Comparison of Transumbilical and Conventional Defunctioning Ileostomy in Laparoscopic Anterior Resections for Rectal Cancer

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Abstract. *Background/Aim: Laparoscopic surgery has made possible anterior resections with small incisions suitable for creating stomas. We retrospectively compared surgical results and stomal complications between transumbilical defunctioning ileostomy (TDI) and conventional defunctioning ileostomy (CDI) in laparoscopic anterior resections for rectal cancer. Patients and Methods: We compared patients who underwent laparoscopic anterior resection with TDI (n=47) with those undergoing CDI (n=27) for rectal cancer between February 2011 and January 2015. Results: For the initial operations, the TDI group had significantly less intraoperative blood loss (30.3 ml vs. 117.0 ml; p=0.014). For stomal closure, the TDI group experienced significantly fewer wound infections (2 vs. 8 cases; p=0.002) and bowel obstructions (none vs. 3 cases; p=0.039). No significant differences in stomal complication rates were observed. Conclusion: TDI is associated with better surgical results and fewer complications than CDI after laparoscopic anterior resection for rectal cancer.*

In general, stomas are created in the right- or left-lower abdomen (1). The ideal site for a stoma is considered to be below the umbilicus; within the rectus muscle; away from scars, creases, bony prominences, umbilicus or belt lines; on the summit of the infraumbilical fat mound; and in an area visible to the patient (2). For open surgery, a stoma at the umbilicus is inconceivable due to the large midline incision required; therefore, a separate incision is required for placement of the stoma at a more suitable site. However, laparoscopic surgery has made it possible to remove tumors through extremely small incisions. As stomas can now be created using surgical incisions performed for laparoscopic surgery, it is not always necessary to create a separate incision for the stoma.

Creating a stoma at the umbilicus has been performed in children (3-7), but is presently not common in adults. The main reason for this is that the umbilicus does not fulfill the aforementioned recommended conditions for a stomal site (1, 2). Complications resulting from permanent stomas can afflict patients for the rest of their lives. For this reason, the stoma site should be designated preoperatively so that it can be placed in the most optimal location (8-11). Defunctioning ileostomies are usually for temporary use, and have the disadvantage of leaving a permanent wound with partial destruction of the *rectus abdominis* muscles even after stomal closure. Additionally, even if the laparoscopic surgery is cosmetically successful, creating a defunctioning ileostomy in the right-lower abdomen leaves a noticeable lifelong scar.

In our practice, we have been able to avoid excessive scarring by creating a defunctioning ileostomy at the umbilical site after laparoscopic anterior resection, then performing an umbilicoplasty at the time of stomal closure. In February 2012, we began performing transumbilical defunctioning ileostomies (TDIs) during laparoscopic anterior resections for rectal cancer. In 2013, we reported a pilot study of 10 cases of TDI (12). In the present study, we included 47 cases of TDI for comparison with conventional defunctioning ileostomy (CDI) in terms of surgical results, including surgical and stomal complications.

Patients and Methods

This study included patients diagnosed with rectal cancer who underwent laparoscopic anterior resection with defunctioning ileostomy at Jikei University Hospital between February 2011 and January 2015. Prior to the operation, all patients underwent colonoscopy, chest computed tomography (CT), and abdominal CT or abdominal magnetic resonance imaging. Patients with

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clinical T3 or T4 lower rectal cancer received long-course preoperative radiochemotherapy. Approximately 6 weeks after completing radiochemotherapy, updated images were obtained and surgery was performed. We recommended defunctioning ileostomy routinely after laparoscopic low anterior resectioning and also for selected patients after high anterior resection who were at a high risk of anastomotic leakage. Since February 2012, attending surgeons have decided whether to perform TDI or CDI depending on the size of the tumor and patient preference. Postoperatively, wound, ostomy, and continence (WOC) nurses educated all patients receiving ileostomies about stoma care before discharge. Additionally, patients who may have had difficulty managing the stoma on their own or who had stomal complications were offered services by WOC nurses in ambulatory care at our hospital.

A gastrografin enema examination was performed at 1 or 2 months postoperatively for patients without adjuvant chemotherapy, and at approximately 6 months for patients who underwent adjuvant chemotherapy. Stomal closure was performed if there was no anastomotic leakage or stenosis.

For the initial operations as well as for the stomal closures, perioperative parameters of the TDI and CDI groups were compared, including operative time, blood loss, postoperative hospital stay, surgical complications, and stomal complications. All surgeries were performed after obtaining informed consent from the patients. This study was approved by an Institutional Review Board (27-283 8168).

Creation of transumbilical defunctioning ileostomy. The incision for the port site wound at the umbilicus was extended, through which the specimen was removed from the abdominal cavity. Following anastomosis of the rectum and after completing all procedures in the abdominal cavity, the size of the fascia at the umbilical incision wound was determined. In most patients, the fascial incision was extended to remove the specimen; hence 2-3 sutures were placed cephalad and caudad in the fascia to reduce the defect and accommodate a loop ileostomy. Since the surrounding skin slanted toward the umbilicus, the subcutaneous tissue was undermined to flatten the skin around the umbilical incision as much as possible. A smooth, oval-shaped design was created for the umbilical skin incision to fit the stoma. A segment of the ileum approximately 25-30 cm from the terminal ileum was then delivered through the umbilical incision (Figure 1a). The height of the rostral side of the stoma was approximately 20-30 mm while that of the caudal side was approximately 5-10 mm, resulting in a double-barreled stoma (Figure 1b).

Transumbilical defunctioning ileostomy closure. The loop ileostomy was closed while minimizing the amount of skin to be resected. After closing the fascia (Figure 2a), umbilicoplasty was performed by a plastic surgeon. For the initial 14 cases, simple skin sutures were used. An umbilicus was formed by suturing the subcutaneous tissue to the fascia of the *rectus abdominis* muscles, which created a depression in the skin in an umbilicus-like shape. However, this led to a high rate of superficial wound infection, and after a year or more, the umbilicus tended to become shallow. Therefore, starting with the 15th case, the skin was not closed and a 4-0 monofilament absorbable suture was used to approximate the subcutaneous tissue to the fascia of the *rectus abdominis* muscles at 6 points (Figure 2b). This left an area without skin in the center, which was covered by a piece of Terudermis artificial dermis (Olympus Terumo Biomaterials Corp., Tokyo, Japan) shaped to match the raw surface and fixed to the skin with eight nylon stitches (Figure 2c). The area without skin shrank over time, and this shrinkage eventually created an umbilicus-like shape. With this method, the area did not become shallow over time and there were no infections due to secondary healing of the wound.

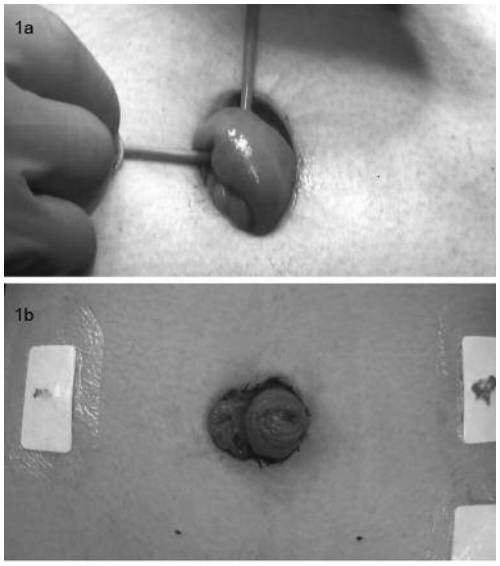

Figure 1. *Creation of transumbilical defunctioning ileostomy. a: A section of the ileum 25 cm away from the terminal ileum is delivered to the wound at the umbilicus, which has been trimmed to a smooth oval shape. b: A stoma is created at the umbilicus.*

The Ostomy Skin Tool. Peristomal skin complications were evaluated based on the discoloration, erosion, and tissue overgrowth (DET) score. The DET score is part of the Ostomy Skin Tool, a standardized tool for assessing peristomal skin complications using 3 domains. The size of the affected area is scored between 0 to 3 points and severity between 0 to 2 points, and each of the 3 domains is scored. The total score (maximum of 15) serves to evaluate peristomal skin complications, with high scores indicating more severe peristomal skin irritation (13, 14).

Statistical analysis. Data are expressed as means±standard deviations (SD). Univariate analysis was performed using the Mann–Whitney *U*-test or chi-square test. Pre- and post-care DET scores were compared using a paired *t*-test, and *p*-values were considered statistically significant when less than 0.05. Statistical analyses were conducted using IBM® SPSS Statistics version 20.0 (IBM Japan, Tokyo, Japan).

Results

Between February 2011 and January 2015, laparoscopic anterior resection with defunctioning ileostomy was performed in 76 patients. After excluding one case

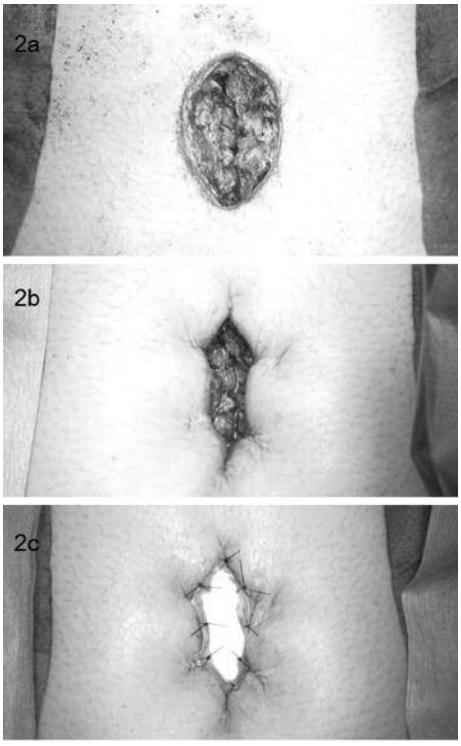

Figure 2. *Closure of the transumbilical defunctioning ileostomy. a: Sutures in the rectus abdominis muscle after closing the ileostomy. b: Six sutures were placed in the subcutaneous tissue at the skin margin of the rectus abdominis muscles using a 4-0 monofilament absorbable material. c: A piece of Terudermis artificial dermis was fixed to the central area of the skin defect with eight nylon sutures.*

Table I. *Patient characteristics in relation to the site of defunctioning ileostomy.*

	TDI group (N=47)	CDI group (N=27)	*p*-Value
Age (years)*	62.9±10.8	62.6±12.8	0.914
Gender, n (%)			0.806
Male	31 (66%)	17 (63%)	
Female	16 (34%)	10 (37%)	
Body mass index (kg/m^2)*	22.2±3.0	23.6±3.7	0.083
Previous abdominal surgery, n (%)			0.591
Yes	14 (30%)	6 (22%)	
No	33 (70%)	21 (78%)	
American Society of Anesthesiologists grade, n (%)			0.922
I	16 (34%)	9 (33%)	
II	30 (64%)	17 (63%)	
III	1 (2%)	1 (4%)	
Preoperative radiochemotherapy, n (%)			1.000
Yes	7 (15%)	3 (11%)	
No	40 (85%)	24 (89%)	
Size of tumor (mm)*	32.6±17.4	42.4±22.3	0.038
TNM classification, n			
T1/T2/T3/T4	11/13/19/4	9/3/15/0	0.114
N0/N1/N2	27/13/7	19/5/3	0.540
M0/M1	46/1	26/1	1.000
Stage, n			0.344
I	18	10	
II	8	9	
III	20	8	
IV	1	0	

*Mean±SD. TDI: Transumbilical defunctioning ileostomy, CDI: Conventional defunctioning ileostomy.

requiring simultaneous laparoscopic total gastrectomy for gastric cancer and another case with concomitant laparoscopic colonic resection for multiple colonic cancer, 74 patients were studied: 47 in the TDI group and 27 in the CDI group.

Patient characteristics. Patient demographics are summarized in Table I. There were no significant differences in baseline clinical characteristics between the TDI and CDI groups except in the size of the tumor, which was significantly smaller in the TDI group than in the CDI group (p=0.038).

Initial surgical results. The TDI group had significantly less blood loss than the CDI group (p=0.014). No significant differences were observed in operative time or hospital stay between the two groups. Moreover, surgical complications, postoperative anastomotic leakage, intra-abdominal abscesses, superficial surgical site infections, bowel obstructions, and stoma outlet obstructions were not significantly different (Table II).

Surgical results for stomal closure. No differences between the TDI and CDI groups were observed in operative time, blood loss, or hospital stay. With respect to surgical complications, the TDI group had significantly fewer wound infections (p=0.002) and bowel obstructions (p=0.039). There were no significant differences in any other surgical complication categories (Table III).

Stomal complications. Differences between groups were not observed in rates of stomal prolapse, stomal fistula, or incisional hernia of the stomal site after stomal closure. The symptoms of the two cases with stomal prolapse were mild and easily resolved manually; elective stomal closures were performed in both cases. For peristomal skin complications, no significant differences were observed in the initial (2.1 *vs*. 1.3) or final (1.2 *vs*. 1.5) DET scores in the TDI and CDI groups, respectively.

When comparing changes in peristomal skin complications among 31 patients who received services from WOC nurses in ambulatory care (Table IV), we observed a significant

Table II. *Operative and postoperative results of the initial anterior resection.*

	TDI group (N=47)	CDI group (N=27)	*p*-Value
Operation time (min)*	334.2±78.0	340.1±95.9	0.772
Blood loss (ml)*	30.3±75.9	117.0±162.6	0.014
Hospital stay (days)*	15.9±10.3	19.6±10.1	0.141
Mortality, n	0	0	1.000
Morbidity within 30 days, n (%)	14 (30%)	12 (44.4%)	0.218
Wound infection	1 (2%)	3 (11.1%)	0.135
Abscess	3 (6%)	1 (3.7%)	1.000
Anastomotic leakage	3 (6%)	3 (11.1%)	0.662
Bowel obstruction	1 (2%)	2 (7.4%)	0.550
Stomal outlet obstruction	6 (13%)	4 (14.8%)	1.000
Ostomy complications			
Stomal prolapse, n (%)	1 (2%)	1 (4%)	1.000
Peristomal dermatitis			
First DET score*	2.1±2.5	1.3±2.1	0.183
Final DET score*	1.2±1.9	1.5±2.3	0.541

*Mean±SD. TDI: Transumbilical defunctioning ileostomy, CDI: Conventional defunctioning ileostomy, DET: Discoloration, erosion, and tissue overgrowth.

Table III. *Operative and postoperative results of stomal closure.*

	TDI group (N=41)	CDI group (N=22)	*p*-Value
Operation time (min)*	108.2±28.6	92.1±35.8	0.057
Blood loss (ml)*	17.7±46.4	27.7±44.0	0.410
Hospital stay (days)*	10.6±5.2	11.3±4.6	0.580
Mortality, n	0	0	1.000
Morbidity within 30 days, n (%)	3 (7%)	10 (45%)	0.001
Wound infection	2 (5%)	8 (36%)	0.002
Bowel obstruction	0 (0%)	3 (14%)	0.039
CD colitis	1 (2%)	0 (0%)	1.000
Incisional hernia at stomal site	1 (2%)	1 (5%)	0.521
Interval between initial and second operation (days)*	153.6±127.8	183.0±97.2	0.084
Patients who required adjuvant chemotherapy, n (%)	17 (41%)	11 (50%)	0.805

*Mean±SD. TDI: Transumbilical defunctioning ileostomy, CDI: Conventional defunctioning ileostomy, CD: *Clostridium difficile*.

Table IV. *Discoloration, erosion, and tissue overgrowth (DET) scores pre- and post-ostomy care by wound, ostomy, and continence nurses.*

	DET score*		*p*-Value
	Before ostomy care	After ostomy care	
TDI group (N=21)	2.7±2.6	0.9±1.4	0.018
CDI group (N=10)	2.0±2.7	2.6±2.8	0.560
Overall (N=31)	2.5±2.6	1.4±2.1	0.088

*Mean±SD. TDI: Transumbilical defunctioning ileostomy, CDI: Conventional defunctioning ileostomy.

improvement in DET scores in the TDI group (p=0.018), while no improvement was seen in the CDI group (p=0.560).

Discussion

Tumor sizes were smaller in the TDI group, which was presumably due to selection of CDI for patients with larger tumors. The CDI group had more intraoperative blood loss during the initial surgery, probably also due to the CDI group having larger tumors and also because CDI requires additional incisions through the *rectus abdominis* muscle. No differences were observed in complications due to the initial surgeries.

We classified bowel obstruction and stomal outlet obstruction separately because of the difference in the mechanism causing the obstructions. Stomal outlet obstructions were the most common complication in the initial surgeries, occurring at a frequency of at least 10% in both groups, with no significant difference. Stomal outlet obstructions occurred 3-6 days after surgery, and symptoms were relieved after the pressure was reduced by passing a nasogastric tube through the stoma for approximately 1 week. The obstructions did not recur after the patients began to eat and their stool solidified. Initially, stenosis of the fascia at the stomal outlet was suspected as the cause. However, manual examination did not reveal stenosis. In all cases, the condition improved with no need for dilation or surgery. Law *et al.* reported that intestinal obstruction and ileus are more common with loop ileostomy than with loop colostomy (15). It has also been reported that the risk of obstruction is higher when loop ileostomy is created with rotation (16). In the present study, rotation was carefully avoided when creating the loop ileostomy. We postulated that after creating the ileostomy, the weight of a large amount of watery stool can sometimes cause the small intestine to sink into the pelvis, leading to traction on the small intestine and obstruction.

Significant differences between the groups were not observed for either the initial or final DET scores. However, the higher mean initial DET score in the TDI group indicates a higher rate of peristomal skin complications at the umbilicus compared to conventional stoma sites. Initially, we did not trim the skin when creating the TDI. However, excess skin at the umbilicus caused wrinkles to form around the stoma, contributing to peristomal skin complications. After we began trimming the skin at the umbilicus to create a smooth and oval shape, peristomal skin complications decreased (Figure 1a). For all cases in the TDI group, we used a pouching system with an attached band, and used

paste to create a donut-shaped raised area around the entire stoma. These modifications facilitated stomal care for most patients in the TDI group. In fact, the mean final DET score improved to below the initial DET score of the TDI group and below the final DET scores of the CDI group. As to the significance of WOC nurses' services in ambulatory care, the improved DET scores in the TDI group suggest that stoma management by WOC nurses plays a major role in care TDI. On the other hand, there was a lack of improvement in DET scores in the CDI group. CDIs are created in areas of the body that are suitable for stomas. Therefore, peristomal skin complications are generally not caused by problems with the site, but by factors such as the shape and height of the stoma. Thus, care by WOC nurses or modifications to the pouching system is unlikely to result in improvement.

If TDIs are used for long periods, there is likely to be a greater risk of late stomal complications, such as stomal prolapse and parastomal hernia. In the present study, 17 out of the 47 patients in the TDI group required adjuvant chemotherapy, which was not interrupted because of stomal complications due to TDI in any of our cases. This suggests that TDI is a sufficiently practical diverting ileostomy for rectal cancer that could become an alternative to CDI.

The observed trend of a longer operative time for stomal closure in the TDI group is likely because of the extra time needed for umbilicoplasty by plastic surgeons. However, our method of umbilicoplasty is simple and can be performed by colorectal surgeons, which can shorten the operative time.

Regarding surgical complications, the TDI group experienced fewer wound infections and bowel obstructions than the CDI group. Terudermis artificial dermis, a sponge-like material that easily drains exudates from a wound, was used instead of skin closure beginning with the 15th TDI patient with the aim of reducing wound infections. As for incisional hernias at the stoma site in each group, a larger number of cases need to be evaluated in order to determine whether there are differences in the incidence of incisional hernia after stomal closures between TDI, which requires a single incision, and CDI, which requires two incisions.

Historically, the first case of umbilical colostomy was reported in 1750 (17). Raza *et al*. (18) reviewed 101 cases of umbilical colostomy and found no complications of peristomal hernia or prolapse with umbilical stomas, concluding that it was superior to conventional left-lower-quadrant colostomy. The location of the stoma at the belt line was mentioned as a potential problem. Thorlakson *et al*. reported on umbilical colostomy for abdominal perineal resection, and found that umbilical colostomy is suitable for obese patients and those with poor eyesight or arthritic hands because conventional left-lower-quadrant colostomy can be difficult to examine or care for in such patients (19). However, umbilical colostomy has not been widely accepted, presumably because of problems that arise over the long term, such as late stomal or peristomal complications. Nowadays, reports of permanent umbilical colostomies are rarely seen.

The results of the present study indicate the following: Firstly, although the umbilicus may not be as ideal as conventional stoma sites, peristomal skin complications of TDI can be managed satisfactorily by WOC nurses. The results of the current study show that TDI is acceptable as long as it is temporary. Moreover, in the present study, TDI was superior to CDI in terms of creating fewer wounds, avoiding injury to the *rectus abdominis* muscle, fewer surgical complications, and superior cosmesis. However, TDI may have a greater tendency toward stomal prolapse or parastomal hernia compared to CDI over the long term, because TDI is not created through the muscle. Moreover, stoma management of TDI is more complex than that of CDI. Considering these factors, we recommend against TDI as a permanent stoma. Furthermore, some stomas cannot be closed after low anterior resection for complications at the anastomosis site or severe anal dysfunction, and as many as 18.7% of stomas that are intended to be temporary become permanent (20). Thus, TDI is not recommended for patients who have a high risk of their stomas becoming permanent, elderly patients, or patients who cannot handle complex stomal management on their own.

In conclusion, TDI appears to be associated with better results and fewer surgical complications than CDI in laparoscopic anterior resection for rectal cancer. However, it is not recommended as a permanent solution, particularly in patients in whom complications are likely or who are unable manage the stoma independently.

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