Original Article: Colorectal Cancer

Use of the FJ Clip for application of the marionette technique in reduced-port surgery performed for sigmoid or rectosigmoid cancer

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Background: We have devised a technique by which we establish the operative field and apply countertraction during performance of reduced-port surgery for sigmoid colon cancer or rectosigmoid colon cancer. The technique was devised to overcome the limitations of reduced-port surgery (RPS) and single-incision laparoscopic surgery (SILS). We applied the technique in 17 patients treated between March 2019 and April 2020.

Methods: Three ports were used in all cases, a 12-mm port inserted via the umbilical fossa, a 5-mm port inserted in the right upper abdomen, and a 5-mm port inserted in the right upper lower abdomen. We used a free jaw (FJ) Clip with two pull threads to apply traction from the left upper and left lower abdominal walls (FJ Clip-marionette technique) and to thus supersede the need for assistant forceps. As with the conventional method, the medial to lateral approach was used, the surgery included appropriate lymph node dissection, and a double-stapling anastomosis or functional end-to-end anastomosis was created.

Results: Patients began oral intake at a mean of 2.4 days (range, 2–3 days), and mean postoperative hospital stay was 10.3 days (range, 9–15 days). The mean number of lymph nodes retrieved was 17, with lymph node metastasis being identified in 2 patients on histopathologic examination. The mean proximal resection margin was 94.9 mm, and the mean distal resection margin was 58.5 mm. There were no postoperative complications, and there has been only 1 recurrence to date, befalling the patient with stage IV disease.

Conclusions: SILS and RPS require surgical field deployment and peeling and dissection by the surgeon alone, but countertraction and the visual field are often insufficient. Use of the FJ Clip-marionette technique allows for countertraction to be maintained and a good view of the operative field. It provides for a procedure close to that of multiport surgery but without the need for an assistant surgeon.

Keywords: Free jaw Clip (FJ Clip); reduced-port surgery (RPS); marionette technique; laparoscopic surgery

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Introduction

Laparoscopic colectomy is being performed with increasing frequency worldwide. Several randomized clinical trials have confirmed that laparoscopic colectomy for treatment of colon cancer is safe and that results are better than results of open surgery. Long-term outcomes of the two procedures are similar, but laparoscopic colectomy is advantageous because patients' postoperative pain is reduced, the hospital stay is shorter, and cosmesis is better (1-3).

Reduced-port surgery (RPS) and single-incision laparoscopic surgery (SILS) are the latest innovations in the realm of minimally invasive surgery, and, in comparison to conventional laparoscopic surgery, each of these approaches reduces the risk of trocar-related complications, requires shorter incisions, reduces postoperative pain, and improves cosmesis. However, RPS and SILS are much more technically difficult than multiport surgery (MPS) (4-6). SILS and RPS are basically solo-surgeries, with the operation and excision done by one person.

Loss of triangulation leading to an inadequate operative field is an issue related to both RPS and SILS. Methods have been devised to resolve this problem, with one such method being use of the GelPort system (Applied Medical, Rancho Santa Margarita, CA, USA) (7). This system allows for application of countertraction with extra forceps. We use the free jaw (FJ) Clip (described below) to assist in establishing the operative field and to apply countertraction. In addition, we use two pull threads to freely change the direction of the traction pull (FJ Clip-marionette technique), thus obviating the need for assistant forceps and resulting in a procedure that, in comparison to SILS or RPS, more closely resembles MPS. Typically, clip-type devices can be towed in only one direction, but with the FJ Clip-marionette technique, the device can be towed in multiple directions. We report the FJ Clip-marionette technique and our use of it as the first method that allows RPS to progress as it would if assistant forceps were used. We present the following article in accordance with the AME Case Series reporting checklist (available at https://asj.amegroups.com/article/view/10.21037/asj-21-89/rc).

Methods

We report application and results of the technique in 17 patients. Their cases were chosen from among the total 20 cases of left-sided colon cancer in which RPS, incorporating the FJ Clip-marionette technique, was performed in our department between March 2019 and April 2020. Of the 20 cases, 12 were of sigmoid colon cancer and 5 were of rectosigmoid colon cancer. The remaining 3 cases were of descending colon cancer, and these 3 were excluded from the study.

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional ethics board of Fukui Red Cross Hospital (approval number: R4-01-70), and individual consent for this retrospective analysis was waived.

Indications for RPS in cases of colon cancer

The basic surgical indications for RPS in cases of sigmoid cancer or rectosigmoid cancer are as follows: (I) the tumor is relatively small (≤4 cm in diameter), (II) no cancer is seen on the serosal surface, (III) lymph node involvement does not extend beyond the para-intestinal lymph nodes, (IV) there is no obvious peritoneal dissemination, and (V) there is no history of lower abdominal surgery. If any of these indications are not met, i.e., if diagnostic laparoscopy leads to a judgment that oncological safety cannot be maintained, MPS is chosen rather than RPS.

The FJ Clip

The FJ Clip and Free Loop Plus were both developed in collaboration with Charmant Inc., which is located in Sabae City, Fukui, Japan. The FJ Clip is available in two sizes, one for use through a 5-mm port and the other for use through a 12-mm port. The clip is made of stainless steel, and it can be easily maneuvered with commonly used laparoscopic forceps (*Figure 1*).

The FJ Clip has undergone repeated tests by the manufacturer and has been tested experimentally on animal organs. The tissue grasp force of each of the two clips is strong (200±20 and 300±30 gf, respectively), but use of these clips causes no or only negligible organ damage. The jaw surface is textured in a lattice-like relief to resist slippage. Regulatory approval was granted in Japan, and the FJ Clip is now in clinical use (8).

FJ Clip-marionette technique

Two 2-0 nylon threads are tied to the 12-mm FJ Clip. The Free Loop Plus is used to pull the threads from the upper left and lower left abdominal walls (*Figure 2A*), and the threads are then grasped with Kocher Mosquito Forceps.

Figure 1 The FJ Clip can be easily maneuvered with commonly used laparoscopy forceps. FJ, free jaw.

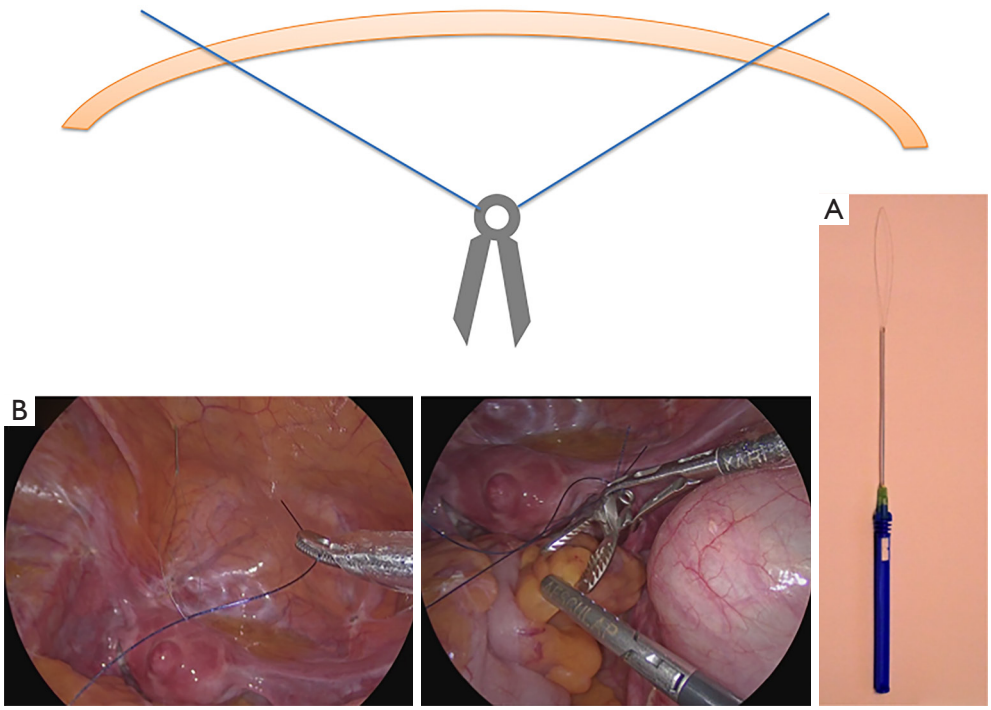

Figure 2 The FJ Clip-marionette method and Free Loop Plus. (A) The FJ Clip-marionette method; (B) Free Loop Plus. FJ, free jaw.

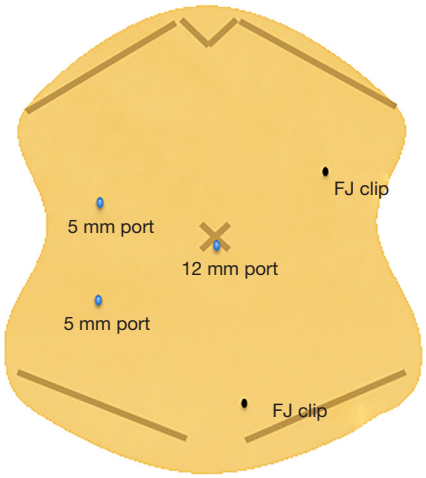

Figure 3 Trocar placement and FJ Clip thread traction sites. FJ, free jaw.

The direction of traction is adjusted to establish the desired surgical field (*Figure 2B*).

Surgical procedure

The patient is placed in the open-leg supine position, similar to the position used for standard laparoscopic surgery. An incision is made in the umbilical fossa, and a 12-mm port is inserted by the open method. The operator's port is the same as that used for MPS, and two 5-mm ports are inserted, one in the upper and the other in the lower right abdomen. Visualization is achieved by means of a 10-mm, 30-degree rigid laparoscope equipped with a camera.

An FJ Clip with two tow threads is inserted into the abdominal cavity through the 12-mm port. By using the F Loop Plus, one tow thread is pulled outside the body from the abdominal wall on the pubis, slightly to the left of the midline. The other tow thread is pulled out from the upper left abdomen (*Figure 3*).

The FJ Clip is used to grasp the right mesentery slightly caudal to the sacral promontory. The cranial mesentery is then grasped by means of forceps held in the operator's left hand, and the sigmoid mesentery is held in "matador-like" traction. A peritoneal incision is made with laparoscopic coagulation shears and then extended caudally along the fascia propria of the rectum.

The left-hand forceps is then repositioned so that it is applied in the caudal direction, and the peritoneal incision is extended in the anorectal direction (*Figure 4A*). The right lower hypogastric nerve and rectal fascia are exposed, and the dissection is advanced centrally. The FJ Clip is then placed on the pedicle of the inferior mesenteric artery (IMA), and the traction is redirected so that the vessel is angled away from the aorta (*Figure 4B*). The surgeon's left hand is now free, and the adipose tissue surrounding the lymph nodes is transected at the level of the root of the IMA. The surgeon grasps the nerve sheath covering the IMA and transects the vessel in the same manner as in conventional surgery.

After the IMA is transected, the descending mesocolon is dissected from the inside. The FJ Clip is then towed in the caudal direction. This maneuver straightens the inferior mesenteric vein and left colic artery. The two vessels are then easily transected (*Figure 4C*). The mesenteric serosa near the sigmoid-descending junction is grasped with the FJ Clip and pulled in the cranial direction. With the peritoneum on the left side of the upper mesorectum having been incised from the medial side, mobilization of the distal descending colon is completed by incising the white line of Tolt. The left side of the rectal mesentery is then grasped with the FJ Clip to straighten the rectum, and the left side of the rectal mesentery is incised (*Figure 5A*). On confirmation of sufficient mobilization up to the intestinal dissection line, mesenteric dissection is performed. The camera used until this point in the procedure is exchanged for a 5-mm camera, with the new camera being inserted via the lower right port, and the dissection proceeds with the use of instruments inserted via the 12-mm umbilical port. The intestinal tract is then washed from the anus. Intestinal dissection is performed with a laparoscopic linear stapler via the umbilical port (*Figure 5B*). If orthogonal intestinal dissection is difficult from the umbilical port, the lower right port is replaced with a 12-mm port, and intestinal dissection is performed from the lower right abdomen. An anastomosis is created by the double-stapling technique, as in standard laparoscopic colectomy.

Statistical analysis

Basic statistical methodology was applied. Continuous variables are presented as mean or range where appropriate.

Results

Patient characteristics

Characteristics of the 17 study patients are shown in *Table 1*. Ten were men, and 7 were women. They ranged in age from

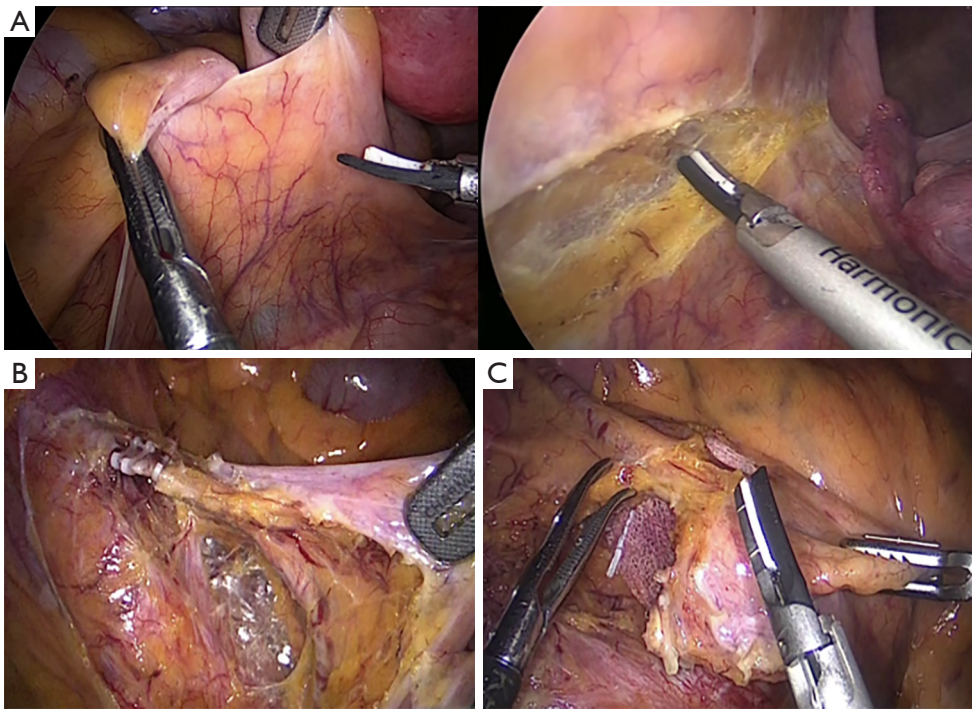

Figure 4 Surgical procedure. (A) The sigmoid mesentery is held in "matador-like" traction with the FJ Clip; (B) the FJ Clip is then placed on the pedicle of the inferior mesenteric artery; (C) the FJ Clip is towed in the caudal direction, and the inferior mesenteric vein and left colic artery are transected. FJ, free jaw.

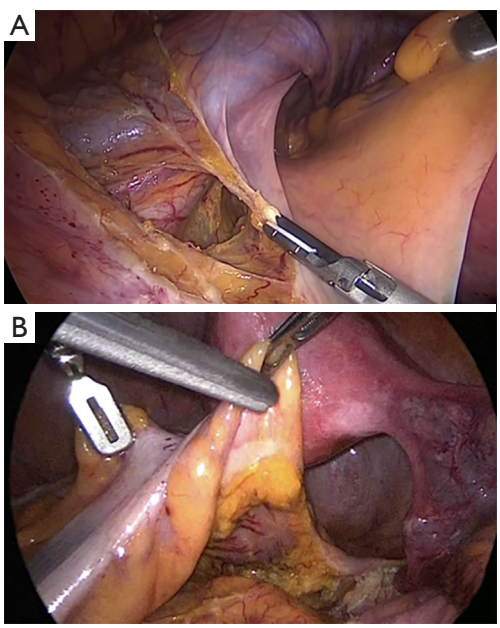

Figure 5 Surgical procedure. (A) The left side of the rectal mesentery is grasped with the FJ Clip to straighten the rectum; (B) intestinal dissection is performed with a laparoscopic linear stapler via the umbilical port. FJ, free jaw.

Table 1 Patients characteristics

Characteristics	Values
Patients	17
Age (years)	64.9 (47–81)
Sex (male/female)	10/7
BMI (kg/m^2)	22.3 (18.0–26.1)
Tumor location (S/Rs)	12/5

Data are presented as n or mean (range). BMI, body mass index; S/Rs, sigmoid/rectosigmoid.

47 to 81 years (mean: 64.9 years), and their body mass index (BMI) ranged from 18.0 to 26.1 kg/m^2 (mean: 22.3 kg/m^2).

Surgical details

Sigmoid colon resection was performed in 12 patients and high anterior resection in 5 patients. Mean operation time was 150.7 minutes (range, 115–198 minutes), and mean blood loss volume was 1.09 mL (range, 0–10 mL). Functional

Table 2 Surgical details

Characteristics	Values
Patients	17
Anastomosis (DST/FEEA)	15/2
Vessel ligation (IMA/SRA/S1–S2)	8/7/2
Operation time (min)	150.7 (115–198)
Bleeding (mL)	1.09 (0–10)
Complications	None
Oral intake (days)	2.4 (2–3)
Postoperative stay (days)	10.3 (9–15)

Data are presented as n or mean (range). DST, double stapling technique; FEEA, functional end-to-end anastomosis; IMA, inferior mesenteric artery; SRA, superior rectal artery.

Table 3 Pathological findings

Characteristics	Values
Patients	17
T-stage	
Tis	1
T1	8
T2	2
T3	6
T4a	0
Tumor size (mm)	26.2 (0–75)
Proximal resection margin (mm)	94.9 (48–225)
Distal resection margin (mm)	58.5 (20–130)
N-stage	
N0	15
N1a/b/c	1/0/0
N2a/b	0/1
Number of retrieved nodes	17.3 (3–51)
TNM classification	
0	1
I	11
IIA/B/C	2/0/0
IIIA/B/C	0/1/1
IVA/B/C	1/0/0

Data are presented as n or mean (range). TNM, tumor node metastasis.

end-to-end anastomosis was performed in 2 of the patients with sigmoid colon cancer, and double-stapling anastomosis was performed in the other 15 patients. A drain was inserted through the right lower abdominal port. None of the patients required insertion of one or more additional ports, none required conversion to standard laparoscopic surgery, and none require conversion to open surgery (*Table 2*).

Postoperative course

Patients began oral intake at a mean of 2.4 days (range, 2–3 days). Mean postoperative hospital stay was 10.3 days (range, 9–15 days). There were no postoperative complications.

Histopathological findings and postoperative treatment

On histopathologic examination, the tumors were diagnosed as follows: Tis (n=1), T1 (n=8), T2 (n=2), and T3 (n=6). The mean number of lymph nodes retrieved was 17, with lymph node metastasis being identified in 2 patients. The mean proximal resection margin was 94.9 mm, and the mean distal resection margin was 58.5 mm. Tumors were classified according to the Union for International Cancer Control (UICC) cancer staging system (version 8) as stage 0 (n=1), I (n=11), II (n=2), III (n=2), and IV (n=1) (*Table 3*). Patients with stage 0-II disease underwent blood sampling and consultation once every 3 months, and computed tomography every 6 months. Patients with stage III disease were treated with capeOX for 6 months following the surgery, and those with stage IV disease underwent chemotherapy. There has been only 1 recurrence to date, befalling the patient with stage IV disease.

Discussion

In all 17 cases of sigmoid or rectosigmoid cancer for which we performed RPS and incorporated the FJ Clip-marionette technique, we were able to perform the operation in almost the same way as in conventional laparoscopic surgery. In a PubMed search, we found two reports of use of an organ retractor during RPS performed for colon cancer (9,10). There are no reports, however, of use of a clip-type assistive device and of altering the direction of the traction during RPS performed for colon cancer. The clip substitutes for an assistant surgeon, and having introduced the FJ Clip-marionette technique, we now need only two surgeons to

perform many of the colorectal cancer surgeries undertaken at our hospital. One of the main benefits of RPS is, of course, improved cosmesis, but RPS is also attracting attention as a solution to the shortage of personnel. Because RPS incorporating the FJ Clip-marionette technique is now standardized, it can easily be performed by two surgeons in many cases, and we believe the indications can be expanded. We think that for most cases of sigmoid colon cancer without infiltration into other organs, surgery can be performed by two surgeons when the FJ Clip is used, application of the FJ Clip-marionette technique will prove to be helpful. In cases requiring dissection below the peritoneal reflection, however, the FJ Clip-marionette technique will be insufficient and MPS will be necessary.

Single-incision laparoscopic colectomy has been shown to be safe and effective in patients with colon cancer, and the outcomes are optimal when it is performed in selected patients by surgeons with extensive laparoscopic experience (5,6,11-13). Single-incision laparoscopic colectomy yields good short-term outcomes, including good cosmetic results. It is, however, ergonomically difficult for the operator because the basic principles of instrument triangulation applicable to conventional laparoscopic surgery are compromised, and interference between instruments occurs frequently (12,14,15).

We have experience performing SILS and RPS without the use of assistive devices, but only cases considered "not difficult" are selected. RPS incorporating the FJ Clip-marionette technique is superior in terms of cosmesis, and oncological safety is maintained. The procedure itself is safe, and although it is performed by only two surgeons, it allows us to expand the field of view to nearly match that of conventional laparoscopic surgery We believe that the FJ Clip-marionette technique will prove to be applicable to RPS performed for other disorders, such as cholelithiasis, right colorectal cancer, and gastric cancer.

As noted above, the FJ Clip was developed in collaboration with Charmant. Charmant is a manufacturer of eyeglass frames. The FJ Clip has a very strong grip, and its usefulness during performance of laparoscopic surgery for gastrointestinal stromal tumor has been reported (8). The risk of organ damage due to the strong grip has been investigated in animal livers. In addition, during surgery, the tow thread stops at the abdominal wall, and the pneumoperitoneum provides a protective cushion that prevents excessive tension. In fact, the risk of a secondary injury, such as bleeding, is lowered. Such secondary injuries are often caused by undue traction from an assistant's forceps. Further, although no comparison has been made, the amount of intraoperative blood loss is also very small. However, the FJ Clip is disadvantageous in the sense that the towing is typically in one direction. To resolve this, we devised a marionette technique that allows pulling from two directions. We can also use two FJ Clips, but because each clip is towed in one direction, the tension applied is not always effective. In addition, we think that the marionette technique performed with one clip is useful in terms of standardizing the procedure because it limits the number of times the clip must be repositioned. In fact, the procedure for sigmoid colon cancer is basically a six-step procedure in terms of how many times the clip must be repositioned.

The FJ Clip-marionette technique is also used for right colon cancer procedures, robot-assisted rectal traction procedures, and stomach traction during surgery for gastric cancer. In addition, the FJ Clip itself is highly useful because it can be attached and detached with ordinary laparoscopic forceps. When the FJ Clip-marionette technique is used for RPS, the operation can be performed by two surgeons, and we consider it useful in cases of colon cancer because it allows for a field of view close to that obtained during standard laparoscopic surgery.

Our experience with the FJ Clip-marionette technique is limited, and it is usually performed under the expectation of a good oncological outcome. We are not yet at a stage where we can properly compare the results of RPS incorporating the FJ Clip-marionette technique with the results of standard laparoscopic surgery. An accumulation of cases over time will allow us to carefully examine the usefulness and safety of the procedure. Our results thus far are promising.

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Footnote

Reporting Checklist: The authors have completed the AME Case Series reporting checklist. Available at https://asj.amegroups.com/article/view/10.21037/asj-21-89/rc

Data Sharing Statement: Available at https://asj.amegroups.

com/article/view/10.21037/asj-21-89/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://asj.amegroups.com/article/view/10.21037/asj-21-89/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional ethics board of Fukui Red Cross Hospital (approval number: R4-01-70), and individual consent for this retrospective analysis was waived.

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