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*Original Article*

# Dual-incision laparoscopic surgery for right-sided colon cancer

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**Abstract:** Background: Laparoscopic surgery for colorectal cancer has become a standard surgical procedure in recent years. Furthermore, reduced port surgery (RPS) has become popular due to fewer ports and trocars, leading to reduction in wound pain and improved cosmetic outcome. In July 2013, RPS was introduced to our hospital. In all cases, an umbilical incision was the main port used to remove specimens and perform anastomosis. In this study, we evaluated the efficacy of dual-incision laparoscopic surgery (DILS), which has 2 ports as an RPS for right-sided colon cancer. Methods: Thirteen patients with Stage 0, I, and IIA right-sided colon cancer underwent DILS from July 2013 to February 2014 and were compared to 19 patients who underwent multiport laparoscopic surgery (MPS). Patient demographics and intra-/post-operative factors were evaluated. Results: There were no significant differences in age, gender, body mass index, tumor location, clinical stage, or surgical procedure between MPS and DILS patients. Clinicopathologically, there were no significant differences in the number of lymph nodes dissected, blood loss, or complications between MPS and DILS patients. The median number of port sites was 2 and 5 in DILS and MPS patients, respectively ($P < 0.001$). DILS operative time was shorter than MPS (Median, 246 versus 273 min, $P = 0.032$); DILS patient postoperative hospital stay was also shorter than MPS patients (Median, 11 versus 14 days, $P = 0.003$). Conclusions: Results of this study suggest that DILS is an effective technique for colon cancer, which achieves a better cosmetic outcome by using fewer port sites.

**Keywords:** DILS, RPS, reduced port surgery, laparoscopic surgery, colorectal cancer

## Introduction

Colorectal cancer (CRC) is one of the most frequent malignancies and leading causes of cancer-related deaths. In developing countries where aging populations are increasing, one in every four deaths is due to cancer [1]. In this decade, laparoscopic surgery has been effectively utilized for CRC in many institutions resulting in less blood loss, shorter hospital stays, decreased postoperative pain, faster postoperative recovery, and improved quality of life [2-5]. Conventional multiport laparoscopic surgery for CRC is generally performed by 4-5 trocars; 1 trocar for a laparoscopist, 2 trocars for an operator, and 1-2 trocars for an assistant. In order to reduce patient stress (i.e., wound pain and cosmetic outcome), efforts have been made to decrease the number of port sites and shorten the skin incision. Therefore, reduced port surgery (RPS), including single-incision laparoscopic surgery, has been introduced to colorectal surgery [6-9].

RPS utilizes an umbilical incision for multi-trocar (generally 2-4 trocars) access to remove specimens and perform anastomosis at bowel ends. These surgical procedures influence the umbilical skin-incision length. Although shorter skin incisions and decreased number of port sites reduce wound pain and improve cosmetic outcome, they limit the work space for laparoscopic handling. Here, we evaluate the efficacy and usefulness of dual-incision laparoscopic surgery (DILS) using 2 ports as an RPS for right-sided colon cancer (RT-CC).

## Patients and methods

Thirty-six patients underwent RPS for CRCs at Osaka Medical Center for Cancer and Cardiovascular Diseases (Japan) from July 2013 to

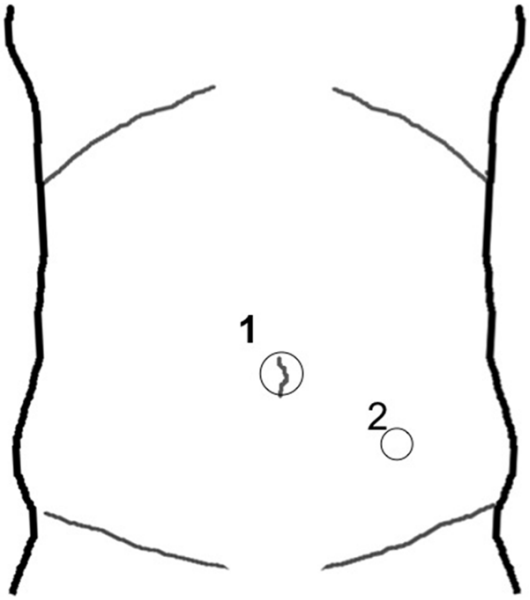


**Figure 1.** Design of dual-incision laparoscopic surgery (DILS). Three trocars were placed in the EZ Access device at the umbilical incision and 1 port was placed in the left lateral abdomen for right hemicolectomy.

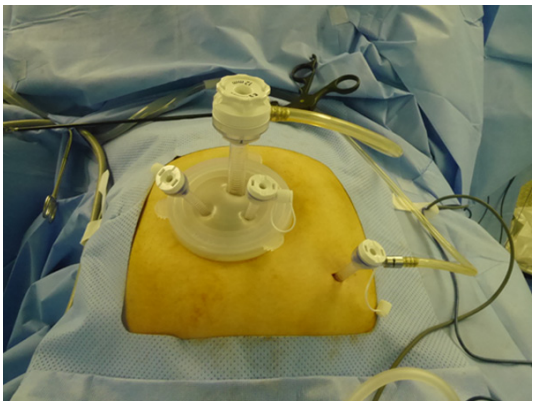

**Figure 2.** The picture of dual-incision laparoscopic surgery (DILS) utilizing multi-trocar access placed in EZ Access at an umbilical incision. DILS was performed by 4 total trocars, 2 trocars for an operator, and 2 trocars including a laparoscope for an assistant.

February 2014. During this period, we performed DILS on 13 patients with Stage 0-IIA Rt-CC. DILS patients were compared to 19 patients who underwent multiport laparoscopic surgery (MPS) for Stage 0-IIA Rt-CC from January 2011 to June 2013. In both DILS and MPS, an umbilical incision was used for primary access to the intra-abdominal space and functioned as a main port in which multi-trocars were placed. DILS was performed as follows: an initial skin incision was made in the umbilical region, and a Lap-Protector (Hakko Co. Ltd., Nagano, Japan) and EZ Access (Hakko) were put into place. Three devices were placed through the EZ Access device adjusted to fit the Lap-Protector, including a flexible laparoscope (Olympus, Tokyo, Japan) and 2 operating forceps (**Figure 1**). One port was placed at the lateral abdomen (**Figure 2**). If it was difficult to complete the surgical procedure with 2 ports, 1 additional port was added to the other lateral abdomen. An operator used 2 trocars and an assistant used 2 trocars including a laparoscope.

Oncological surgery by DILS including length and segment numbers of colon and lymph node dissection was performed according to tumor location, as described in the Japanese clinical guidelines edited by the Japanese Classification of Colorectal Carcinoma [10]. Tumors were extracted through the Lap-Protector, which was placed at the umbilical incision, and functional end-to-end anastomosis was performed after tumor resection. Finally, a drainage tube was placed in a pouch of Douglas's fossa through the lateral abdominal port site to drain the abdominal fluid. The fascia was closed with Vicryl (size 1; Johnson & Johnson, New Brunswick, NJ, USA). After washing the skin with saline to reduce surgical site infection, the skin was closed with PDS (size 4.0; Johnson & Johnson). Clinical and operative factors and postoperative outcomes between DILS and MPS were analyzed. According to the tumor node metastasis classification of the International Union against Cancer, clinical and pathological factors/Stages were assigned [11]. Surgical complications were assessed according to the Clavien-Dindo classification system [12], by which all complications were graded from I to IV. This study was approved by the institutional review board of Osaka Medical Center for Cancer and Cardiovascular Diseases.

*Statistical analysis*

For continuous variables, data were expressed as medians (ranges). Clinicopathological factors between MPS and DILS groups were analyzed using the Wilcoxon rank-sum, Pearson's chi-square, and Fisher's exact tests. All data were analyzed using JMP software (version 11.0; SAS Institute, Cary, NC, USA). Differences with two-sided $P < 0.05$ were considered statistically significant.

**Table 1.** Patient demographics in multiport laparoscopic surgery (MPS) and dual-incision laparoscopic surgery (DILS)

| Factors | MPS (n=19) | DILS (n=13) | *P* value |
|---|---|---|---|
| Age (year) | 69 (38-83) | 66 (38-90) | 0.847 |
| Sex (male/female) | 9/10 | 11/2 | 0.062 |
| Body mass index | 21.2 (16.2-30.2) | 20.6 (18.1-24.8) | 0.862 |
| Tumor location (C/A/T) | 9/9/1 | 3/9/1 | N/A |
| Clinical stage* (0/I/IIA) | 1/14/4 | 2/8/3 | N/A |
| Surgical procedure (ICR/right hemicolectomy) | 9/10 | 3/10 | 0.163 |
| Lymph node dissection** (D2/D3) | 8/11 | 9/4 | 0.131 |

Tumor location: C, cecum; A, ascending colon; T, transverse colon. *Clinical stages were decided according to tumor node metastasis classification of the International Union against Cancer. **Lymph node dissection was performed according to the Japanese Society for Cancer of the Colon and Rectum guidelines. N/A, not available. All continuous variables are expressed as medians (range).

**Table 2.** Clinicopathological factors in multiport laparoscopic surgery (MPS) and dual-incision laparoscopic surgery (DILS)

| Factors | MPS (n=19) | DILS (n=13) | *P* value |
|---|---|---|---|
| Number of lymph nodes dissected | 24 (8-43) | 18 (9-46) | 0.155 |
| Pathological stage* (0/I/IIA/IIIA) | 0/12/4/1 | 2/8/3/0 | N/A |
| Number of port sites | 5 (5-6) | 2 (2-3) | < 0.001 |
| Operative time (min) | 273 (175-490) | 246 (163-321) | 0.030 |
| Bleeding (ml) | 40 (10-150) | 30 (0-100) | 0.861 |
| Conversion to open | 0 | 0 | N/A |
| Complications (grade ≥III**) | 1 | 1 | N/A |
| Surgical site infection | 0 | 0 | N/A |
| Ileus | 0 | 0 | N/A |
| Anastomotic bleeding | 1 (grade IIIa) | 1 (grade IIIa) | N/A |
| Anastomotic leakage | 0 | 0 | N/A |
| Others | 0 | 0 | N/A |
| Postoperative hospital stay (days) | 14 (12-19) | 11 (6-17) | 0.003 |

*Pathological stages were assigned according to tumor node metastasis classification of the International Union against Cancer. **Postoperative complications ≥ Grade III are listed. N/A, not available. All continuous variables are expressed as medians (range).

## Results

Patient demographics such as age, gender, body mass index, tumor location, clinical stage, surgical procedure, and lymph node dissection did not differ significantly between the 2 surgical groups (**Table 1**). Clinicopathologically, the number of port sites and operative time were significantly different between the 2 groups (**Table 2**). The median port number was 2 (range, 2-3 ports) in the DILS group and 5 (range, 5-6 ports) in the MPS group. Median operating time was 246 min (range, 163-321 min) and 273 min (range, 175-490 min) in the DILS and MPS groups, respectively.

In the postoperative complication survey, 1 MPS and 1 DILS patient had anastomotic bleeding following surgery. They were diagnosed by colonoscopy after their operations, and endoscopic clipping was performed in both cases. In the present study, there were no cases with anastomotic leakage and/or postoperative ileus corresponding to a Clavien-Dindo classification of more than Grade I. The median postoperative hospital stay was 11 days (range, 6-17 days) in the DILS group and 14 days (range, 12-19 days) in the MPS group. In both groups, there was no case in which laparoscopic surgery was converted to open surgery. These results suggest that the RPS procedure had no negative impact on operative/surgical or clinicopathological factors.

## Discussion

The overall goal of CRC treatment is to perform radical resection in order to reduce recurrence and improve survival. Therefore, laparoscopic surgery was introduced to improve patient quality of life by reducing wound length and pain, leading to rapid postoperative recovery. Results from several randomized studies demonstrate the non-inferiority of oncological outcomes in laparoscopic surgery compared to conventional open surgery [2, 13-15]. The introduction of

RPS has been shown to improve cosmetic outcomes; however, reduction in the number of port sites limits laparoscopic handling space. In recent years, a few reports have compared the clinicopathological factors and outcomes of single-incision laparoscopic surgery or RPS to MPS for colectomy [16-19]. These studies found no differences in operative time, conversion rate to open surgery, number of lymph nodes harvested, length of hospital stay, postoperative complications, or mortality [16-18]. Feasible and safe umbilical incision laparoscopic colectomy with 1 additional port for CRC has been reported, wherein right hemicolectomy or extended colectomy was performed in 6 cases [19]. In our 13 cases, the median follow-up time for DILS patients was 10.6 months compared to 32.0 months for MPS patients; however, the feasibility of using DILS for CRC resection still remains to be elucidated.

In our study, reducing the number of port sites was a major concern as it might increase difficulties in operative handling of DILS for CRC. However, our finding of operative time in DILS group indicates that DILS is not so much time-consuming compared to MPS, and indirectly shows that the challenges encountered in DILS may be less than anticipated. We included the consecutive cases of both groups as a cross-section study, without randomization. A selection bias may have been induced due to the lack of randomization. The present study shows no significant differences between DILS and MPS patient demographics, suggesting such a bias may be nominal if any Further more, there were no significant differences in the clinicopathological factors except for the number of port sites and operative time. Although the factor of lymph node dissection did not show statistically significant differences, for D3 lymph node dissection, the MPS group had 11 cases (57.8%) as compared to the DILS group that had 4 cases (30.7%). This lymph node dissection trend, but not yet difference, could have influenced the difference in operative time between DILS and MPS groups. Further studies are needed to address this potential influence. Moreover, each surgical group had 1 patient with postoperative bleeding at the anastomosis. These 2 patients were treated endoscopically by clipping the bleeding sites. Otherwise, there were no complications greater than Grade III in both the DILS and MPS groups. Thus, reducing the number of ports in the DILS group did not further impede the oncological laparoscopic surgery procedure, suggesting that DILS is a useful technique for Rt-CC.

## Conclusions

DILS for Rt-CC is a feasible surgical procedure, introduced as a useful technique, which reduces the number of port sites and improves cosmetic outcomes and patient quality of life.

## Disclosure of conflict of interest

All authors have declared no conflicts of interest directly relevant to the content of this article.

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