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Postoperative Defecatory Function of an Ileal Pouch–Anal Anastomosis After a Restorative Proctocolectomy for Ulcerative Colitis: Evaluation Using Fecoflowmetry

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An ileal pouch is usually reconstructed as an alternative to a neorectum after a total proctocolectomy for ulcerative colitis (UC). However, the real defecatory function of an ileal pouch is uncertain. This study was designed to analyze the functional and clinical outcomes after a proctocolectomy and ileal pouch–anal anastomosis (IPAA) for UC using fecoflowmetry (FFM). Sixteen patients who underwent IPAA for UC between 1990 and 2005 were studied. They were evaluated by FFM, together with Kelly's clinical score (KCS), and anorectal manometric assessments were also performed. FFM showed that the fecoflow pattern (FFP) of 14 patients (87%) was the block type and of 2 patients (13%) was the segmental type. The clinical score and tolerance volume showed no improvement 1 year or more after IPAA. However, the value of the maximum fecal stream flow rate (Fmax) improved with time. FFM shows that the defecatory function improved after IPAA, and it may therefore contribute to a good long-term outcome after the surgery.

Key words: Fecoflowmetry – Ulcerative colitis – Proctocolectomy – Ileal pouch–anal anastomosis – Defecatory function

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A total proctocolectomy is performed for refractory ulcerative colitis (UC) patients to prevent the possibility of recurrence by leaving the inflamed mucosa.[1–4] The rectum is thought to play an important role in reserving stool, therefore a total proctocolectomy and ileo-anal anastomosis usually leads to frequent bowel movements. An ileal pouch is likely to be constructed in most cases to minimize this complaint.[5,6] There are many reports on clinical defecatory function, bowel movement, and quality of life (QOL) after ileal pouch–anal anastomosis (IPAA) for UC. However, few studies so far have analyzed the objective defecatory function after IPAA. Defecation is the sum of the functions of all the mechanisms of anorectal evacuation, but conventional functional evaluations do not necessarily provide a good correlation between the investigative results and the symptoms. Yagi *et al* introduced fecoflowmetry (FFM) to carry out a dynamic study of the anorectal motor activity, simulating natural anorectal evacuation in children,[7,8] and FFM is valuable for evaluating defecatory function even in adult patients after an ultra-low anterior resection for rectal cancer.[9] The aim of this study was to analyze the functional and clinical outcomes after IPAA using FFM, manometry, and the clinical score; and to clarify whether FFM positively contributes to the evaluation of the defecatory function and physiology after IPAA for UC.

Patients and Methods

Between April 1990 and July 2005, 36 UC patients underwent IPAA in the Department of Digestive and General Surgery, Niigata University, Graduate School of Medical and Dental Sciences; among them, 16 patients consented to participate in this trial. The mean age was 49.4 years (range, 25–72 years), and 12 patients were male. One patient had undergone a previous procedure for prolapse and hemorrhoids, but the other patients had no particular procedures before the IPAA. Before the operation, 11 patients were total colitis type, 3 were left-sided colitis type, and 2 had toxic mega colon. All were reconstructed with a W-shaped ileal pouch. The ileal W-pouch was adopted among several types of reservoirs for UC patients in 1984, because a large and wide reservoir might allow better defecatory function.[10] Some key aspects of the surgical procedure are as follows: (1) two or three separate staged operations, (2) a distal rectal mucosectomy and hand-sewn ileo-anal anastomosis, (3) and a short muscular cuff. A staged operation with a diverting ileostomy helps to decrease the risk of pelvic infection. The total removal of the rectal mucosa reduces the risk of recurrence, and the short muscular cuff shortens the operating time and decreases the bleeding.

Table 1 Kelly's clinical score

Kelly's clinical score (KCS)	Points	Assessment
[1] Continence		
(a) Normal	2	
(b) Occasional escape of feces or flatus	1	KCS = [1]+[2]+[3]
(c) No control	0	
[2] Staining		Good: 5–6 points
(a) None	2	Fair: 3–4 points
(b) Occasional stain	1	Poor: 0–2 points
(c) Always stained	0	
[3] Sphincter contraction		
(a) Effective strong squeeze	2	
(b) Weak or partial squeeze	1	
(c) No contraction detectable	0	

Postoperative data were obtained from a retrospective chart review and interview. The patients were questioned according to Kelly's clinical score (KCS) to obtain the functional outcome assessment[11] (Table 1). In addition, anorectal manometric assessments were performed together with FFM at more than 1 year after closure of the diverting ileostomy.

Manometry was performed using a flexible 4-channel, water-perfused, 4.8-mm outer diameter catheter. The four 0.8-mm sensor ports were radially oriented at 90° intervals, and each was perfused with 24 mL/h water with a hydraulic microcapillary constant perfusion pump. The catheters were connected to pressure transducers and, in turn, to a computer interface.

FFM was measured by a scale redesigned uroflowmeter with a maximum fecal flow rate of over 100 mL/s (Sakura Seiki Company, Tokyo, Japan), consisting of a weigh transducer, an amplifier, and a chart recorder. The patients were given a 120-mL 50% glycerin enema to evacuate their bowels prior to the examination. In order to imitate stool, a normal saline enema of 20 mL/kg body weight was instilled at 37°C, under gravity through an 8-French (Fr) catheter, with the patient in the left lateral position, while monitoring the anorectal pressure. The manometric catheter in the pouch was then advanced 10 cm from the anal verge. When the urge to defecate could no longer be suppressed, the patient was placed on the fecoflowmeter in a sitting position and left alone while defecating to minimize any psychologically inhibitive factors. The tolerance rate (TR), the evacuative rate (ER), the maximum fecal stream flow rate (Fmax), and the fecoflow pattern (FFP) were measured by FFM. The

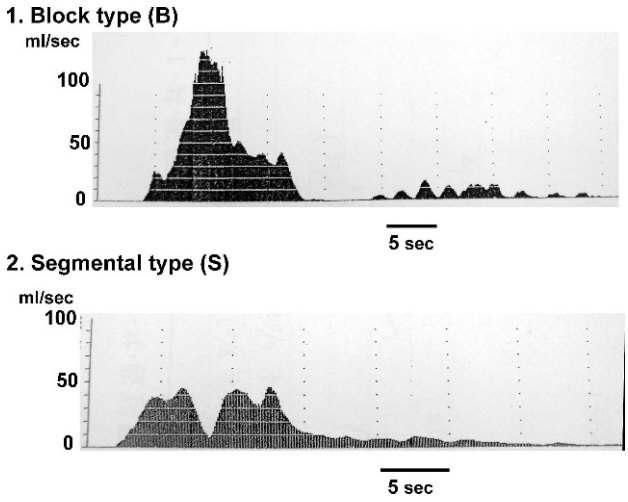

Fig. 1 Fecoflow pattern. The x-axis represents the time (seconds) and the y-axis represents the fecal flow rate (mL/s). Block type: this curve showed a hump shape without segmentation and Fmax was above 45 mL/s. Segmental type: this showed some segmental parts and Fmax was above 15 mL/s. Flat type: Fmax was below 15 mL/s, but there were no cases with flat pattern after IPAA in this study.

parameters for FFM were defined as the tolerance volume (TV), being the intended tolerance volume (mL) of warmed normal saline as the imitation of stool; tolerance rate (TR), being [TV/20 mL/kg × body weight (kg)] × 100%; EV, being the evacuated imitated stool volume (mL) into the fecoflowmeter; ER, being (EV/TV) × 100%; and maximum fecal stream flow rate (Fmax) in mL/s in the fecoflow curve recorded on FFM. There are 3 fecoflow patterns in the postoperative patients with anorectal disease: the block (B) type, segmental (S) type, and flat (F) type; the B-type pattern was seen in the patients classified as ''clinically good.''[8,9]

Conventional manometry was performed before starting FFM. The pouch pressure (PP), anal canal pressure [(AP) = the resting pressure], and anal canal squeezing pressure (ASP) were measured using infused water introduced through the open-tip method at 24 mL/h without sedation. Simultaneously, they were assessed using KCS, and the results were defined as follows: good, 5 to 6 points; fair, 3 to 4 points; poor, 1 to 2 points. Clinically good was defined as a good KCS in this study.

Student t test and the χ^2 test were used where appropriate for the comparison of the clinical and biomechanical parameters. The relationships between the biomechanical markers and clinical scores were analyzed by the Spearman rank correlation test for nonparametric data and by the Pearson method

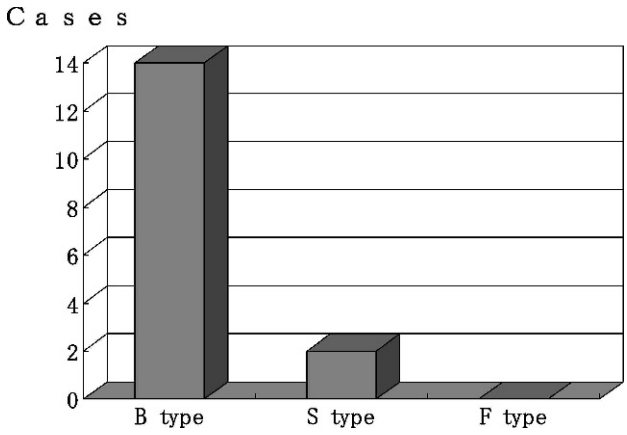

Fig. 2 FFP after IPAA. In 16 patients after IPAA, there were 14 block types (87%), 2 segmental types (13%), and no flat type by FFM.

for parametric data. Differences, and the results of the correlation analysis, were considered to be significant at $P < 0.05$.

Informed consent was obtained from all patients before examination. This study was approved by the ethical committee for human subjects in Niigata University Faculty of Medicine (Approved No. 251).

Results

FFPs of patients after IPAA

FFPs were grossly classified into 2 types: the block (B) type and segmental (S) type (Fig. 1). Fourteen of 16 patients were block types after IPAA (87%); there were 2 segmental types (13%) and no flat types (Fig. 2).

The parameters going up according to postoperative duration

FFM showed that the Fmax improved with time after the surgery: $r = 0.61$, $P = 0.011$ (Fig. 3a). However, the TR and KCS showed no improvement postoperatively: $r = 0.13$, $P = 0.63$ (Fig. 3b) and $r = -0.42$, $P = 0.11$ (Fig. 3c), respectively.

Relationship between Fmax and KCS

Fmax showed no correlation with the KCS ($r = -0.23$, $P = 0.39$; Fig. 4).

Discussion

Restoration of the intestinal continuity with IPAA is a well-established procedure used to treat UC

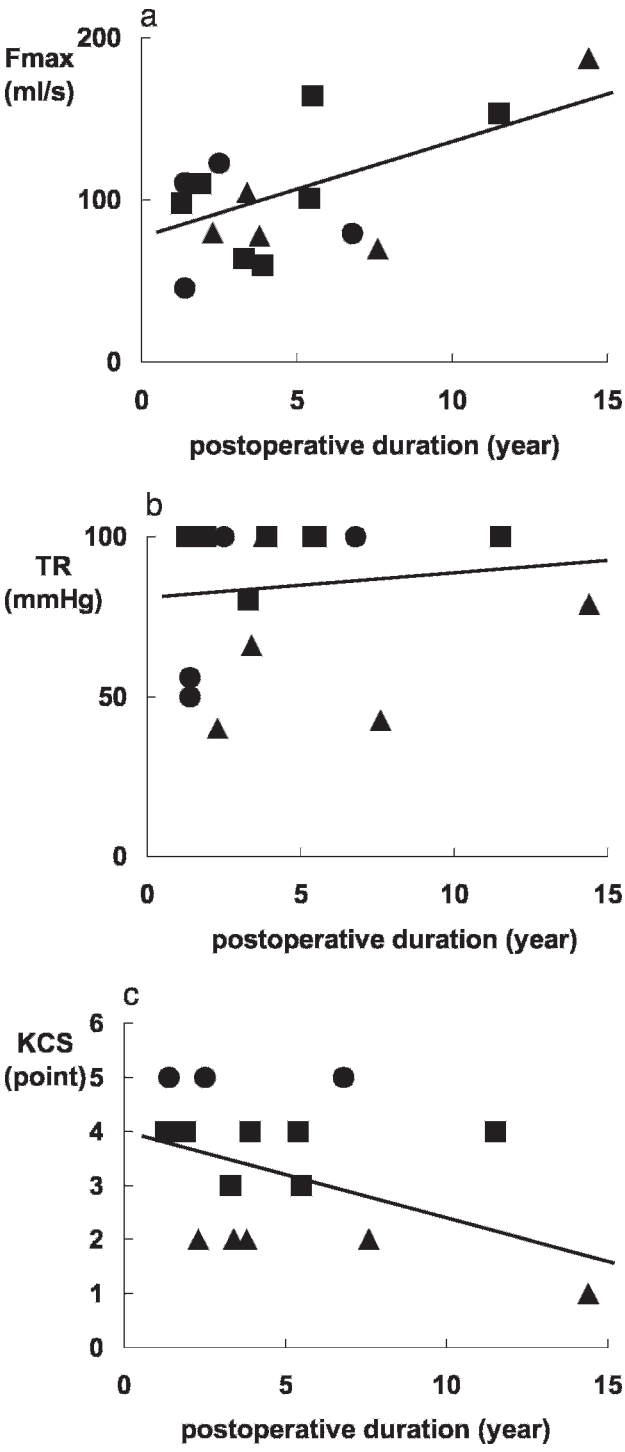

Fig. 3 (a) Relationship between the postoperative duration and Fmax. There was a close relationship between the postoperative duration and Fmax ($r = 0.61$, $P = 0.01$). (b) Relationship between the postoperative duration and TR. No particular relationship was observed between the postoperative duration and TR ($r = 0.13$, $P = 0.63$). (c) Relationship between the postoperative duration and KCS. KCS unexpectedly did not correlate with the postoperative duration ($r = -0.42$, $P = 0.11$). • Good, ■ Fair, ▲ Poor.

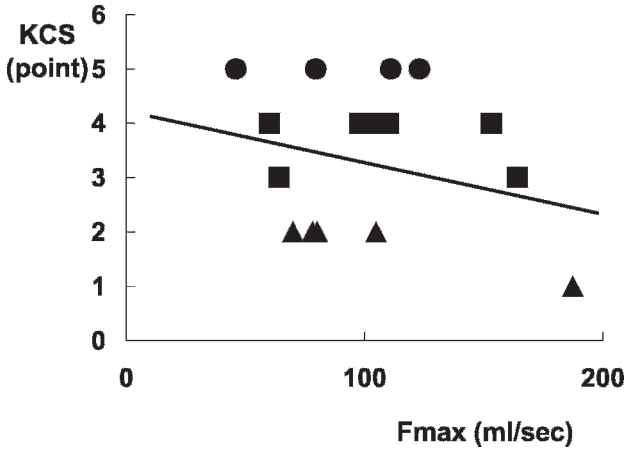

Fig. 4 Relationship between Fmax and KCS. KCS did not demonstrate any relationship with Fmax ($r = -23$, $P = 0.39$).

patients in need of surgical treatment, but a few patients often complain about functional disorders and inconvenience in postoperative stool evacuation after a proctocolectomy with IPAA.[12] They indicate decreased continence for gas and liquid stool and a high stool frequency. There is also an increase in stool urge and clustering, and patients often complain about a feeling of incomplete evacuation.[6,13–15] The problem is that it is difficult to evaluate these functional differences accurately and objectively. There are several examinations for anorectal function such as the clinical score, manometry, barium enema, electromyography, evoked-potentials, etc. However, the accuracy of these examinations is still unclear. Defecography, for example, is also a good technique of evaluation, but it has problems concerning the effects of radiation and cost.

FFM was first introduced by Shafik and Moneim to assess defecation disorders in adults.[16,17] They said that it was a useful method to evaluate the objective defecatory function in adult patients. However, there have only been a few reports so far describing the use of FFM in the pediatric anorectal surgical field.[7,8,18] This study attempted to evaluate the postoperative IPAA motor function using FFM in UC patients after a proctocolectomy.

The KCS was simultaneously adopted in this study for clinical scoring. The KCS includes a factor of anal sphincter contraction. KCS is a simple and effective method for assessing anorectal function in patients after a proctocolectomy. However, it may be somewhat subjective.

FFM simulates the act of defecation and is carried out under conditions as close to natural defecation

as possible. The fecal flow rate is the product of a rectal detrusor action against outlet resistance, including rectal contraction and intra-abdominal pressure. It indicates the defecated volume that passes per second and provides quantitative as well as qualitative data concerning defecation. According to previous reports, there are 3 FFPs, and the typing of FFP is an objective parameter of the anorectal motor function that can be accurately assessed.[7–9] However, there were no cases with a flat pattern after IPAA in this study. Patients with a good KCS usually showed a characteristic block-type flow curve in FFM.[7–9] The flow parameters and curve configuration of the patients with a fair or poor score differed from those with a good KCS. These patients could not retain the full contents in the colorectum. The shape of the curve is as important as the flow rate. The FFP is considered to possibly reflect the motor activity of the pelvic floor muscle from the viewpoint of the quality of the fecal stream. FFM can show the dynamics of defecation by revealing both the flow rate and the evacuation time, which might play a role in both the anal sphincter and lower intestinal motility. It could also provide valuable information for making the diagnosis that is not provided by KCS. An Fmax $>$ 45 mL/s, a TR $>$ 70%, and an ER $>$ 50% is the statistical borderline of fecal continence in adolescent children.[7,8] FFM is a simple, less invasive, and nonradiologic method that might be more informative than other conventional examinations.[8] Endoscopic ultrasound, for instance, might provide data concerning the thickness of the sphincter muscle, but not a functional evaluation.

Various randomized controlled trials have shown that an ileal pouch reconstruction after a proctocolectomy for UC patients is functionally superior to a straight ileo-anal anastomosis.[5,6] Although the preservation of an intact anorectal sphincter makes it possible to achieve continence, the absence of a reservoir for the storage of fecal contents results in frequent loose or watery stools, perianal excoriation, and inflammation at the site of the anastomosis with occasional disruption between the pull-through segment of ileum and the anus.[5] This study attempted to evaluate the functional outcomes of IPAAs using FFM.

This study revealed that defecatory function after an IPAA was good from the viewpoint of FFM, because most FFPs of patients after IPAA were block types and Fmax improved with time after the surgery. Defecatory function usually deteriorates abruptly after a proctectomy, but in most cases, its function gradually improves after the operation. The defecatory function of patients with lower rectal cancer, after a low anterior resection evaluated by FFM, improves over time after the surgery.[9] The results of this study suggest the usefulness of FFM even in UC patients after an IPAA.

Many reports have revealed that the clinical score also improves with time after a low anterior resection for rectal cancer.[19,20] Therefore, UC patients should also show improved defecatory function with time after a proctocolectomy with an IPAA. However, KCS did not improve statistically with time in this study. Many UC patients are relatively young and might be excessively sensitive to a slight inconvenience. In addition, there might be a possibility that even a little soiling would affect or restrict their daily life or work. Moreover, the fact that there is no criterion to compare with their own defecatory function would possibly make them restless and confused with regard to defecation. This might explain why the KCS, which is a somewhat subjective score, did not improve as time passed.

Fmax is correlated with the KCS after a low anterior resection for lower rectal cancer; however, Fmax was not correlated with the KCS after an IPAA in this study. The differences between the subjective and objective defecatory evaluation in UC patients after an IPAA may affect this result. Compared with the previous reports, postoperative defecatory function depends on the ileal motility in this series.[7–9] The majority of colonic contractions are of the segmenting movement that aid in the absorption of the water and electrolytes. The frequency of segmenting contractions is higher in the descending and sigmoid colon than in more orad areas. Aboral movements of contents are slow, usually taking days to pass material through the colon. Most aboral movement takes place during infrequent peristaltic contractions called mass movements. However, movements of contents in the intestinal lumen depend upon the type of contraction. Segmenting contractions cause mixing and local circulation of contents. Peristaltic contractions cause net aboral transit. In the fasting state, intestinal contractions do not occur evenly over time. During postprandial state, most contractions are of the segmenting type, with short peristaltic contractions occurring randomly. In this series, there may always be feces pooling in the ileum, including the W-shaped ileal pouch. From the viewpoint of intestinal motility, postoperative patients tend to suffer from soiling for these reasons, thus they may be underestimated in the clinical scores.

It was remarkable that the TR was over 70% in all cases from the beginning and that there were no flat type cases in this study. This result means that defecatory function after an IPAA is already on a satisfactory level. In addition, the KCS might show improvement with a larger sample size.

On the aspects of rather objective evaluation, FFM presents valuable information. Fmax, which is the most important factor in defecatory function, improves with time after a proctocolectomy with an IPAA in patients with UC. Therefore, although the clinical score might not improve, the real defecatory function is expected to improve over time.

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