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Rational Manipulation of the Standard Laparoscopic Instruments for Single-Incision Laparoscopic Right Colectomy

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This report clarifies the rational manipulation of standard laparoscopic instruments for single-incision laparoscopic right colectomy (SILRC) using the SILS Port. We classified the manipulations required into 4 techniques. Vertical manipulation was required for medial-to-lateral retroperitoneal dissection. Frontal manipulation was needed for extension and establishment of a retroperitoneal plane. External crossing manipulation was used for dissection or ligation of the ileocolic or right colic vessels. Internal crossing manipulation was required for mobilization from the cecum to ascending colon. We performed SILRC for a series of 30 consecutive patients. One additional port was needed in 5 of the patients (16.7%) because of severe adhesion between the ileum and abdominal wall. No intraoperative complications were encountered. Four rational manipulations of the standard laparoscopic instruments are required for SILRC using the SILS Port. However, more experience and comparative trials are needed to determine the exact role of SILRC.

Key words: Single-incision laparoscopic right colectomy – Colon cancer – SILS Access Port – Technique – Manipulation – Standard instruments

Single-incision laparoscopic surgery has grown in use in many general surgical operations.[1] Single-incision laparoscopic surgery using the SILS Access Port (Covidien, Mansfield, Massachusetts) has realized a number of potential benefits, such as improved cosmetic appearance, reduction of postoperative abdominal pain, and a short postoperative hospital stay.[2–5] On the other hand, the technique has the drawback of having the 2 instruments and laparoscopes competing for the same space at the fulcrum of the entry port. This causes hand collisions externally and conflict between the 2 instruments internally.[6] To improve this limitation, we propose rational manipulation of the 2 standard

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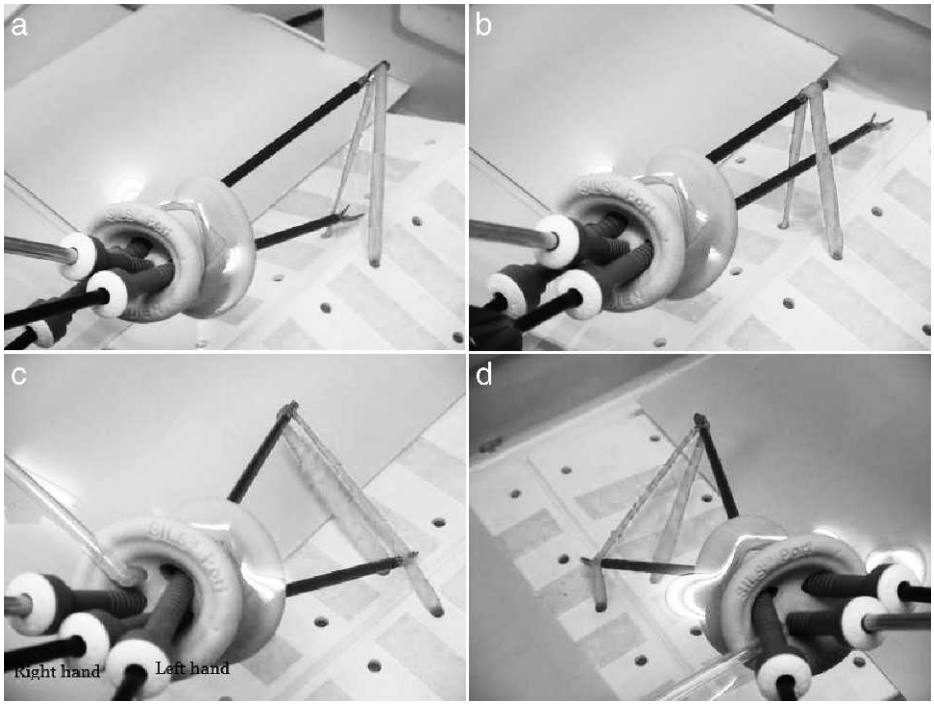

Fig. 1 (a) Vertical manipulation. This manipulation does not cause conflict of instruments because both instruments remain parallel. It gives a very wide range of freedom in the vertical direction. (b) Frontal manipulation. This manipulation also does not cause conflict of instruments because both instruments remain parallel. (c) External crossing manipulation. The surgeon crosses the instrument of the left hand over the instrument of the right hand by crossing both hands. In this manipulation the 2 instruments cross externally. (d) Internal crossing manipulation. The surgeon crosses the instrument of the left hand over the instrument of the right hand without crossing the hands. In this manipulation the 2 instruments cross internally.

straight laparoscopic instruments. The purpose of this report is to clarify the technique of single-incision laparoscopic right colectomy (SILRC) using the SILS Access Port based on rational manipulation of standard laparoscopic instruments.

Patients and Methods

Patients

We performed SILRC for a series of 30 consecutive patients with right colon cancer between July 2010 and December 2011. All of the patients provided informed consent for SILRC before undergoing the operation. Patients with intestinal obstruction or perforation, a physical status of IV or V in the American Society of Anesthesiologists grading system, and a history of colonic resection were excluded. Patient details and outcomes for operative procedures were recorded in a prospective database. All procedures were performed by 3 endoscopic colon and rectal surgeons (M.W., T.K., and M.M.).

Manipulation techniques

There are 4 basic manipulation techniques for the instruments used at the SILS Access Port, which we will describe before noting the operative technique used in the present case.

1. Vertical manipulation (Fig. 1a): In this manipulation, there is no conflict because both instruments remain parallel to each other. There is a very wide range of freedom in the vertical direction. This technique is recommended for medial-to-lateral retroperitoneal dissection.
2. Frontal manipulation (Fig. 1b): In this manipulation, there is also no conflict because both instruments remain parallel to each other. This technique is recommended to extend and establish a retroperitoneal plane.
3. External crossing manipulation (Fig. 1c): The surgeon is required to cross the instruments by crossing the hands. The 2 instruments are crossed externally. This technique is recommended for holding and countering to the left side of the monitor.

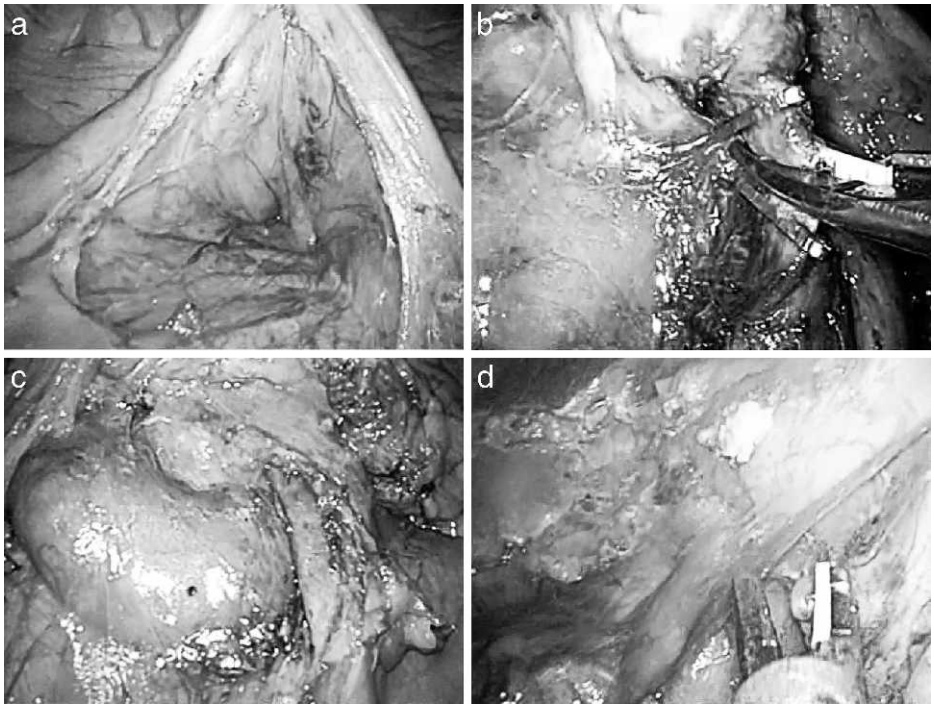

Fig. 2 (a) A medial-to-lateral approach achieved by vertical and frontal manipulation. (b) High ligation of the ileocolic artery performed with the endoclip and Harmonic scalpel by external crossing manipulation. (c) After dissection of lymph nodes and ileocolic and right colic vessels. (d) Mobilization of the right colon by internal crossing manipulation.

4. Internal crossing manipulation (Fig. 1d): The surgeon crosses the instruments of both hands internally, without crossing the hands. This is recommended for mobilization from the cecum to ascending colon.

Surgical technique

The patient was positioned in the supine position under general anesthesia. The surgeon and the assistant stood on the left side of the patient with the monitor placed on the opposite side. A vertical incision of 2.5 cm was made through the umbilicus, and the fascia was exposed and entered. The length of the fascial incision was kept to 3 cm in order to avoid leakage of pneumoperitoneum during the procedure. The SILS Access Port was inserted through the transumbilical incision, and through this the 3 packaged 5-mm trocars were introduced in an inverse triangle position to access the ascending colon. The surgeon used a standard laparoscopic 5-mm atraumatic grasper for the left hand and a standard laparoscopic dissector or a Harmonic scalpel (Ethicon Endo-Surgery Inc, Tokyo, Japan) for the right hand through 2 of the upper ports. A standard 5-mm, 30° rigid laparoscope was inserted through the lower port, forming in an inverse triangular fashion with the other 2 instruments. After laparoscopic exploration was performed, the patient was placed in the Trendelenburg position with the right side uppermost. The omentum and mid transverse colon was retracted above the stomach, and the small bowel was retracted to the left. The retroperitoneal dissection was undertaken in a medial-to-lateral fashion by vertical and frontal manipulation, and combinations of the two (Fig. 2a). The ileocolic pedicle was elevated with the atraumatic grasper and was identified by the Harmonic scalpel until the duodenum and the right colic vessels were confirmed by the vertical manipulation. External crossing manipulation was performed so that the ileocolic vascular pedicle was held by the left-hand instrument, and high ligation of the pedicle was then undertaken with the Harmonic scalpel and endoclip (Fig. 2b). If the ileocolic vascular pedicle was difficult to hold using external crossing manipulation, vertical manipulation was useful to hold and undertake high ligation of the pedicle. After ligation of the ileocolic vessels, soft tissue was removed along the surgical trunk, and high ligation of the right colic vessels was per-

Table 1 Demographic and clinical characteristics of the patients

Age, y	74 (44–86)[a]
Sex, No.	
Male	13
Female	17
ASA grade, No.	
I	14
II	16
BMI (kg/m^2)	23.0 (19.1–33.5)[a]
Tumor location, No.	
Cecum	15
Ascending colon	15

ASA, American Society of Anesthesiologists.

[a]Values are median (range).

formed in the same way (Fig. 2c). A retroperitoneal plane was then established and extended laterally and deep to the right colon by vertical and frontal manipulation, superiorly over Gerota fascia, and medially by detaching the retroperitoneal adhesions of the duodenum. The colon was then mobilized along the white line of Toldt up to the level of the hepatic flexure by the internal crossing manipulation (Fig. 2d). The portion of the omentum attached to the colon was then divided proximally, and the hepatic flexure was mobilized distal to the middle colic vessels by the internal crossing manipulation. If the mobilization of the hepatic flexure by the internal crossing manipulation was difficult, the hepatic flexure was mobilized by taking it down from the middle transverse colon by vertical and frontal manipulation, and combinations of the two. The ligation of the middle colic vessels was not performed. After the SILS Access Port was removed, a Lap-Protector (Hakko Co Ltd, Tokyo, Japan) was placed for exteriorization of the right colon. The proximal and distal extent of resection was determined based on the mesentery of the divided pedicles. The bowel was resected extracorporeally, and a side-to-side functional, end-to-end anastomosis was then created with staplers. The ileocolic anastomosis was returned to the abdominal cavity, the Lap-Protector was removed, and the SILS Access Port was reinserted. No drain was inserted in situ. The fascial incision and skin edges were closed in a primary fashion, and a sterile dressing was applied.

Results

Demographic and clinical characteristics of the patients are shown in Table 1. The operation was performed for 17 female and 13 male patients. The median age of the patients was 74 years (range, 44–86 years), and median body mass index (BMI) was 23.0 kg/m^2 (range, 19.1–33.5 kg/m^2). Location of tumor was cecum in 15 patients and ascending colon in 15 patients. Operative results and outcomes of the patients are shown in Table 2. The median operating time was 130 minutes (range, 65–210 minutes), and operative blood loss was 3 mL (range, 1–200 mL). There were no conversions to open laparotomy. One additional port was needed in 5 of the patients (16.7%) because of severe adhesion between the ileum and abdominal wall. No intraoperative complications were encountered. A total of 3 patients (10.0%) experienced postoperative complications, including 2 superficial surgical site infection and 1 paralytic ileus. All of the pathologic findings were adenocarcinoma, and all surgical margins were negative. The median number of lymph nodes harvested was 18 (range, 8–46), and 6 of the 30 patients showed positive metastasis in harvested lymph nodes. The median length of hospital stay was 9 days (range, 6–27 days). There was no readmission caused by postoperative complication.

Discussion

A recent report suggested that SILRC using the SILS Access Port with standard laparoscopic instruments was technically feasible.[5] Bucher *et al*[7] used a single 12-mm umbilical port and standard laparoscopic instruments for right hemicolectomy, whereas Podolsky and Curcillo[8] used standard laparoscopic instruments for single-port access surgery. However, to the best of our knowledge, the literature contains no detailed reports referring to manipulation techniques for standard laparoscopic instruments using

Table 2 Operative results and outcomes of the patients

Operating time, min	130 (65–210)[a]
Operative blood loss, mL	3 (1–200)[a]
Additional ports, %	16.7 (5 of 30)
Postoperative complication, %	10.0 (3 of 30)
Superficial SSI, No.	2
Paralytic ileus, No.	1
Lymph node harvest, No.	18 (8–46)[a]
Dukes stage, No.	
A	14
B	10
C	6
Length of hospital stay, days	9 (6–27)[a]

SSI, surgical site infection.

[a]Values are median (range).

the SILS Access Port; hence, our report is the first to describe such techniques.

There are many access port devices for single-incision laparoscopic surgery,[1,6] and each has its advantages and limitations. We use the SILS Access Port for right colectomy because it is a flexible laparoscopic port that can accommodate up to 3 instruments, and because its simplicity allows it to maintain adequate pneumoperitoneum.[6,9] The limitations of this port are hand collisions externally and difficulty with instrument tip manipulation internally.[6] To avoid internal conflict of instruments, a cross-handed approach using curved laparoscopic instruments has been established. This approach creates difficulty in safe dissection of the target tissues because the surgeon's left hand must operate the instrument on the right and vice versa, which can be uncomfortable.[6] Our 4 manipulations create a wide degree of freedom in the fulcrum of the SILS Access Port; hence, there is no conflict of instruments and it becomes possible to retract the target tissue safely. There are characteristic steps in laparoscopic right colectomy, such as medial-to-lateral retroperitoneal dissection and ligation of the ileocolic and right colic vessels. Because each series of procedures can be performed by making full use of the 4 manipulations without internal conflict, we believe that SILRC is possible with standard straight laparoscopic instruments. If the instruments and laparoscope become conflicted internally despite the performance of these manipulations, the problem can be overcome by drawing the scope out to the level of the entry port until the motion of the instruments becomes free. This was also noted by Choi *et al*.[10] To avoid external conflict between the instruments and laparoscope, we recommended using a long laparoscope.

We performed SILRC based on these rational manipulations for a series of 30 consecutive patients with right colon cancer. One additional port was needed in 5 of the patients because of severe adhesion between the ileum and abdominal wall. In those cases, an additional port was inserted to the right lower abdomen for the surgeon's left hand, and it was performed without conversion to open or conventional laparoscopic surgery. Patients with BMI >25 kg/m^2 numbered 6 in a series of 30 consecutive patients. The mean operative time for patients with a BMI >25 kg/m^2 was significantly longer than that for patients with BMI <25 kg/m^2. However, there were no significant differences in operative blood loss, number of additional ports, or postoperative complications. Furthermore, no intraoperative complications were encountered in any of the 30 patients. All surgical margins were negative. We therefore believe that SILRC using our 4 manipulation techniques is a feasible and safe procedure comparable to conventional laparoscopic right colectomy.

We presented a technique for SILRC using the SILS Access Port and standard laparoscopic instruments that emulates all of the steps of a safe multiport right colectomy. We believe that the technique has a relatively short learning curve and is reproducible. However, more experience and comparative trials are needed to determine the exact role of single-incision laparoscopic surgery.

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