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Umbilical Defunctioning Ileostomy for Rectal Cancer Results in Reduced Risk for Incisional Hernia

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Abstract. *Background/Aim: Umbilical defunctioning ileostomy (UDI) spares one incision, which may reduce the overall incidence of incisional hernia. Our aim was to evaluate the occurrence and risk factors of incisional hernias between UDI and conventional defunctioning ileostomy (CDI) after ileostomy closure. Patients and Methods: Incidence of incisional hernia after ileostomy closure was compared between UDI (n=51) and CDI (n=86) groups. Risk factors for incisional hernia were also considered through a retrospective analysis. Results: The overall incidence of incisional hernia was 5.9% in the UDI group, which was significantly lower than the 22.1% (7.0% at the midline incision and 15.1% at the stoma site) in the CDI group (p=0.012). Multivariate analysis showed higher BMI (p=0.035) and CDI (p=0.031) as risk factors for developing incisional hernias overall. Conclusion: UDI results in fewer incisional hernias than CDI and seems to be superior to CDI from the standpoint of overall incidence of incisional hernias.*

Since our initial report in 2013 (1), several reports on umbilical defunctioning ileostomy (UDI) have been published from various countries (2-6). Many of these reports are preliminary studies that discuss the cosmetic advantages of UDI over conventional defunctioning ileostomy (CDI) and feasibility of stoma management. We have reported the outcomes and short-term complications related to peristomal dermatitis in 2016 (7); however, there are no reports on the long-term complications after stoma closure for UDI. Many reports have indicated a high incidence of incisional hernias at the stoma closure site, which in some cases exceeded 30% (8-14). Abdominal incisional hernia causes discomfort, pain, swelling, risk of strangulation, and reduced quality of life, often necessitating surgery (12, 15). Defunctioning ileostomy is an effective countermeasure against anastomotic leakage in rectal cancer surgery, and patients at high risk for anastomotic leakage often undergo defunctioning ileostomy despite the risk of developing incisional hernia (16-18). In CDI, the midline incision, the site for specimen extraction site, and the stoma site incision result in separate wounds. UDI, however, results in only one wound as the incision for specimen extraction and stoma site are the same (Figure 1). Fewer incisions may reduce the risk of incisional hernia, a major late complication of defunctioning ileostomy after ileostomy closure. The purpose of the present study was to examine the effect of UDI on the occurrence of incisional hernia after stoma closure and to investigate the risk factors for developing such a complication after stoma closure.

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Key Words: Umbilical defunctioning ileostomy, incisional hernia, rectal cancer, laparoscopic surgery.

Patients and Methods

This retrospective cohort study included patients with rectal cancer who underwent anterior resection and defunctioning ileostomy followed by ileostomy closure at the Jikei University Hospital between January 2008 and December 2016. Cases with a post-ileostomy closure observation period of less than 90 days were excluded. Examinations in all cases prior to rectal cancer surgery consisted of colonoscopy, chest computed tomography (CT), abdominal CT, or abdominal magnetic resonance imaging (MRI) to determine the TNM classification preoperatively. Patients with comorbidities or those deemed at high risk for anastomotic leakage were encouraged to undergo defunctioning ileostomy at the discretion of the attending surgeon. The location of ileostomy (UDI or CDI) was determined by the attending surgeon based on the patient's wishes after obtaining informed consent from the patient. Thus, the patients were divided into UDI (n=51) and CDI (n=86) groups. Ileostomy closure was performed if there was no anastomotic leakage or stricture when a gastrografin enema was performed. CT or MRI Images and medical records were used to detect abdominal incisional hernias (midline abdominal incisional hernia or stoma site hernia) after ileostomy closure. The overall incidence of incisional hernias, those at the stoma site and those at the median incisional site were compared retrospectively between the UDI and CDI groups, in which the stoma site and median incision site in the UDI group were identical.

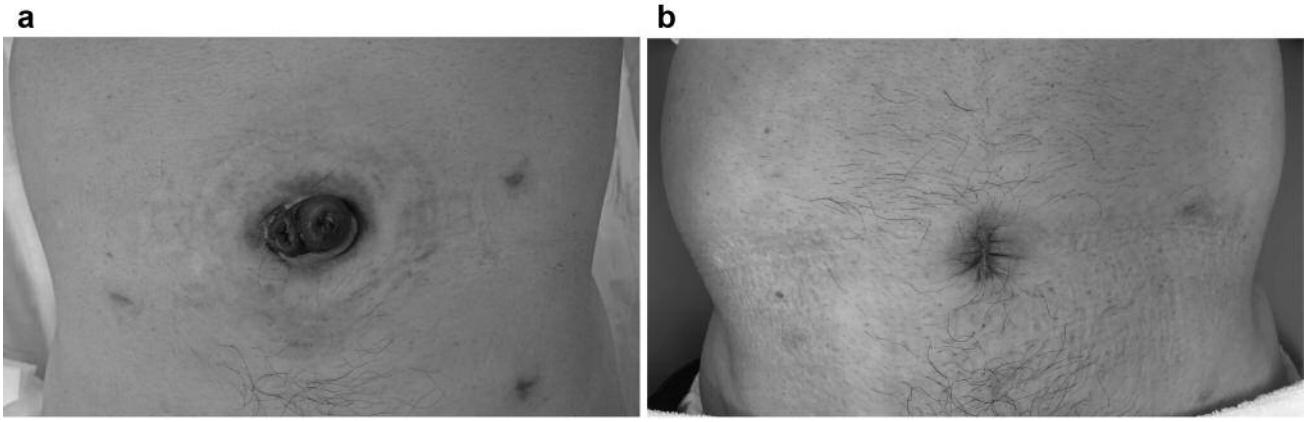

Figure 1. *Umbilical defunctioning ileostomy. a: 4 months after construction of umbilical defunctioning ileostomy. b: 5 years after ileostomy closure.*

The risk factors for incisional hernia overall, those for incisional hernia at the stoma site, and those for incisional hernias at the median incisional site were also investigated separately.

The following clinical variables were studied from the medical records: age; sex; body mass index (BMI); American Society of Anesthesiologists score (ASA); UICC-TNM classification; operative method (laparoscopic or open); duration between initial operation and ileostomy closure; observation period after ileostomy closure; and surgical results of initial operation and ileostomy closure, including operative time, intraoperative blood loss, length of hospital stay and postoperative complications within 30 days consisting of surgical site infection (SSI) and small bowel obstruction. Diagnosis of incisional or organ/space SSI was based on the Center for Disease Control and Prevention National Nosocomial Infections Surveillance system criteria (19). All patients and their families were informed about the possible risks and benefits of performing these surgical procedures and provided written consent. The study protocol was reviewed and approved by the ethics committee and Institutional Review Board (30-418 9439).

Statistical analysis. All data were expressed as a median (25-75th percentile) or number (%). The Mann-Whitney's *U*-test and the Chi-square test were used for the continuous and categorical variables, respectively. Logistic regression model was used to assess associations between exposures and outcomes. A logistic multivariate regression analysis was performed, using stepwise backward elimination, to identify independent risk factors for incisional hernia. All analyses were performed using SPSS (version 22.0; IBM, Tokyo, Japan), and *p*-values less than 0.05 were considered significant.

Results

Of the cases diagnosed with rectal cancer at the Jikei University Hospital between January 2008 and December 2016, 159 patients underwent anterior resection and defunctioning ileostomy. Of these, 19 patients who underwent ileostomy closure and had an observation period of less than 90 days were excluded. Further, 3 patients who simultaneously underwent concomitant abdominal surgery during the ileostomy closure were also excluded. Subsequently, 137 cases (UDI group: 51 cases; CDI group: 86 groups) were analyzed in this study (Figure 2).

Patient characteristics. The patient demographics are summarized in Table I. The results for the UDI group showed less patients in stage II and more patients in stage III than the CDI group (p=0.046). At the initial surgery, the UDI group had a significantly higher rate of laparoscopic surgery and significantly less blood loss than the CDI group (p<0.001, p<0.001). Though the UDI group had a significantly shorter postoperative hospital stay than the CDI group (p=0.004), no difference was observed in the occurrence of postoperative complications. The UDI group also had a significantly shorter period from the first surgery to colostomy closure than the CDI group (p=0.010).

Comparison of the incidence of incisional hernias between UDI and CDI. Although the incidence of incisional hernia at the stoma site showed no difference between the UDI group and the CDI group (5.9% *vs*. 7.0%; p=0.553), the UDI group had a significantly lower overall incidence of incisional hernias than the CDI group (5.9% *vs*. 22.1%; p=0.012). The incidence of incisional hernias at the midline incisional site also showed no difference between the CDI group and the UDI group (5.9% *vs*. 15.1%; p=0.104) (Table II).

Correlations between clinical variables and development of incisional hernia by univariate analysis. The group with incisional hernia showed higher BMI (p=0.007), more frequent CDI (p=0.012), greater blood loss during initial surgery (p=0.042) and higher occurrence of SSI after the ileostomy closure (p=0.036) (Table III).

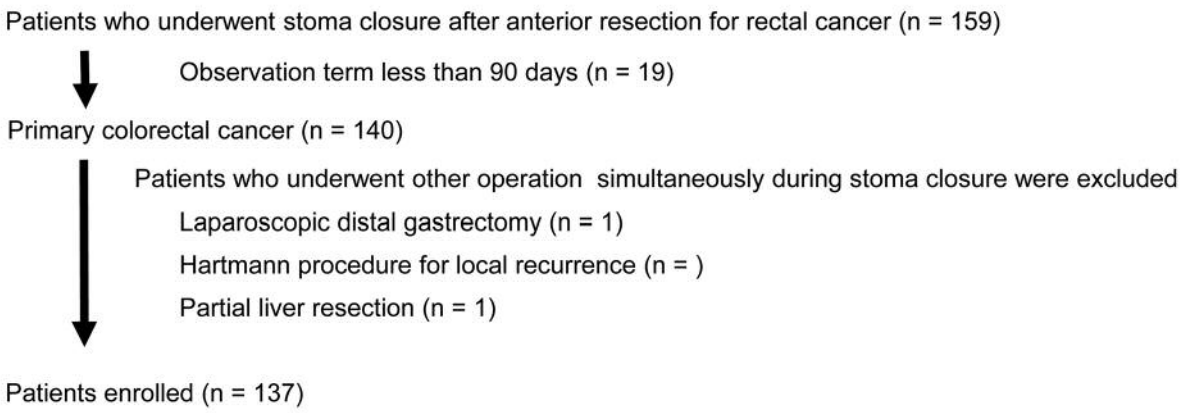

Figure 2. *The selection process for the study.*

Table I. *Patient characteristics and clinical variables between UDI and CDI by univariate analysis.*

	UDI (N=51)	CDI (N=86)	*p*-Value
Patients' characteristics			
Age (years)	61.0 (40-82)*	64.0 (35-90)	0.410**
Gender (male/female)	37/14	53/33	0.193***
Body mass index (kg/m^2)	22.1 (15.4-31.9)	23.4 (14.6-40.7)	0.240**
ASA			0.545***
I	15 (29.4%)	24 (27.9%)	
II	36 (70.6%)	60 (69.8%)	
III	0 (0%)	2 (2.3%)	
TNM classification			0.046***
0	1 (2.0%)	0	
I	22 (43.1%)	32 (37.2%)	
II	4 (7.8%)	24 (27.9%)	
III	21 (41.2%)	25 (29.1%)	
IV	3 (5.9%)	5 (5.8%)	
Operative method (Laparoscopic/open)	51/0	67/19	<0.001***
Surgical results of initial operation			
Operative time (min)	349 (211-826)	329 (130-988)	0.685**
Intraoperative blood loss (ml)	0 (0-340)	50 (0-2255)	<0.001**
Hospital stay (days)	12 (7-59)	17 (8-54)	0.004**
Complication			
SBO	1 (2.0%)	13 (15.1%)	0.583***
SSI			0.394***
None	45 (88.2%)	68 (79.1%)	
Incisional(superficial+deep)	2 (4.0%)	6 (7.0%)	
Organ/space	4 (7.8%)	12 (13.9%)	
Surgical results of stomal closure			
Operative time (min)	110 (57-177)	98 (86-262)	0.005**
Intraoperative blood loss (ml)	0 (0-270)	18 (0-410)	0.045**
Hospital stay (days)	9 (7-34)	9 (7-26)	0.571**
Complications			
SBO	1 (2.0%)	3 (3.5%)	0.608***
SSI			0.206***
None	49 (96.0%)	75 (87.2%)	
Incisional(superficial+deep)	1 (2.0%)	8 (9.3%)	
Organ/space	1 (2.0%)	3 (3.5%)	
Duration between initial operation and stoma closure (days)	109 (39-582)	161 (26-848)	0.010**

*Median (25-75th percentile); **Mann-Whitney's *U*-test; ***Chi-square test. UDI: Umbilical defunctioning ileostomy; CDI: conventional defunctioning ileostomy.

Table II. *Risk comparison between UDI and CDI group*.

	UDI (N=51)	CDI (N=86)	OR	95%CI	*p*-Value*
Primary outcome					
Any incisional hernia	3 (5.9%)	19 (22.1%)	4.573	1.271-16.202	0.012
Secondary outcome					
Incisional hernia at stoma site	3 (5.9%)	6 (7.0%)	1.200	0.287-5.021	0.553
Incisional hernia at midline incisional site	3 (5.9%)	13 (15.1%)	2.849	0.771-10.530	0.104

*Chi-square test. UDI: Umbilical defunctioning ileostomy; CDI: conventional defunctioning ileostomy.

Table III. *Comparison between patients with and without any incisional hernia after ileostomy closure by univariate analysis*.

	Any incisional hernia (N=22)	No incisional hernia (N=115)	*p*-Value
Patients' characteristics			
Age (years)	64.0 (46-77)*	63.0 (35-90)	0.847**
Gender (male/female)	13/9	77/38	0.476***
Body mass index (kg/m^2)	24.4 (18.9-32.0)	22.1 (14.6-40.7)	0.007**
ASA			0.644*3
I	5 (22.7%)	34 (29.6%)	
II	17 (77.3%)	79 (68.7%)	
III	0	2 (1.7%)	
TNM classification			0.655***
0	0 (0%)	1 (0.9%)	
I	8 (36.4%)	46 (40.0%)	
II	6 (27.2%)	22 (19.1%)	
III	8 (36.4%)	38 (33.0%)	
IV	0	8 (7.0%)	
Location of ileostomy (UDI/CDI)	3/19	48/67	0.012***
Operative method (Laparoscopic/open)	16/6	102/13	0.056***
Surgical results of initial operation			
Operative time (min)	353 (160-666)	330 (130-988)	0.714**
Intraoperative blood loss (ml)	40 (0-860)	0 (0-2255)	0.042**
Hospital stay (days)	14 (8-49)	15 (7-59)	0.810**
Complications			
SBO	1 (4.5%)	13 (11.3%)	0.146***
SSI	6 (27.3%)	14 (12.2%)	0.156***
Surgical results of stomal closure			
Operative time (min)	101 (43-187)	106 (44-262)	0.394**
Intraoperative blood loss (ml)	0 (0-65)	15 (0-410)	0.268**
Hospital stay (days)	10 (7-24)	9 (7-34)	0.127**
Complications			
SBO	1 (4.5%)	3 (3.0%)	0.508***
SSI	5 (22.7%)	8 (6.9%)	0.036***
Duration between initial operation and stoma closure (days)	172 (37-541)	143 (26-848)	0.243**
Observation period after stoma closure (days)	1260 (204-3144)	1187 (99-2943)	0.727**

*Median (25-75th percentile); **Mann-Whitney's *U*-test; ***Chi-square test. UDI: Umbilical defunctioning ileostomy; CDI: conventional defunctioning ileostomy.

Risk factors for incisional hernia by multivariate analysis. BMI (OR=1.128, 95%CI=1.009-1.261, p=0.035) and CDI (OR=4.110, 95%CI=1.135-14.875, p=0.031) showed a correlation with the incidence of incisional hernia overall. The incidence of incisional hernias at the stoma site was related to SSI after ileostomy closure (OR=6.870, 95%CI=1.425-33,128, p=0.016). However, no factors showed a correlation with the incidence of incisional hernias at the median incisional site (Table IV).

Table IV. *Effect of risk factors on incisional hernia in patients after ileostomy closure assessed by multivariate analysis.*

	Any incisional hernia			Incisional hernia at stoma site			Incisional hernia at midline incisional site		
	OR	95%CI	*p*-Value*	OR	95%CI	*p*-Value*	OR	95%CI	*p*-Value*
Body mass index (kg/m^2)	1.128	1.009-1.261	0.035			0.120			0.070
CDI	4.110	1.135-14.875	0.031			0.546			0.104
Laparoscopic surgery in initial operation			0.214			0.859			0.170
Intraoperative blood loss in initial operation (ml)			0.432	1.001	1.000-1.003	0.63			0.857
SSI after stoma closure			0.084	6.870	1.425-33.128	0.016			0.179

*Backward stepwise elimination. UDI: Umbilical defunctioning ileostomy; CDI: conventional defunctioning ileostomy.

Discussion

This retrospective study showed that the UDI group had a significantly lower incidence of incisional hernias than the CDI group. Incisional hernias in the current study were related with higher BMI, more frequent CDI, greater blood loss during initial surgery and higher occurrence of SSI after ileostomy closure. Higher BMI and CDI were risk factors for developing incisional hernias. Postoperative SSI after ileostomy closure increased the risk for incisional hernia at the stoma site; however, no factors were found to be associated with the occurrence of midline incisional hernias. In terms of short-term surgical outcomes, the results showed that the CDI group had significantly more blood loss in the initial surgery. In the current study, the CDI group included 19 cases of open surgery. The lower blood loss during the ileostomy closure in the UDI group seems to be attributable to its passage through a thinner part of the abdominal wall. The umbilical area also has less subcutaneous tissue, and the route passes through the linea alba, and not the rectus abdominis, which may reduce blood loss. However, UDI involved longer surgery time than CDI, possibly because UDI requires umbilicoplasty.

CDI is associated with significantly higher occurrence of incisional hernias, owing to the inherent presence of two wounds as compared to a single wound in UDI. On the other hand, the stoma site and the midline incisional site are identical in UDI.

The UDI and CDI groups showed no difference in the occurrence of incisional hernias in the umbilical or right lower abdominal stoma site. Apart from the site of ileostomy, another major difference between UDI and CDI is whether the approach is through the rectus abdominis. The results in the current study show that whether the stoma goes through the rectus abdominis has no impact on the occurrence of abdominal incisional hernias following ileostomy closure. The reported risk factors for abdominal incisional hernias at the stoma site include SSI, obesity, diabetes mellitus, male sex, duration of follow-up, and higher BMI (9-11, 13, 14, 20-24). The current study showed that SSI was a risk factor for the incidence of incisional hernias at the stoma site following ileostomy closure, which agrees with the report by Oriel *et al*. (23).

The UDI and CDI groups showed no difference in the occurrence of incisional hernias at the midline incisional site. No significant differences were observed in the risk factors. Switching to laparoscopic surgery, with a smaller wound, was predicted to reduce abdominal incisional hernias; however, in the present study, open surgery was not a risk factor for the occurrence of incisional hernias at the midline incisional site. These results are consistent with previous studies (25, 26).

In the current study, multivariate analysis showed BMI and CDI as risk factors for overall incisional hernias. CDI (OR=4.110) was a greater risk factor for abdominal incisional hernias. Thus, UDI is associated with reduced occurrence of incisional hernias, which is a major advantage over CDI.

Patients who have undergone prophylactic mesh placement during stoma closure have been shown to have reduced risk for incisional hernia after ileostomy closure (10, 15, 27, 28). Barranquero *et al*. have stated that prophylactic mesh placement should be considered when an ileostomy closure is performed on a patient at high risk for incisional hernia (24). However, ileostomy closure is performed to close a contaminated abdominal wound. Considering the risk for mesh infection, there is hesitation to proactively use meshes. With no established surgery that is effective at reducing the risk of incisional hernias after ileostomy closure, the ability of UDI to eliminate one wound is regarded as a reliable countermeasure against the development of incisional hernias.

Complications in defunctioning ileostomy arise in cases where ileostomy closure is not possible owing to conditions such as anastomotic leakage or anastomotic stricture (29, 30). UDI, being more difficult for patients to manage than CDI, has the potential to lower the patient's quality of life (QOL). If ileostomy closure is impossible for reasons mentioned

above, irrespective of UDI or CDI, we perform colostomy instead and ileostomy closure. As a colon stoma is more physiological and surveillance is easier with the large intestine, it is more suitable for a permanent stoma. With this strategy, the situation where UDI becomes a permanent stoma can be avoided even if ileostomy closure is impossible.

UDI is a stoma that is not yet commonly performed. However, in the era of laparoscopic surgery, umbilical midline incision has been small enough to enable stoma construction. Advances in ostomy appliance have also made the management of UDI possible and UDI more practical. The approach for UDI is not through the rectus abdominis, and it is therefore possible that the late complications may involve increased occurrence of parastomal hernias or stomal prolapse. Stoma management is also complicated, making it unsuitable for a permanent stoma. However, from the perspective of a temporary stoma, UDI is considered superior to CDI, with better cosmetics after ileostomy closure and a lower incidence of incisional hernias.

This study has some limitations. The sample size was small, and large-scale randomized control trials are warranted to validate the results.

Conclusion

Umbilical ileostomy showed reduced incidence of abdominal incisional hernia and is suitable for temporary stoma.

Conflicts of Interest

The Authors have no conflicts of interest to declare in relation to this study.

Authors' Contributions

Ken Eto, MD, PhD: Corresponding Author who made substantial contributions to the conception and design of the work; Makoto Kosuge, MD, PhD: Substantial contributions to the analysis and interpretation of the data of the work; Masahisa Ohkuma, MD, PhD, Yasuhiro Takeda, MD, PhD, Saori Yatabe, MD, Hiroshi Sugano, MD, PhD, Naoki Takada, MD, Tomotaka Kumamoto, MD, Daisuke Ito, MD, PhD: Substantial contributions to the acquisition of data; Katsuhiko Yanaga, MD, PhD: Final approval of the version to be published.

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