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Comparison of Defecatory Function After Colonic J-Pouch Anastomosis and Straight Anastomosis for Stapled Low Anterior Resection: Results of a Prospective Randomized Trial

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Abstract

Purpose. Although defecatory function after low anterior resection for rectal cancer is reported to be better following colonic J-pouch than straight anastomosis, few prospective randomized trials comparing the two forms of anastomosis have been reported. We performed a prospective randomized trial comparing straight anastomosis with colonic J-pouch anastomosis both clinically and physiologically in patients undergoing stapled low colorectal anastomosis.

Methods. A total of 42 consecutive patients were intraoperatively randomized to undergo either straight anastomosis or colonic J-pouch anastomosis. Clinical defecatory function was evaluated by a questionnaire answered preoperatively, then 6 and 12 months postoperatively. Anorectal physiological assessment was also carried out before surgery, then 12 months postoperatively.

Results. The clinical defecatory function assessed 6 months and 12 months after surgery did not differ between the two groups. However, while the length of high-pressure zone was significantly shortened, and (neo)rectal capacity was significantly reduced postoperatively in the straight group, none of these physiological parameters were significantly altered in the pouch group.

Conclusion. Although the aim of colonic J-pouch to preserve reservoir function was physiologically achieved, the improvement in clinical defecatory function was not significant. Thus, further prospective studies are needed to confirm the functional superiority of colonic J-pouch anastomosis for stapled low colorectal anastomosis after low anterior resection.

Key words Low anterior resection · Stapled anastomosis · Colonic J-pouch · Defecatory function · Anorectal physiology

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Introduction

Since its introduction in 1986 by Lazorthes et al.[1] and Parc et al.,[2] it has been thought that colonic J-pouch anastomosis is a better alternative to traditional straight anastomosis after low anterior resection (LAR) of the rectum. Previous studies have demonstrated better defecatory function and less frequent anastomotic complications in patients with a colonic J-pouch anastomosis than in those with a straight anastomosis.[3–13]

We started to perform colonic J-pouch anastomosis after LAR in 1994, and our early results appeared promising in most patients, including those who underwent hand-sewn coloanal anastomosis. However, some of these patients still suffered from impaired defecatory function. Furthermore, postoperative defecatory function after straight anastomosis was not only acceptable in certain patients, but it was also predictable to some extent from preoperative anorectal physiological examinations.[14]

To date, five randomized trials comparing straight and colonic J-pouch anastomosis have concluded that colonic J-pouch anastomosis provides superior function.[4–6,8,9] In one study, the operations were performed by different surgeons from four centers.[6] In another study, patients were part of a multicenter trial,[6,8] and in yet another study,[9] some patients underwent hand-sewn, while others underwent stapled, coloanal anastomosis. Therefore, differences in techniques may have biased the results. The number of prospective studies supporting the superiority of colonic J-pouch anastomosis over straight anastomosis is still too limited to draw definite conclusions. In the present study, we report the results of our prospective randomized trial comparing straight and colonic J-pouch anastomosis, clinically and physiologically, in patients undergoing low anterior resection and low colorectal anastomosis using the double stapling technique (DST).

Patients and Methods

Between January 1995 and December 1998, a total of 42 consecutive patients with middle or low rectal cancer were enrolled in the study. All the operations were performed by the same surgeon and each patient was intraoperatively assigned to undergo either straight or colonic J-pouch anastomosis when the DST was possible. Nurses who were unaware of the ongoing operations opened a sealed envelope containing the choice of anastomosis to be performed. Twenty-one patients were in each arm of the study. None of the patients were given pre- or postoperative radiotherapy.

Operative Technique

After the origin of the inferior mesenteric artery (IMA) had been identified, the surrounding lymph nodes were dissected en bloc with the superior rectal lymph nodes along the superior rectal vessels, so that the IMA was denuded up to the root of the left colic artery. The IMA was divided just distal to the root of the left colic artery. Almost the entire length of the sigmoid colon was preserved and used as the neorectum, without mobilizing the splenic flexure. The rectum was posteriorly mobilized down to the level of anorectal junction, with total mesorectal excision being carried out. The lateral sides of the rectum were dissected at the inner layer of the pelvic nerve plexuses, which were totally preserved unless the tumor directly invaded the nerves. After the rectum had been completely mobilized, the lower rectum or anal canal was closed using a TL 30 linear stapler (Ethicon, Somerville, NJ, USA), and the rectum was transected. When macroscopic examination of the resected specimens revealed that the tumor penetrated the proper muscle, bilateral dissection of the lateral lymph nodes was carried out with preservation of the pelvic nerve plexuses.[15] In the pouch group, a colonic J-pouch, 80 mm in length, was constructed using the sigmoid colon with single use of the GIA 80 mm stapler (U.S. Surgical, Norwalk, CT, USA). Low colorectal anastomosis was carried out using the PCEEA #31 (U.S. Surgical) in both groups. In 14 patients, a diverting colostomy was fashioned in the proximal transverse colon and closed 3 months after LAR. In the straight group, a diverting colostomy was created only when an air leak from the anastomosis was found. In contrast, in the pouch group, a diverting colostomy was preferably used when the anastomosis was located at or below the anorectal junction. Thus, 2 patients in the straight group and 12 in the pouch group had a diverting colostomy.

Clinical Assessment

Tumor height was measured as the distance between the lower edge of the tumor and the anal margin, by preoperative digital examination and rigid proctoscopy. Anastomotic height was determined using the same diagnostic maneuvers as the distance between the anastomosis and the anal margin, 6 months after the operation.

A questionnaire about defecatory function was completed by patients, with minimum aid by medical staff, before surgery, then 6 and 12 months after surgery, and following colostomy closure in patients who had a diverting colostomy. The questionnaire asked patients to quantify the frequency of bowel movements, the frequency of fecal incontinence, the use of pads, and the duration that patients could defer defecation. Patients who could not defer defecation for 10 min or longer were determined to have defecatory urgency. The questionnaire also asked about symptoms suggesting incomplete evacuation, such as the need for laxatives, the duration patients usually spent on a single evacuation, the feeling of residual stool after evacuation, and the need for an enema, suppository, or catheter for evacuation. However, these symptoms were not analyzed before the operation since some patients had bulky tumors that made defecation difficult. Postoperatively, patients were asked to subjectively grade their defecatory function as good, fair, or poor.

Anorectal Physiological Assessment

An anorectal physiological study was carried out as previously reported[14,16] before surgery and 12 months postoperatively. The maximum resting pressure (MRP), maximum squeeze pressure (MSP), length of the high-pressure zone (HPZ), (neo)rectal sensory threshold (Thre), maximum tolerable volume of the (neo)rectum (MTV), and the threshold of anal mucosal electrosensitivity (T-AMES) 2 cm from the anal margin were recorded.

Ethical Compliance

The study protocol was approved by the institutional review board. Both forms of anastomosis were fully explained to the patients before the operation, and written informed consent was obtained from all patients.

Statistical Analysis

Comparisons of clinical symptoms, apart from daily bowel frequency, were based on the severity of each symptom, which was scored as 0 (poor), 1 (fair), or 2 (good) according to the criteria shown in Table 1. Numerical variables were compared between the groups using the Mann-Whitney *U*-test. Categorical variables were compared between the groups using the chi-squared test or Fisher's exact probability test. Correlations between two numerical variables were examined by the Spearman rank correlation. The significance of

Table 1. Scoring system to evaluate the severity of impaired defecatory function

	Score		
	0	1	2
Fecal incontinence (/week)	≥2	<2–0	Never
Use of pads	Always	Occasionally	Never
Duration for which patients could defer defecation (min)	<10	≥10–30	≥30
Need for laxatives	Always	Occasionally	Never
Feeling of residual stool after evacuation	Always	Occasionally	Never
Time spent on a single evacuation (min)	>30	10–30	<10
Need for enema, suppository, or catheter for evacuation	Always	Occasionally	Never
Patients' subjective evaluation of defecatory function	Poor	Fair	Good

Table 2. Comparison of clinical backgrounds

	Straight	Pouch	*P*
n	21	20	
Age (years)[a]	59 (42–80)	61 (47–79)	0.389
Sex (M:F)[b]	8:13	8:12	0.901
Tumor height from the anal margin (cm)[a]	6.0 (3.0–8.0)	6.5 (3.0–8.0)	0.803
Anastomotic height from the anal margin (cm)[a]	5.0 (2.5–6.0)	5.0 (3.0–6.0)	0.738
Dukes A:B:C[b]	6:4:11	4:5:11	0.783
Diverting stoma (used:not used)[b]	2:19	12:8	0.002

[a] Values represent medians with ranges in parentheses. Statistical analyses were carried out using the Mann-Whitney *U*-test
[b] Values represent the number of patients. Statistical analyses were carried out using the chi-squared test

Table 3. Comparison of preoperative defecatory function

	Straight	Pouch	*P*
n	21	20	
Bowel frequency (/day)[a]	2.0 (0.1–12)	2.0 (0.3–8.5)	0.934
Fecal incontinence (≥2/week:2–0/week:never)[b]	0:4:17	0:2:18	0.418
Use of pad (always:occasionally:never)[b]	1:0:20	1:0:19	0.971
Duration for which patients could defer defecation (<10:10–30:>30 min)[b]	3:6:12	4:4:12	1.000

[a] Values represent medians with ranges in parentheses. Statistical analyses were carried out using the Mann-Whitney *U*-test
[b] Values represent the number of patients. Statistical analyses were carried out using the Mann-Whitney *U*-test on the scores for the severity of symptoms shown in Table 1

postoperative changes in physiological parameters was examined using the Wilcoxon signed rank test. *P* values of less than 0.05 were considered statistically significant.

Results

Clinical Background

Age, gender, tumor height, anastomotic height, and Dukes' classification did not differ significantly between the two groups (Table 2).

Preoperative Defecatory Function

Daily bowel frequency, the frequency of fecal incontinence, the use of pads, and the duration that patients could defer defecation did not differ between the two groups (Table 3).

Operative Morbidity

There were no operative deaths. None of the 42 patients in the present study had an anastomotic leakage. One patient in the pouch group was found to have a small

bowel obstruction which was treated conservatively, and two patients in the pouch group had minor wound infections. One patient in the pouch group who suffered acute renal failure requiring hemodialysis was excluded from the functional assessment because stoma closure was delayed until 12 months after LAR. No other significant operative morbidity was encountered in either group.

Short-Term Oncological Results

Local recurrence was found in one patient from the straight group 9 months after surgery, and one patient from the pouch group was found to have peritoneal dissemination of disease 8 months postoperatively. These two patients were excluded from the 12-month postoperative analysis. No other clinically confirmed recurrence was detected within the first 12 months after surgery.

Postoperative Defecatory Function

The symptoms of impaired defecatory function did not significantly differ between the two groups 6 or 12 months postoperatively (Table 4). None of the patients needed an enema, suppository, or catheter for evacuation 6 or 12 months after their operation. The patients' subjective evaluation of defecatory function did not differ between the two groups.

Preoperative and Postoperative Physiological Parameters

The preoperative values of MRP, MSP, HPZ, Thre, MTV and T-AMES were similar in the two groups. Postoperatively, no significant differences in physiological parameters were found between the groups, although MTV and T-AMES were marginally higher in the pouch group than in the straight group. Regarding the changes in physiological parameters, HPZ was significantly shortened, and Thre and MTV were significantly decreased after the operation in the straight group, whereas MSP was significantly increased after the operation in the pouch group (Table 5).

Influence of Diverting Colostomy on Postoperative Defecatory Function and Physiological Parameters in the Pouch Group

In the pouch group, the anastomotic height was significantly lower in patients with a diverting colostomy than in those without (median (range): 4.0 (3–6) cm in pa-

Table 4. Comparison of defecatory function 6 and 12 months after surgery

	Straight	Pouch	*P*
Six months after surgery			
n	21	20	
Bowel frequency (/day)[a]	4.0 (0.5–7.5)	3.0 (0.4–10)	0.218
Fecal incontinence (≥2/week : 2–0/week : never)[b]	2 : 10 : 9	0 : 9 : 11	0.310
Use of pad (always : occasionally : never)[b]	5 : 2 : 14	1 : 4 : 15	0.388
Duration patients could defer defecation (<10 : 10–30 : >30 min)[b]	9 : 6 : 6	9 : 6 : 5	0.834
Need for laxatives (always : occasionally : never)[b]	4 : 2 : 15	3 : 3 : 14	1.000
Feeling of residual stool after evacuation (always : occasionally : never)[b]	4 : 11 : 6	8 : 7 : 5	0.295
Time spent on a single evacuation (>30 : 10–30 : <10 min)[b]	1 : 3 : 17	1 : 3 : 16	0.940
Need for enema, suppository or catheter for evacuation (always : occasionally : never)[b]	0 : 0 : 21	0 : 0 : 20	1.000
Patients' subjective evaluation of defecatory function (poor : fair : good)[b]	11 : 4 : 6	11 : 7 : 2	0.517
Twelve months after surgery			
n	20	19	
Bowel frequency (/day)[a]	3.0 (1–6)	2.5 (0.5–10)	0.165
Fecal incontinence (≥2/week : 2–0/week : never)[b]	1 : 9 : 10	0 : 11 : 8	0.761
Use of pad (always : occasionally : never)[b]	3 : 3 : 14	1 : 2 : 16	0.277
Duration patients could defer defecation (<10 : 10–30 : >30 min)[b]	7 : 6 : 7	8 : 5 : 6	0.698
Need for laxatives (always : occasionally : never)[b]	3 : 4 : 13	3 : 2 : 14	0.641
Feeling of residual stool after evacuation (always : occasionally : never)[b]	2 : 13 : 5	4 : 12 : 3	0.299
Time spent on a single evacuation (>30 : 10–30 : <10 min)[b]	1 : 3 : 16	1 : 3 : 15	0.936
Need for enema, suppository or catheter for evacuation (always : occasionally : never)[b]	0 : 0 : 20	0 : 0 : 19	1.000
Patients' subjective evaluation of defecatory function (poor : fair : good)[b]	8 : 4 : 8	5 : 9 : 5	1.000

[a] Values represent medians with ranges in parentheses. Statistical analyses were carried out using the Mann-Whitney *U*-test
[b] Values represent the number of patients. Statistical analyses were carried out using the Mann-Whitney *U*-test on the scores for the severity of symptoms shown in Table 1

Table 5. Comparison of physiological parameters before and 12 months after surgery

	Straight	Pouch	*P*
Before surgery			
n	21	20	
MRP (mmHg)	60 (44–89)	60 (40–80)	0.824
MSP (mmHg)	250 (145–280)	170 (120–255)	0.210
HPZ (cm)	3.5 (3.0–4.0)	3.5 (3.0–4.0)	0.582
Thre (ml of air)	55 (40–86)	63 (43–80)	0.865
MTV (ml of air)	150 (99–249)	145 (108–190)	0.434
T-AMES (mA)	5.5 (3.7–7.3)	5.3 (4.3–7.8)	0.969
Twelve months after surgery			
n	19	18	
MRP (mmHg)	48 (35–80)	58 (40–80)	0.330
MSP (mmHg)	240 (135–288)	220 (120–280)*	0.831
HPZ (cm)	3.0 (3.0–3.5)*	3.5 (3.0–4.0)	0.373
Thre (ml of air)	40 (30–50)*	50 (35–65)	0.246
MTV (ml of air)	100 (81–130)†	140 (100–170)	0.065
T-AMES (mA)	5.5 (3.9–7.0)	7.3 (5.0–8.0)	0.072

Values represent medians with interquartile ranges in parentheses
MRP, maximum resting pressure; MSP, maximum squeeze pressure; HPZ, the length of high-pressure zone; Thre, rectal or neorectal sensory threshold; MTV, maximum tolerable volume of the rectum or neorectum; T-AMES, threshold of anal mucosal electrosensitivity at 2 cm from the anal margin
* $P < 0.05$ vs preoperative values, † $P < 0.01$ vs preoperative values

tients with a colostomy versus 5.5 (3.5–6) cm in those without, $P = 0.032$). However, there was no significant difference in the symptoms of impaired defecatory function or in the patients' subjective evaluation of defecatory function 6 or 12 months after surgery between patients with a diverting colostomy and those without. The physiological parameters before and after surgery did not differ according to the use of a diverting colostomy, except for a relatively low MSP in patients with a diverting colostomy (median (range): 170 (116–245) mmHg in patients with a colostomy versus 275 (270–300) mmHg in those without a colostomy, $P = 0.034$). Although the postoperative MSP significantly increased in patients without a diverting colostomy, none of the other changes in physiological parameters were significant in the patients with a diverting colostomy or those without.

Discussion

This randomized trial did not reveal any significant differences in defecatory function 6 or 12 months after LAR between patients given straight anastomosis and those given colonic J-pouch anastomosis. Therefore, our results did not confirm a superiority of colonic J-pouch anastomosis over straight anastomosis, as reported by previous studies.[3–13]

The clinical defecatory function of the patients in the pouch group 12 months postoperatively in the present study was similar to that found in the previous studies.[3–8,11,13] The median frequency of defecation was 2.5 times daily, and no patient reported suffering major fecal incontinence such as total inability to control bowel movement, although minor fecal incontinence, defined as spotting twice or less in 1 month, occurred in more than 50% of the patients. While the incidence of defecatory urgency was slightly higher than that reported by previous studies,[5,6,9,11] it was similar to that described by Ortiz et al.[3] and Wang et al.[7] Moreover, no severe evacuation difficulty requiring enema or suppository for evacuation was reported by any patient. Therefore, the equality in postoperative defecatory function between the patients given straight anastomosis and those given colonic J-pouch anastomosis was not because defecatory function after colonic J-pouch anastomosis was worse in the present study than in previous studies.

On the other hand, the defecatory function 12 months after straight anastomosis was slightly better in the present study than in previous studies.[3,5–7,9,11] A median frequency of defecation of three times daily was less than that reported by any previous studies. Moreover, perfect continence in 45% of patients was better than that reported by Joo et al.,[11] while urgency in 35% of patients was equal to or better than that found in previous studies.[3,5–7,11] We assume that postoperative defecatory function in the present study was similar in the two groups because defecatory function after straight anastomosis was acceptable.

In the present study, the more frequent use of diverting colostomy in the pouch group than in the straight

group might have biased the results because the time between LAR and postoperative examinations was longer in patients who had a diverting colostomy than in those who did not. However, among the patients in the pouch group, both defecatory function and the patients' subjective evaluation of defecatory function 6 and 12 months after the operation were similar in patients with a diverting colostomy and those without. Furthermore, none of the postoperative physiological parameters except for MSP differed according to whether or not a diverting colostomy was employed.

The incidence of anastomotic complications has been reported to be higher after straight anastomosis than after colonic J-pouch anastomosis.[6,17] Hallböök et al. reported that anastomotic leakage was associated with poor postoperative defecatory function,[18] and also reported better blood supply to the colonic J-pouch anastomosis than to the straight anastomosis.[19] This suggests that a relatively good blood supply after colonic J-pouch anastomosis might have resulted in their low incidence of anastomotic complications and good defecatory function.[8]

In the present study, we preserved the left colic artery to optimize the blood supply to the anastomosis in all the patients.[20] The use of the sigmoid colon as the neorectum after LAR is not generally recommended because the sigmoid colon is frequently compromised with diverticular disease;[21] however, we preserved the entire length of the sigmoid colon and used the neorectum to avoid tension on the anastomosis because the sigmoid colon of Japanese patients rarely has extensive diverticular disease.[22,23] These surgical procedures might have contributed not only to the low incidence of anastomotic leakage,[24–26] but also to the acceptable defecatory function after straight anastomosis.

In our analysis of the physiological parameters, postoperative decreases in Thre and MTV were seen in the straight group, but not in the pouch group. Therefore, the purpose of colonic J-pouch anastomosis in preserving reservoir function was achieved, but this preserved reservoir function did not contribute to a significant improvement in overall postoperative defecatory function.

Since the colonic J-pouch is constructed from two colonic limbs having peristalsis in opposite directions, the motility of the colonic J-pouch may have differed fundamentally from that of the colonic segment in the straight group. Stool retention in the neorectum is more likely to occur in the pouch group, which may result in not only evacuation difficulty but also a deterioration in overall defecatory function. Indeed, colonic J-pouch anastomosis has been reported to be associated with a risk of evacuation difficulty in the long term.[27–30] We previously reported that postoperative defecatory function after stapled straight anastomosis was predictable using preoperative physiological parameters.[14] Therefore, if a patient who was predicted to have acceptable defecatory function after straight anastomosis underwent pouch surgery, evacuation difficulty in the long-term follow-up would be more serious than the functional benefit in the early postoperative period.

Although our results did not confirm the functional benefit of a colonic J-pouch for stapled low colorectal anastomosis, we do not deny the usefulness of this technique. However, the functional benefit of colonic J-pouch anastomosis may be greater in patients undergoing hand-sewn coloanal anastomosis, the level of which is lower than that of a stapled low colorectal anastomosis. Ikeuchi et al.[31] reported that the postoperative defecatory function after hand-sewn colonic J-pouch anal anastomosis was similar to that after stapled straight low colorectal anastomosis, while Hida et al.[10] found that colonic J-pouch anastomosis had greater functional benefit in patients with an anastomosis 1–4 cm from the anal margin than in those with an anastomosis 5–8 cm from the anal margin.

In conclusion, the findings of our randomized trial suggest that the functional benefit of colonic J-pouch anastomosis is limited in patients undergoing stapled low colorectal anastomosis.

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