotomy approach (n=47)	Laparoscopic-assisted approach (n=30)	*P* value
Maximal tumor diameter (cm)*	3.0 [2.1, 3.6]	2.0 [1.5, 3.3]	0.026
No. of lymph node removed*	12 [6, 20]	4 [3, 50]	<0.0001
Proximal margin (cm)*	7.5 [4.0, 11.54]	3.0 [2.2, 5.0]	<0.0001
Distal margin (cm)*	5.0 [3.0, 9.0]	3.4 [1.5, 5.0]	0.010
Histologic type†			<0.0001
Well differentiated	15 (31.9)	28 (93.3)	
Moderately differentiated	31 (66.0)	2 (6.7)	
Mucinous	1 (2.1)	0 (0)	
Stage†			0.0010
I	23 (48.9)	28 (93.3)	
II	14 (29.8)	1 (3.3)	
III	10 (21.3)	1 (3.3)	

* Values are expressed as median [lower quartile, upper quartile] and statistical analyses were conducted using the Mann-Whitney test.

† Values are expressed as number of patients (%), and statistical analyses were conducted using the χ^2 test.

Postoperative events

Important parameters related to postoperative recovery, including pain relief, bowel function, and nutrition are shown in Table 4. Times until initial walking, duration time with urinary catheter, time until flatus, and time until fluid and solid food did not differ between the groups. All patients in both groups received postoperative pain relief, by means of continuous epidural anesthesia (mepivacaine hydrochloride plus buprenorphid hydrochloride). Eleven of 47 patients (23.4%) and 7 of 30 patients (23.3%) in the minilaparotomy and laparoscopic-assisted groups, respectively, required analgesic injections. The amount of pentazocine used in the two groups did not differ, nor did postoperative hospital stays.

Table 4. Postoperative course

Variable	Minilaparotomy approach (n=47)	Laparoscopic-assisted approach (n=30)	*P* value
Time until walking (days)*	2 [1, 2]	2 [2, 2]	0.38
Time with urinary catheter (days) *	2 [1, 3]	2 [1, 2]	0.69
Time until flatus (days)	2 [2, 3]	2 [2, 3]	0.36
Time until fluid food (days)	4 [3, 5]	4 [3, 5]	0.86
Time until solid food (days)	6 [5, 7]	6 [5, 6]	0.15
Analgesics (pentazocine) usage (mg)	0 [0, 0]	0 [0, 0]	0.85
Postoperative hospital stay (days)	15 [13, 19]	12 [10, 18]	0.12

Values are expressed as median [lower quartile, upper quartile] and statistical analyses were conducted using the Mann-Whitney test.

* Six patients who were postoperatively treated in the intensive care unit (ICU) were excluded.

Postoperative complications

There was no operative mortality in either group. Three patients (6.4%) from the minilaparotomy group postoperatively developed intestinal obstructions (2 patients) and wound infection (1 patient), while 4 patients (13.3%) in the laparoscopic-assisted group developed intestinal obstruction (1 patient), anastomotic bleeding (1 patient), intra-abdominal abscesses (1 patient), and wound infection (1 patient). The frequency

of postoperative complications between two groups did not differ (P=0.42). In both groups, these postoperative complications were successfully treated with conservative therapies.

Short-term surgical outcome for cancer treatment

We confirmed the outcome in all patients at the time of writing this report (August, 2000). Of 47 patients in the minilaparotomy group, 42 were alive without tumor recurrence and 5 had developed tumor recurrence (metastasis to liver, lung, and/or ovary). Of these 5 patients, 3 were alive and 2 had died of colon cancer. All 30 patients in the laparoscopic-assisted group were alive without tumor recurrence. To date, there has been no tumor recurrence at the laparotomy incision or port sites in either group.

Discussion

The current study revealed that minilaparotomy and laparoscopic-assisted approaches to colon cancer resection are similar in terms of early return of function and discharge, although the minilaparotomy patients had more advanced staged tumors and underwent wider resection than did the laparoscopic-assisted patients. This study showed that the minilaparotomy approach for colon cancer resection was feasible and safe. We feel that the minilaparotomy approach is a suitable technique for many colorectal cancers.

Unfortunately, not all patients with colorectal cancer can be resected via such a small incision. In our series, we were unable to achieve it in 5 (9.6%) of 52 colon cancer patients in whom we attempted it. Reasons for our inability to use the technique were a tumor that invaded an adjacent organ in 1 patient and technical difficulties in 4 patients. Specifically, it was impossible to divide the lienocolic and phrenicocolic ligaments around the splenic flexure of the colon. However, 3 of the 4 patients in whom the lienocolic and phrenicocolic ligaments could not be divided, subsequently underwent laparoscopic-assisted surgery, without elongation of the incision length beyond 7cm. These 3 patients showed rapid postoperative recoveries. Specifically, time until standing and walking was 1, 1 and 2 days, time with urinary catheter was 1, 1, and 2 days, and there was no requirement for analgesics. Thus, in some circumstances, minilaparotomy may not be possible and laparoscopic-assisted techniques may be a better choice. Patients in whom a full view of the abdomen is necessary or who require mobilization of distant structures may best be approached by laparoscopy[22]. Our surgical technique, in which a minilaparotomy wound is moved-horizontally or vertically-to the best position for good visualization, using the OMNI-TRACT® retractor system, may be best suited for straightforward, simple resections.

What should be called a "minilaparotomy" seems to be a matter of opinion, as is the meaning of "a small incision." To the best of our knowledge, there are 12 reports in which the length of the minilaparotomy or of the small incision used in laparoscopic surgery for colonic cancers were clearly described (Table 5)[10-21]. A small incision of 4-6cm is typically used in laparoscopic-assisted colectomies, though several reports included patients operated on with incisions exceeding 10cm[13,16,18]. In our series, we indicated 7cm as the maximum incision length for the minilaparotomy, because 7cm incision may be the minimum size that allows insertion of the surgeon's hand into the perito-

Table 5. Literature review concerning the meaning of 'minilaparotomy' and 'a small incision' used in laparoscopic surgery for colorectal cancer.

Author	Year	Incision length (cm)	Notes
Corbitt JD, et al [11]	1992	2.5 – 5.1	Colectomy, and LAR for benign disease, adenoma, and cancer
Monson JR, et al [12]	1992	2 – 4	Colectomy, AR, and APR mainly for cancer
Senagore AJ, et al [13]	1993	4 – 10	Colectomy for benign disease, adenoma, and cancer
Mathis CR, et al [14]	1994	6 – 8	Colon and rectal resection for benign and malignant disease
Jager RM, et al [15]	1994	4 – 5	Right colectomy for Crohn's disease, adenoma, and cancer
Milsom JW, et al [16]	1994	4 – 10	Colectomy and stoma creation for Crohn's disease, adenoma, and cancer
Ballantyne GH, et al [17]	1995	5.1 – 7.6	Colectomy, AR, APR, TPC for benign disease, polyps, and cancer
Ou H [10]	1995	5 – 6	Right colectomy for benign disease and cancer
Huscher C, et al [18]	1996	5 - 12	Colectomy, AR, APR, and stoma creation for benign disease, adenoma, and cancer
Bockey EL, et al [19]	1996	3 - 5	Right hemicolectomy for cancer
Fukushima R, et al [20]	1996	3 - 5	Sigmoid colectomy for cancer
Young-Fadok TM, et al [21]	2000	4 –6	Right hemicolectomy for benign disease and cancer

LAR, low anterior resection; AR, anterior resection; APR, abdominoperineal resection; TPC, total proctocolectomy

neal cavity. Thus, most colectomies can be performed via a smaller incision than many surgeons believe.

Fleshman et al. reported that although the difference between mean incision lengths in the minilaparotomy and laparoscopy approaches (10 and 6 cm) was statistically significant, the use of a small incision, whether by minilaparotomy or by laparoscopy, resulted in similar early return of bowel function[22]. Fürstenberg et al. speculated that avoiding touching and stretching the small bowel reduced the time of postoperative paralysis[23]. In our minilaparotomy approach, the small bowel was never exposed to the air of the operating room during surgery. We also speculate that early return of function, whether by minilaparotomy or by laparoscopy, may be dependent on the use of small incisions, although the issue cannot be directly determined from this study.

The main reason for conversion from laparoscopic surgery to open surgery is obesity[31]. Surgeons generally seem to consider morbid obesity a relative contraindication for laparoscopic colorectal resection[19]. BMI has been used as an objective index of obesity; a BMI greater than 30 indicates morbid obesity[31,32]. In our series, there was no difference in BMI between the minilaparotomy and laparoscopic-assisted approaches. In addition, only 1 (2.1%) of 47 patients who underwent minilaparotomy surgery was morbidly obese (BMI=32.0 kg/m^2), while no patient was in the laparoscopic-assisted group. Gatsoulis et al. reported that 23 (15.8%) of 145 patients who underwent laparoscopic cholecytectomy were morbidly obese (BMI>30)[33]. Thus, the frequency of morbid obesity in Japanese surgical patients was lower than that of patients from Western countries[34]. In our series, obesity did not influence the completion of the resection via a small (7cm) incision. We did not exclude obese patients from the minilaparotomy approach in this series. Consecutive patients were entered into this study, except those meeting the exclusion criteria described in the Patients & Methods. As a result, we feel that the minilaparotomy approach is suitable for many Japanese patients with colon cancer.

Fleshman et al. reported that mean operating time was significantly higher for laparoscopic-assisted than minilaparotomy surgery (163 versus 70 minutes; $P<0.0001$)[22]. However, in our series, there was no significant difference in operating time between the laparoscopic-assisted and minilaparotomy groups (median operating time, 199 versus 179 minutes, respectively). Operating time is affected by many factors, including experience of the surgeons and the first assistant, camera operator, and nursing staff[22]. Fleshman et al.'s study included patients with benign diseases (including diverticulitis and Crohn's disease)[22], while our series included only colon cancers (Tis / T1 / T2 / T3 / T4 tumors). In addition, the mean incision length in the minilaparotomy group was 12 cm (range: 8-18cm) in Fleshman et al.'s study[22], while it was less than 7cm in our series. From our experience, the minilaparotomy approach with an incision length of less than 7cm sometimes required a longer operating time than the conventional approach. We believe that these issues may affect the difference in operating time between the two studies.

The application of laparoscopic surgery in treating colorectal cancer is still somewhat controversial[7,19,35]. There are crucial issues, including the unresolved problem of port site metastases and the unclear outcome of oncologic results[35-37]. The major controversy lies in whether it is feasible to perform an adequate tumor and lymph node resection laparoscopically, particularly in patients with cancer invasion of the proper muscle[7]. However, recent studies have reported that oncologic resection can be safely performed using the laparoscope, and that lymph node harvest was comparable to that with open cancer surgery[38,39]. Another major problem is the incidence of port site recurrences, which have been reported in many studies[36,37,40,41]. Recurrence of the tumor in the abdominal wall after open colectomy is uncommon, being typically under 1%[42,43]. On the other hand, the incidence reportedly varies from 0 to 21% after laparoscopic colectomy for malignancies[36,37,40,41].

We found it surprisingly simple to perform complete resection for colon cancer via a small incision (less that 7cm), using conventional surgical techniques. Not only the bowel resection with adequate lengths of resection margins (proximal and distal), but also the removal of lymph nodes at the root of the ileocolic, right coloic, middle colic, or inferior mesenteric arteries could be accomplished by the minilaparotomy approach. In fact, the current study revealed that number of lymph nodes removed was comparable to those with the conventional approach[38]. In short-term follow-up (median: 27.8 months [range: 17.4-45.2 months]) of our patients treated using the minilaparotomy approach, there was no wound recurrence. Fleshman et al. also reported that short-term follow-up for patients with colorectal cancer treated by minilaparotomy approach showed no wound recurrence[22]. We speculate that wound recurrence after minilaparotomy surgery may be rare, because it generally develops within 2 years after conventional large-bowel cancer surgery[42,43].

In conclusion, the use of a small incision, whether by the minilaparotomy or laparoscopic-assisted approach, results in similar early return of function and discharge. The options of minilaparotomy and

laparoscopic-assisted surgeries seem to be attractive alternatives to conventional colon surgery in select patients with colon cancer.

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