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Difference in Recurrence Patterns Between Anastomosis and Strictureplasty After Surgical Treatment for Crohn Disease

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This study aimed to investigate whether the initial indication for surgery or type of surgery (strictureplasty or resection) performed determines recurrence patterns in patients with Crohn disease. Recurrence patterns of 41 patients (31 patients: only resection and anastomosis of the intestine, and 10 patients: strictureplasty with/without resection and anastomosis) who underwent operation for recurrent Crohn disease (June 2002–December 2010) were evaluated. Strictureplasty for nonperforating disease was performed at 17 sites, and reoperation was required at 11 sites (10 sites for nonperforating disease and 1 site for perforating disease). There was a significant difference in the recurrence pattern in patients who underwent resection and anastomosis ($P < 0.01$) and in patients who underwent strictureplasty with resection and anastomosis ($P < 0.05$) between sites at which resection and anastomosis was performed for nonperforating and for perforating disease. Initial indication for surgery, but not the type of surgery, appeared to determine recurrence patterns.

Key words: Crohn disease – Operative procedures – Recurrence

Strictureplasty is performed to preserve the bowel, and the safety and efficacy of this technique for Crohn disease have already been reported.[1–8] The indication for strictureplasty is strictures within areas of diffuse involvement of the disease.[8] Perforating disease or phlegmonous inflammation is generally considered to be a contraindication for this technique.[8] The main concern is that strictureplasty preserves the diseased segment, whereas resection and anastomosis remove the diseased

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segments entirely. Cosnes *et al*[9] investigated the natural course of 2002 patients with Crohn disease and found that the risk of developing perforating disease increases from 20% at 5 years to 70% at 20 years after diagnosis. They suggested that perforating disease is the common conclusion in the natural history of Crohn disease. Therefore, it is possible that the preserved diseased segment after strictureplasty might cause complicated disease when disease recurs. On the contrary, resection of a diseased site might result in recurrence as simple disease. Nonperforating disease is generally considered a good indication for strictureplasty,[8] whereas resection and anastomosis are performed on nonperforating disease and perforating disease. Therefore, it remains possible that differences in the initial indications for surgery, strictureplasty versus resection and anastomosis, might cause differences in recurrence rates between the two techniques. To our knowledge, however, differences in recurrence patterns between resection and strictureplasty have not been studied.

Therefore, the purpose of this study was to identify differences in recurrence patterns between strictureplasty and resection and anastomosis in postoperative patients with Crohn disease and to discuss whether recurrence patterns are determined by the initial indication for surgery or the type of surgery performed. Intraoperative enteroscopy was used to evaluate recurrence at each site.

Patients and Methods

Between June 2002 and December 2010, 43 patients underwent abdominal surgery for recurrent Crohn disease at our institution, and intraoperative enteroscopy was performed in 42 of these patients. The surgical procedure was not clearly defined in 1 patient whose previous operation was performed at another institution; therefore, the data for this patient was excluded from the final analysis. Forty-one patients (24 men and 17 women, aged 41.0 ± 11.9 years [mean ± SD]), were ultimately included in this study. The number of previous operations undergone by the patients included 1 in 23 patients, 2 in 13 patients, 3 in 3 patients, and 4 in 2 patients. Previous operation was performed at other institutions in 37 patients and at our institution in 4 patients.

Patients were categorized into 2 groups according to the surgical procedures they underwent at previous surgery: patients who underwent only resection and anastomosis of the intestine and patients who underwent strictureplasty. The latter group was further categorized into patients who underwent resection and anastomosis and strictureplasty, and patients who underwent strictureplasty only. Disease behavior according to the Vienna classification[10] at the previous operation in 10 patients who underwent strictureplasty with/without resection and anastomosis was B2 disease in 5 patients and B3 disease in 5 patients, and in 31 patients who underwent resection and anastomosis only, it was B2 disease in 15 patients, B3 disease in 14 patients, and unknown disease in 2 patients.

Details of the surgical strategies and the intraoperative enteroscopy procedure were reported previously.[11] Briefly, a sterile enteroscope (CF 200L, 15.4 mm in diameter, or CF-1T20I, 14.3 mm in diameter; Olympus, Tokyo, Japan) was inserted through an enterotomy opening made near the severe stricture to be surgically treated. When multiple lesions were present and an enteroscope could not be passed through the lumen, the enteroscope was inserted through several sites. Thus, the entire lumen of the small intestine, including any lesions, could be observed from the ligament of Treitz to the ileocecal valve. Active ulcer, ulcer scar, and stricture were identified intraoperatively. The stricture was considered severe if the enteroscope could not pass (CF 200L) or could barely pass (CF-1T20I) through the lumen (diameter, <15 mm). If the enteroscope did pass through the lumen, the luminal diameter was determined by measuring the intestinal diameter using a ruler under insufflation of air through the enteroscope into the lumen. A stricture was judged as mild when the intestinal lumen was >15 mm and <25 mm in diameter. Surgery was indicated when severe stricture was present and was also performed on a mild stricture with active ulcer even if the enteroscope passed through it. However, surgery was not performed when a scarred ulcer was present on a mild stricture. Identification of disease recurrence at a previously operated site or of newly occurring disease was made using the criteria we previously reported.[11] When the length between the diseased site and the previously operated site was >5 cm, the diseased site was considered a new site. A diseased site was considered recurrence of the previously operated site when the length between the diseased site and the previously operated site was <5 cm. Perforating disease was defined according the criteria of Greenstein *et al*,[12] as acute free perforation, subacute perforation with abscess, or chronic perforation with internal or external fistula from findings at laparotomy.

Table 1 Surgical procedures performed at previous operation

Surgical procedure	Previous operation (n)
Patients who underwent resection and anastomosis only (n = 31)	
Partial resection of SI	10
ICR	5
Resection of anastomotic site	3
Resection of AS + partial resection of SI	2
ICR + partial resection of SI	2
ICR + partial colectomy	2
Partial colectomy	2
Subtotal colectomy	2
Resection of AS + partial colectomy	1
Right or left hemicolectomy	1
Right or left hemicolectomy + partial resection of SI	1
Patients who underwent strictureplasty with/without resection and anastomosis (n = 10)	
Partial resection of SI + Sx	4
ICR + partial resection of SI + Sx	1
ICR + partial colectomy + partial resection of SI + Sx	1
Low anterior resection + partial resection of SI + Sx	1
Subtotal colectomy + resection of AS + partial resection of SI + Sx	1
Sx	2

AS, anastomotic site; ICR, ileocolic resection; n, number of patients undergoing each procedure; Previous operation, latest previous operation; SI, small intestine; Sx, strictureplasty.

Duration between earlier operation and reoperation is expressed in relation to the operation site. For example, when the anastomosis was performed at the first operation (operation A), and the site was not operated on at the second operation (operation B) but was operated on at the third operation (operation C), the duration between operation A and operation C was considered the duration between earlier operation and reoperation at this site.

This study was approved by the Ethical Committee of the Miyazaki University School of Medicine.

Statistical analysis

Differences in recurrence patterns between groups were analyzed with the χ^2 test. Fisher's exact test was used for 2×2 tables between 2 groups. Differences in clinical characteristics between mean and median values were analyzed by Mann-Whitney *U* test. A *P* value of < 0.05 was considered to indicate statistical significance. All analyses were performed with SPSS version 16.0J for Windows (SPSS Japan Inc., Tokyo, Japan).

Results

Among the 41 patients investigated, 31 underwent only resection and anastomosis of the intestine, and 10 patients underwent strictureplasty with or without resection and anastomosis. The previous operations (latest previous operation) performed are shown in Table 1. Various surgical procedures were performed at the previous operations, and partial resection of the small intestine with and without strictureplasty and ileocecal resection were predominant. Eight patients underwent both anastomosis and strictureplasty, and 2 patients underwent strictureplasty only.

Characteristics of the study patients are shown in Table 2. Patients who underwent strictureplasty were significantly younger ($P < 0.05$) than the patients who underwent only resection and anastomosis. Duration after previous operation was significantly shorter ($P < 0.01$) in patients who underwent strictureplasty than in patients who underwent only resection and anastomosis. Other factors, including sex, number of previous operations undergone, duration after diagnosis, distribution of Vienna classification, and ratios of patients who smoked, took steroids, or underwent nutritional therapy were not significantly different between groups.

Types of operations performed at diseased sites in previous operations for each patient group are shown in Table 3. Wedge resection of the intestine at 2 sites because of fistula formation at the diseased sites and 1 colostomy were excluded. Anastomosis was performed at 57 sites, and strictureplasty was performed at 18 sites. Anastomosis was performed between small intestine and small intestine at 28

Table 2 Characteristics of the patients with Crohn disease

Characteristic	Anastomosis only (n = 31)	Strictureplasty with/without anastomosis (n = 10)
Present age (years)	44.0 [17–60]	32.5 [23–44]*
Sex (male/female)	17/14	7/3
Duration after diagnosis (years)	13.3 [3.8–24.2]	8.5 [3.8–17.0]
Duration after previous operation (years)	7.0 [0.4–23.4]	3.1 [1.5–5.6]**
Number of previous operations	1 [1–3]	1 [1–4]
Vienna classification		
L1/L2/L3/L4	10/3/8/10 (32.3/9.6/25.8/32.3)	2/0/3/5 (20.0/0.0/30.0/50.0)
A1/A2	25/6 (80.6/19.4)	10/0 (100.0/0.0)
B2/B3/Bx	15/14/2 (48.4/45.2/6.4)	5/5/0 (50.0/50.0/0.0)
Smoking habit (yes/no)	16/15 (51.6/48.4)	5/5 (50.0/50.0)
Corticosteroid usage (yes/no)	5/26 (16.1/83.9)	1/9 (10.0/90.0)
Nutritional therapy (yes/no)	22/9 (71.0/29.0)	8/2 (80.0/20.0)
Anti-TNF-α antibody use (yes/no)	5/26 (16.1/83.9)	3/7 (30.0/70.0)
Immunomodulator use (yes/no)	7/24 (22.6/77.4)	4/6 (40.0/60.0)

Previous operation, latest previous operation; TNF-α, tumor necrosis factor-α.

Three patients whose procedure or behavior was unknown were excluded.

Data are expressed as median value [range] or number of patients. Numbers in parentheses indicate percentage of patients.

*$P < 0.05$ versus anastomosis only.

sites, between small intestine and large intestine at 21 sites, and between large intestine and large intestine at 8 sites. End-to-end anastomosis was the most preferred procedure, but other procedures were also performed. For strictureplasty, Heineke-Mikulicz strictureplasty was performed at 12 sites, and Finney procedure was performed at 5 sites. The type of strictureplasty could not be identified at 1 site where surgery was performed at a different institution. Stapled anastomosis was performed at 2 sites where functional anastomosis was performed between small intestine and large intestine. Anastomoses at another 55 sites and all strictureplasties were performed by hand suturing techniques.

Patient-specific recurrence patterns according to disease behavior are shown in Fig. 1. Among the 31 patients who underwent resection and anastomosis only, recurrence in 15 patients (B2 disease at the previous operation) was B2 disease in 12 patients (80.0%) and B3 disease in 3 patients (20.0%). In 14

Table 3 Surgical procedure at previous operation

Surgical procedure at previous operation		Anastomosis only	Strictureplasty		Total
			With anastomosis	Without anastomosis	
Anastomosis					
SI and SI	End to end	14	11		25
	Side to side	2			2
	End to side	1			1
SI and LI	End to end	13	3		16
	Functional End to end	2*			2
	Side to side	2			2
	End to side	1			1
LI and LI	End to end	6	2		8
Strictureplasty					
Heineke-Mikulicz			9	3	12
Finney			2	3	5
Unknown			1		1
Total		41	28	6	75

SI, small intestine; LI, large intestine.

*Stapled anastomosis.

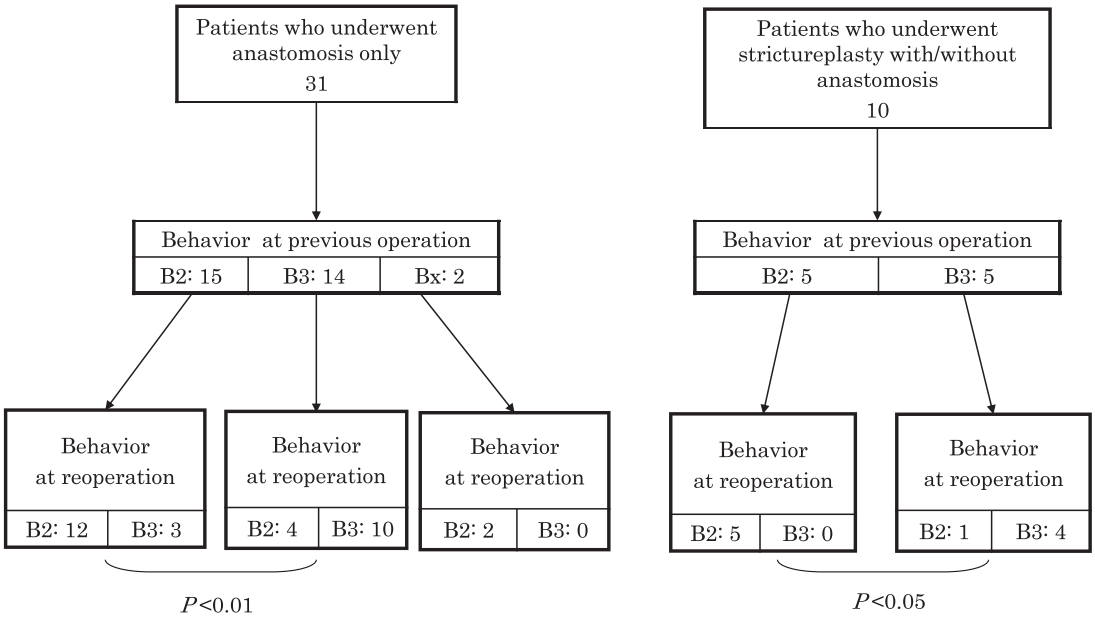

Fig. 1 Recurrence patterns according to the behavior of Crohn disease as classified by the Vienna classification. B2, structuring; B3, penetrating; Bx, unknown.

patients (B3 disease at previous operation), recurrence was B2 disease in 4 patients (28.6%) and B3 disease in 10 patients (71.4%). There was a significant difference in the recurrence pattern between patients with B2 disease and those with B3 disease. Among patients who underwent strictureplasty with/without resection and anastomosis, significant difference was also observed in the recurrence pattern between 5 patients with B2 disease and 5 patients with B3 disease.

Recurrence patterns according to disease type at previous operations in patients who underwent resection and anastomosis at previous operation are shown in Fig. 2. Among 22 sites at which anastomosis was performed for nonperforating disease, reoperation was performed at 16 sites, 15 sites for nonperforating disease and 1 site for perforating disease. Among the 17 sites at which anastomosis was performed for perforating disease, reoperation was performed at 13 sites (6 sites for nonperforating disease and 7 sites for perforating disease). There was a significant difference ($P < 0.01$) in the recurrence pattern between sites at which anastomosis was performed for nonperforating versus perforating disease.

Recurrence patterns according to disease type at previous operations in patients who underwent strictureplasty with/without resection and anastomosis at previous operation are shown in Fig. 3. Among 10 sites at which anastomosis was performed for nonperforating disease, reoperation was performed at 5 sites, all for nonperforating disease. At the 6 sites at which anastomosis was performed for perforating disease, reoperation was performed at 4 sites (1 site for nonperforating disease and 3 sites for perforating disease). Significant difference ($P < 0.05$) was observed in the recurrence pattern between sites at which anastomosis was performed for nonperforating versus perforating disease. Strictureplasty for nonperforating disease was performed at 17 sites, and reoperation was required at 11 sites (10 sites for nonperforating disease and 1 site for perforating disease). There was no significant difference in the recurrence pattern between sites at which either resection and anastomosis or strictureplasty was performed for nonperforating disease. Significant difference ($P < 0.05$) was observed in the recurrence pattern between sites at which resection and anastomosis was performed for perforating disease and sites at which strictureplasty was performed for nonperforating disease.

Discussion

Strictureplasties are usually carried out for strictures not exceeding 25 cm in length.[8] Various procedures, such as the Heineke-Mikulicz, Finney, Jaboulay, and Judd procedures, have been proposed according to the length of the stricture.[8] However, the side-to-side strictureplasty and modifications of this

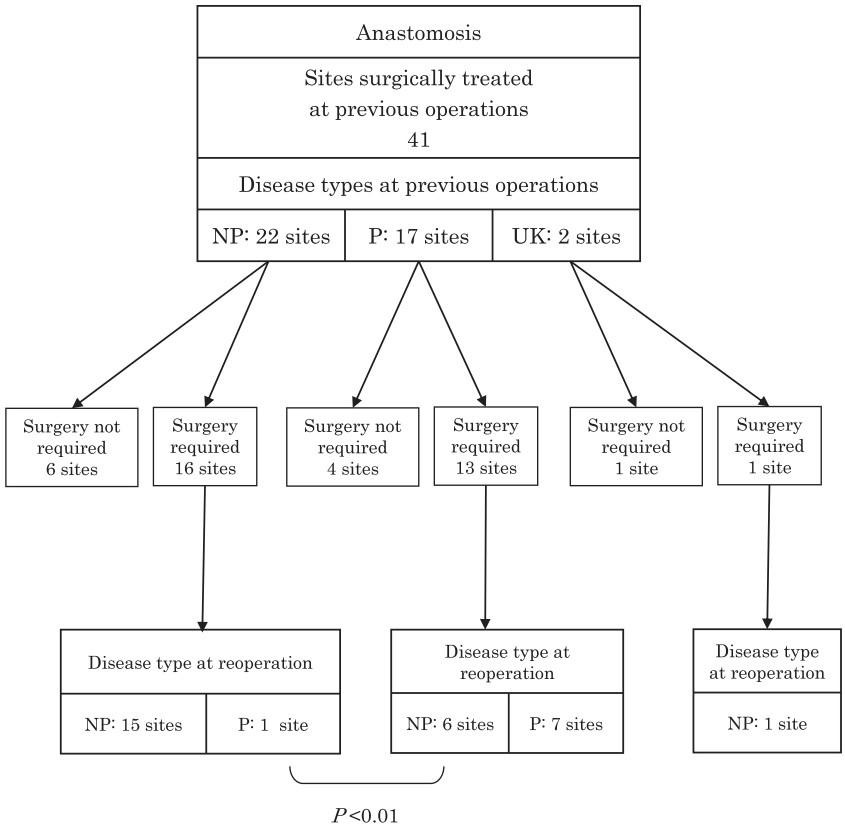

Fig. 2 Requirement of surgery and recurrence patterns according to the indication for surgery in patients who underwent resection and anastomosis only. NP, nonperforating disease; P, perforating disease; UK, unknown disease.

technique have been developed,[13–15] which allow application to longer strictures with safety and efficacy. Strictureplasty is indicated for fibrotic strictures, and it can be applied to short actively diseased sites provided that the segment is not complicated and shows no sign of sepsis.[8] Resection and anastomosis are performed when perforating disease, sepsis formation, fistula, or phlegmonous inflammation exists.[16] However, resection and anastomosis are also applied to strictures, and selection of the procedure for stricture depends on surgeon preference. In addition, patients often have both perforating and nonperforating disease at surgery. A meta-analysis reported by Yamamoto *et al*[16] showed concomitant bowel resection was performed in 61% of patients who underwent strictureplasty. In the present study, the indication for almost all sites (17 of 18 sites) at which strictureplasty was performed was for nonperforating disease, and 80% of patients underwent concomitant bowel resection. For this reason, we investigated the recurrence pattern of Crohn disease in detail.

Using a meta-analytical technique, Simillis *et al*[17] found that the indication for primary operation is an important factor that affects the indication for reoperation. They reported that 71.1% of patients first presenting with perforating disease required reoperation because of perforating disease, whereas 75.8% of patients first presenting with nonperforating disease underwent reoperation for nonperforating disease. In the present study, we also showed that in patients who underwent operation for B2 disease, B2 disease tended to recur without relation to the initial surgical procedure. In addition, when the data were analyzed in detail, we showed that sites operated for nonperforating disease tended to recur as nonperforating disease and sites operated for perforating disease tended to recur as perforating disease, even after resection in patients who underwent resection and anastomosis only. This finding is the same as that for the sites at which resection and anastomosis were performed in patients who underwent strictureplasty and resection and anastomosis. Most strictureplasties were performed for nonperforated sites, and these sites tended to recur as nonperforated sites. Therefore, the disease behavior at each site appears to be more

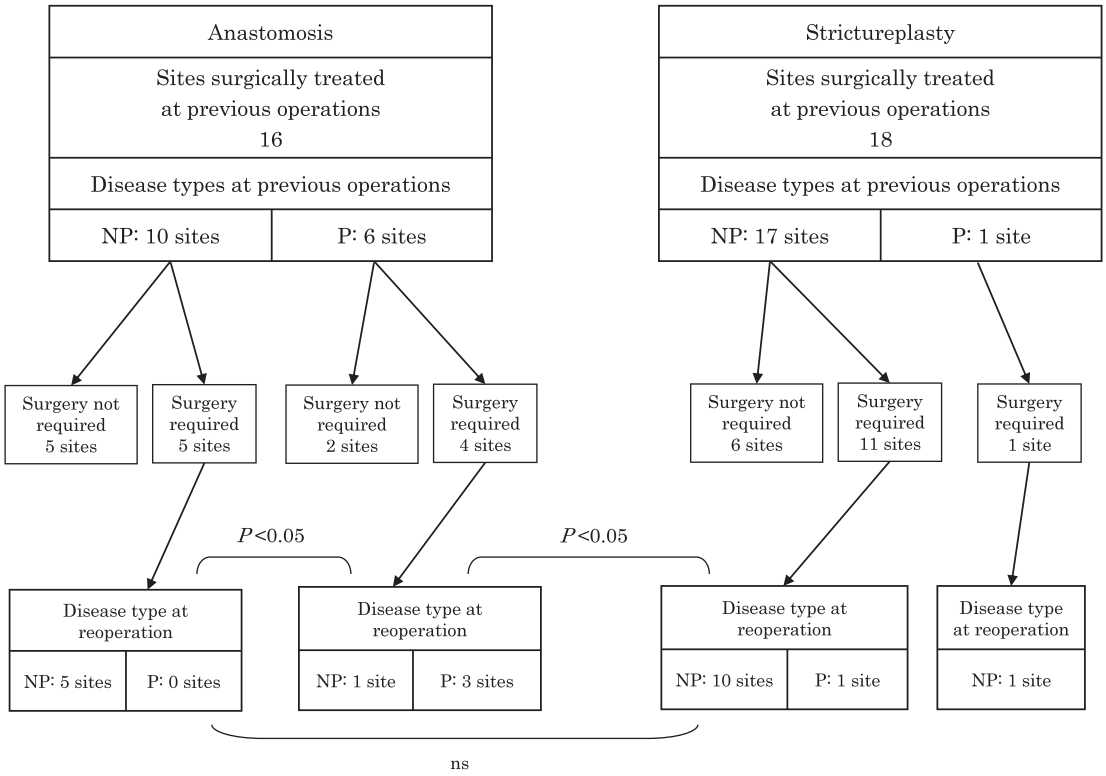

Fig. 3 Requirement of surgery and recurrence patterns according to the indication for surgery in patients who underwent strictureplasty with/without resection and anastomosis. NP, nonperforating disease; P, perforating disease; ns, not significant.

important for recurrence pattern in postoperative patients with Crohn disease than does the procedure performed.

Controversy exists on the recurrence rate after strictureplasty and resection.[16,18–23] Several investigators[18,19] have reported no significant differences in rates of recurrence after strictureplasty versus resection. No significant difference is also reported in the recurrence rate after strictureplasty alone and strictureplasty plus resection.[16,20] However, meta-analysis of 7 studies performed by Reese *et al*[21] showed that patients who underwent resection had significantly longer recurrence-free survival than did those who underwent strictureplasty alone. In the present study, duration between previous operation and recurrence was significantly shorter in patients who underwent strictureplasty than in patients who underwent resection and anastomosis. However, we cannot conclude that the patients who underwent resection experienced longer recurrence-free survival than did the patients who underwent strictureplasty at previous operation because most of the previous operations in our patients were performed at other institutions, and most patients were referred to our hospital because of recurrence. In addition, the sample size in the present study was small, and nonsignificant results might be due to a lack of power in the study. Therefore, these results should be interpreted with caution. Another concern is that this study was performed retrospectively, and a prospective study will be necessary to clarify recurrence patterns after strictureplasty and resection and anastomosis. Several investigators have considered it difficult to compare the outcome of strictureplasty and anastomosis because extension of disease and indications for surgery are different.[3,6] Primary anastomosis is usually performed at the first operation and often for perforating disease, whereas strictureplasty is performed at repeat operations in patients with shortened bowel and fibrotic disease. Thus, physicians should be careful when evaluating the difference in postoperative recurrence rates between strictureplasty and resection.

Sites with multiple disease and new disease are often found in patients with Crohn disease. To differentiate recurrence of a previously operated site and a new site in the present study, we considered a diseased site to be a new site when the length between the diseased site and the previously operated site was >5 cm. A diseased site was considered

recurrence of the previously operated site when the length between the diseased site and the previously operated site was <5 cm. Although these criteria were previously reported,[11] discrimination between recurrent and newly diseased sites may require additional evaluation.

Of great concern after strictureplasty is that this procedure preserves diseased sites postoperatively. A previous report by Fazio *et al*[22] showed that presence of microscopic Crohn disease does not increase the risk of postoperative recurrence. In addition, Michelassi *et al*[23] reported that active Crohn disease regressed at the site of strictureplasty by radiologic, endoscopic, and histopathologic study. These findings support the use and value of the bowel-sparing technique. In the present study we showed that strictureplasty, which preserves the actively diseased site, does not increase the risk of perforating disease when it recurs. It is possible that a diseased site turns into a quiescent site after strictureplasty, and disease recurs as nonperforating disease when it does recur. Results of the present study may validate the performance of strictureplasty because it does not appear to increase the risk of severe recurrent disease such as perforation and abscess formation. In the present study, we investigated the recurrence pattern at each operated site in patients who underwent anastomosis only and in patients who underwent strictureplasty with/without anastomosis. Recurrence patterns after strictureplasty and those after anastomosis should also be investigated in detail. For example, recurrence patterns after strictureplasty in patients who underwent strictureplasty only should be studied. The sample size in the present study was small; thus, additional study will be required for further detailed evaluation of recurrence patterns in patients who have undergone operation for Crohn disease.

In conclusion, strictureplasty was indicated for nonperforating disease, and disease at most of the sites recurred as nonperforating disease even if strictureplasty preserved the diseased site. Disease at sites operated on for perforating disease tended to recur as perforating disease, whereas disease at sites operated on for nonperforating disease tended to recur as nonperforating disease without relation to the procedure performed, whether resection or strictureplasty.

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