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Antimesenteric cutback end-to-end isoperistaltic anastomosis (Sasaki-Watanabe anastomosis) for Crohn's disease: Novel surgical technique and early results of surgical anastomotic recurrence

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Abstract

Background: Antimesenteric cutback end-to-end isoperistaltic anastomosis (Sasaki-Watanabe anastomosis; Sasaki-W anastomosis), which was developed in our department, is a novel hand-sewn anastomotic technique for Crohn's disease intended to prevent anastomotic stenosis and preserve the peripheral circulation.

Aim: The aim of the present study is to present the surgical technique of Sasaki-W anastomosis and to assess the safety and the early results of the surgical anastomotic recurrence of Sasaki-W anastomosis.

Patients and Methods: The present study was a single-center retrospective cohort study. As an early-period group, 13 patients with Crohn's disease, who were mainly selected from cases considered to be at high risk of recurrence, underwent 15 Sasaki-W anastomoses from August 2009 to January 2012. As a late-period group, 36 patients with Crohn's disease, who were selected regardless of risk factors, underwent 37 Sasaki-W anastomoses from September 2016 to March 2020. The medical data including patient characteristics, surgical records, postoperative details, and surgical recurrences were assessed.

Results: There were no intraoperative complications. With a median follow-up of 107 mo, surgical recurrence occurred in one patient at 106 mo after surgery in the early-period group. The cumulative surgical recurrence-free rate in the early-period group was 100% at 5 y and 86% at 10 y after surgery. No patients required reoperation in the late-period group.

Conclusion: Sasaki-W anastomosis is safe and feasible. Although long-term study is needed, this anastomotic technique can be a reasonable operative option for Crohn's disease.

KEYWORDS
antimesenteric cutback end-to-end isoperistaltic anastomosis, Crohn's disease, Sasaki-W anastomosis, Sasaki-Watanabe anastomosis, surgical technique

1 | INTRODUCTION

Crohn's disease (CD) is a chronic inflammatory bowel disease, and approximately 40%–80% of patients require surgical treatment for intestinal lesions such as strictures, fistulas, and abscesses.[1–3] Postoperative recurrence is also common, and approximately 30%–61% of these patients require reoperation within 10 y after the initial surgery,[3–7] which increases the risk of short bowel syndrome-related intestinal failure.[8] The site of recurrence frequently involves the previous anastomotic site, and prevention of anastomotic recurrence is one of the most important issues in the management of CD. Although there is still no full consensus, recent studies showed that the type of anastomosis can reduce anastomotic recurrence.[9–11]

The "antimesenteric cutback end-to-end isoperistaltic anastomosis (Sasaki-Watanabe anastomosis; Sasaki-W anastomosis)," which was developed in our department, is a novel hand-sewn anastomotic technique for CD intended to prevent anastomotic stenosis. With this technique, the luminal diameter proximal and distal to the anastomosis becomes wider than the original diameter of the intestine by the antimesenteric cutback procedure. A smooth, wide anastomotic shape is obtained by cutback-incising the antimesenteric bowel wall in accordance with the bowel diameter of the other side of the intestine and twisting it 180 degrees to anastomose it. Bowel caliber difference can be adjusted by this cutback procedure. This anastomotic technique is also intended to preserve the peripheral circulation of the intestine by avoiding anastomosis with the side of the mesenteric attachment, where ulceration is likely to occur. In the present article, the surgical technique and outcomes of Sasaki-W anastomosis are presented.

2 | PATIENTS and METHODS

As an early-period group, 13 patients with CD underwent 15 Sasaki-W anastomoses from August 2009 to January 2012. Two of the 13 patients underwent two Sasaki-W anastomoses. These patients were mainly selected from cases considered to have high-risk factors for recurrence, such as penetrating type, undergoing multiple surgeries in the short term, and active smokers. Between February 2012 and August 2016, no patients underwent Sasaki-W anastomosis because the main surgeons (Sasaki I. & Watanabe K.) for performing Sasaki-W anastomosis left for other institutions during the periods. Because the medium-term results were acceptable in the early-period group and the main surgeon (Watanabe K.) returned to our hospital, the Sasaki-W anastomosis was resumed as a standard anastomotic technique in our hospital from September 2016. As a late-period group, 36 patients with CD underwent 37 Sasaki-W anastomoses from September 2016 to March 2020. Most patients in the late-period group were recruited consecutively.

Thus, a total of 49 patients with CD underwent 52 Sasaki-W anastomoses from August 2009 to March 2020. The medical data including patients' characteristics, surgical records, postoperative details, and surgical recurrences were retrospectively collected and assessed. The location of disease and the behavior of disease were classified using the Montreal classification.[12] Patients' complications were assessed using the Clavien–Dindo classification, and the complications of grade II or greater were collected.[13] Surgical recurrence was defined as reoperation with resection for recurrent anastomotic disease at the site of the Sasaki-W anastomosis. Operation for CD at other sites was not considered anastomotic recurrence.[10] This retrospective study received approval from the Institutional Review Board of Tohoku University Hospital.

2.1 | Statistical analysis

The Mann–Whitney *U* test was used for continuous variables. The chi-squared test was used for categorical variables. The cumulative endoscopic and surgical recurrence-free rate was evaluated using the Kaplan–Meier method and the log-rank test. Values of $P < .05$ were considered significant. All statistical analyses were performed using SPSS version 13.0J software (SPSS Japan).

2.2 | Indication for Sasaki-W anastomosis

The Sasaki-W anastomosis can be performed when reconstruction with a tension-free hand-sewn anastomosis is possible. This anastomosis is suitable for entero-entero anastomosis and entero-colonic (rectal) anastomosis. Colo-colonic (rectal) anastomosis is also suitable, but the length of bowel caliber of the colon (rectum) is usually sufficiently long (more than 6 cm when crushed by Pean forceps); in these cases, ordinary hand-sewn end-to-end anastomosis was performed. Attention is needed in cases where the mesentery is extremely thickened due to inflammation, since it may be difficult to anastomose by rotating the intestine; in these cases, ordinary hand-sewn end-to-end anastomosis was performed. In addition, attention should be paid to the positional relationship between the bowel and the mesentery to ensure that internal herniation does not occur after anastomosis. Before performing this anastomosis, it is important to determine whether rotation of the bowel is possible and whether a tension-free anastomosis is possible.

2.3 | Surgical technique of the Sasaki-W anastomosis (Figure 1, Figure 2, Video S1)

2.3.1 | Measurement and marking (Figure 1A, Figure 2A)

Pean forceps are applied to the proximal and distal intestines where resection is planned. The crushed bowel lengths on the proximal and distal sides are measured. Using a skin marker pen, a marking line is placed on the antimesenteric side of the bowel wall for the length of the other crushed bowel.

2.3.2 | Cutback-incision of the antimesenteric bowel wall (Figure 1B, Figure 2B,C)

After resection of the diseased intestine, the intestinal loops selected for anastomosis are placed in an isoperistaltic orientation. A longitudinal cutback-incision is created along the marked line at the proximal and distal antimesenteric walls by the electric scalpel. This procedure allows an equal length of the anastomotic line between the proximal and distal sides, allowing for a smooth, wide anastomosis. Because the mucosal surface of the mesenteric side, where ulceration is likely to occur, can be closely observed by this cutback procedure, the presence or absence of retained lesions can be checked.

2.3.3 | Supporting thread setup (Figure 1C, Figure 2D)

Supporting threads are placed by seromuscular sutures using 4/0 braided polyglycolide lactide (Vicryl, Johnson & Johnson, New Brunswick, NJ). For posterior wall suturing, supporting threads are applied at three points (mesenteric side of the bowel wall and the termination point of the cutback-incision (A′ and D, C′ and B in Figures 1C and 2D), and both initiation points of the cutback-incision (Ⓐ and C in Figures 1C and 2D)). With traction of the supporting threads, the operator makes sure that the length of the planned anastomotic line is equal for the anastomosis of the proximal and distal intestines. If the lengths do not match, a further cutback-incision is added or the supporting thread is applied again to adjust the lengths to match each other.

2.3.4 | Suturing (Figure 1D,E, Figure 2E,F)

The anastomosis was created in hand-sewn fashion in the Albert–Lembert manner (a full-thickness running suture using double-ended needle 4/0 polydioxanone (PDS, Johnson & Johnson) and seromuscular interrupted sutures using 4/0 braided polyglycolide lactide). After suturing the posterior wall,

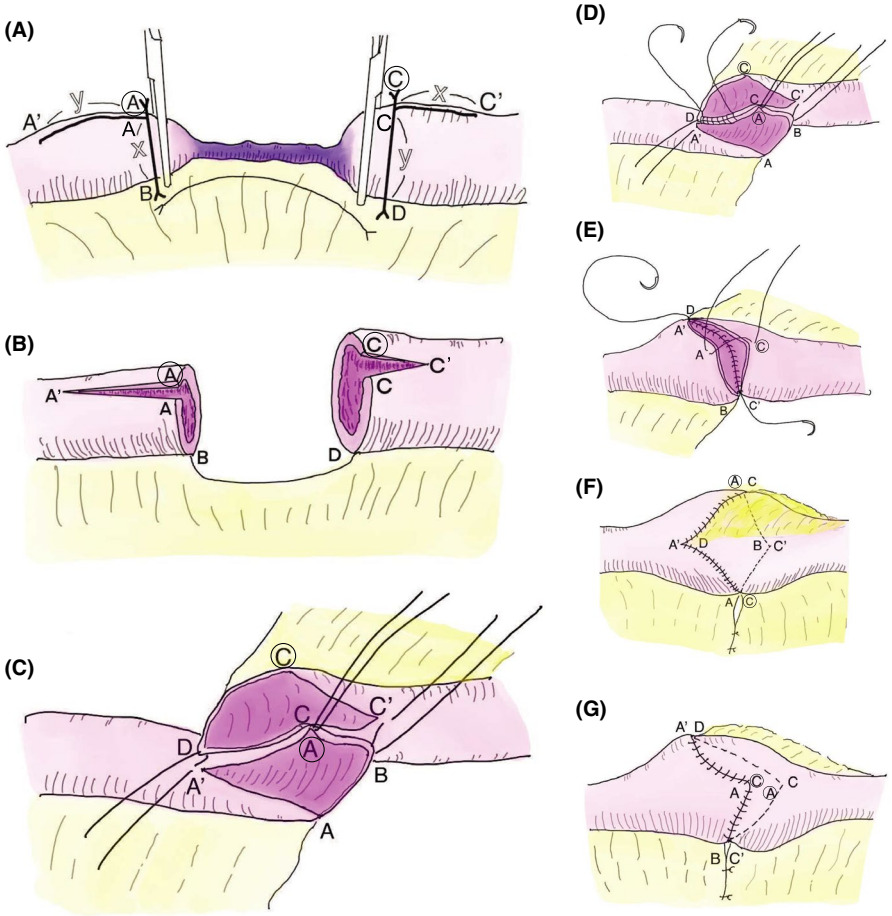

FIGURE 1 Surgical technique for Sasaki-W anastomosis (schema). A, Measurement and marking of crushed bowel length. B, Antimesenteric cutback-incision. C, Supporting thread setup. D, Suturing of the posterior wall with supporting thread. E, Suturing of the anterior wall with supporting thread. F, Completion of anastomosis (upper view). G, Completion of anastomosis (lateral view)

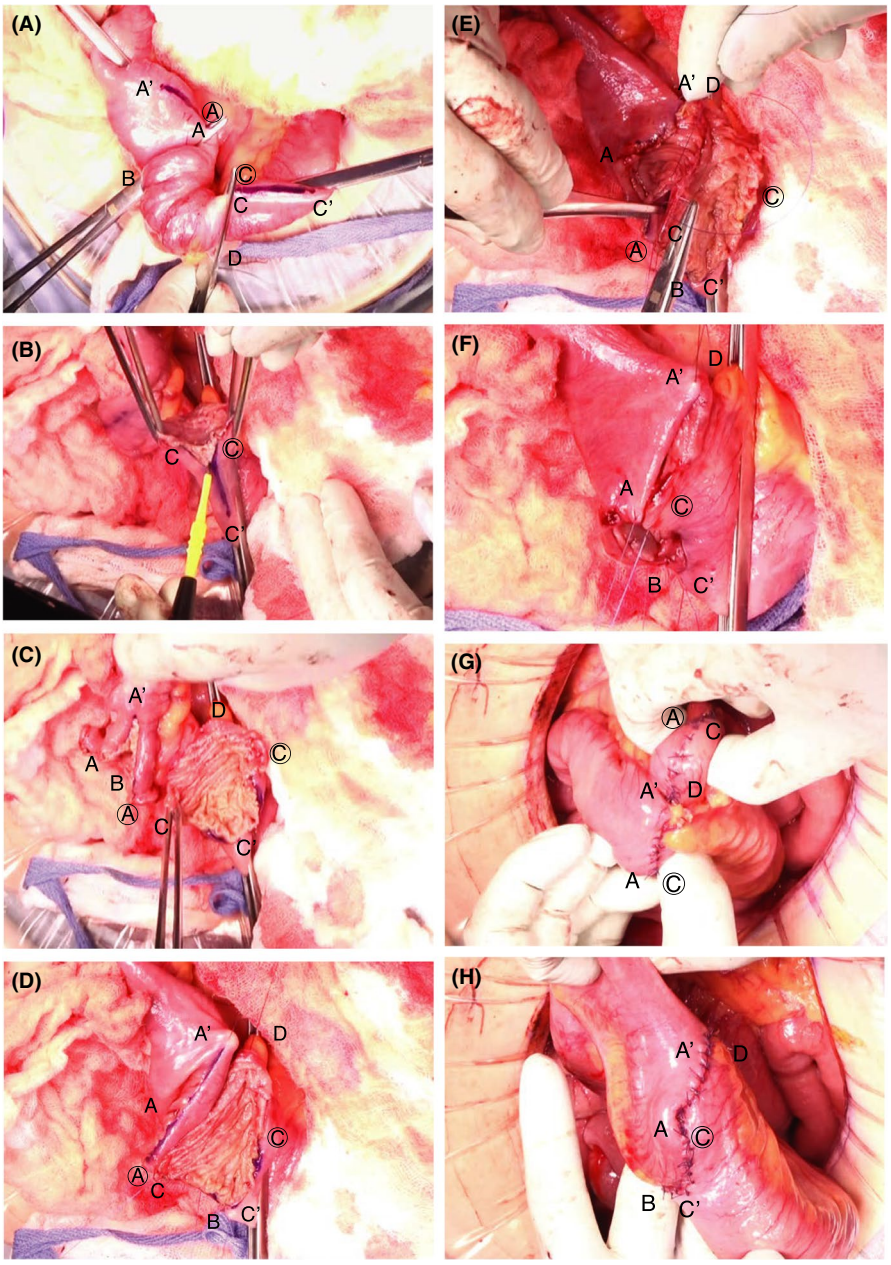

FIGURE 2 Surgical technique for Sasaki-W anastomosis (ileo-ileal anastomosis) (photograph). A, Measurement and marking of crushed bowel length. B, Antimesenteric cutback-incision. C, Intestine placed in isoperistaltic orientation. D, Supporting thread setup. E, Suturing of the posterior wall with supporting thread. F, Suturing of the anterior wall with supporting thread. G, Completion of anastomosis (upper view). H, Completion of anastomosis (lateral view)

a supporting thread is added at one point for anterior wall suture (both initiation points of the cutback-incision) (A and © in Figures 1E and 2F). The reasons for choosing a full-thickness suture are that (a) the anastomotic lumen is not narrowed even when a needle is held firmly with a full-thickness suture because of its wide anastomotic diameter, and (b) a full-thickness suture seems to be safe in many cases when the intestinal wall is fragile. In our department, full-thickness running sutures are performed using 90-cm double-ended needle sutures, but 90-cm sutures may not be sufficient for all circumferential sutures; when necessary, other double-ended needle sutures are added and sutured circumferentially. The suture is performed with traction of two supporting threads and straightening of the anastomotic line. The mesentery is closed to some extent to prevent internal herniation.

2.3.5 | Completion of anastomosis (Figure 1F,G, Figure 2G,H)

The completed shape of the anastomosis results in a smooth, sufficiently widened diameter. Because the posterior wall at the site of the supporting thread is likely to be convex to the lumen by the traction of the supporting thread, it is adjusted so that it is manually convex to the lateral side.

2.4 | Endoscopic finding of anastomosis (Figure 3)

Figure 3 shows the endoscopic findings of the Sasaki-W anastomosis (ileocolonic anastomosis) 1 y after surgery. The anastomotic lumen was smooth and sufficiently wide.

3 | RESULTS

The patients' characteristics are shown in Table 1. Active smokers were significantly more common in the early-period group than in the late-period group (62% vs 31%, $P = .049$). In terms of the location of disease, the ileocolic type was significantly more common in the early group (92% vs 64%, $P < .001$). The percentage of patients who underwent bowel surgery four or more times was significantly greater in the early-period group (23% vs 3%, $P = .022$). The length of time from the last previous surgery to this surgery was significantly shorter in the early-period group among patients who had undergone previous surgery (45 mo vs 112 mo, $P = .004$). In terms of the behavior of the disease, the penetrating type tended to be more common in the early-period group, but not significantly (69% vs 46%, $P = .173$). In terms of surgical indications, perforation or bleeding tended to be more common in the early-period group, but not significantly (8% vs 0%, $P = .093$, respectively). There were no significant differences related to sex, age at diagnosis, age at this surgery, and preoperative medications.

The surgical results are shown in Table 2. Between the two groups, there were no significant differences in operative time, estimated blood loss, site of anastomosis, short-term complications, postoperative hospital stay, or postoperative medications. In terms of short-term complications, one patient in the early-period group developed ileus, and three patients in the late-period group developed portal vein thrombosis, exacerbation of chronic heart failure, and bleeding of the small bowel not related to the anastomotic site. All patients with complications recovered with conservative management. There were no intraoperative complications, and mortality was zero in both groups.

The results in terms of surgical recurrence are shown in Table 3 and Figure 4. In the early-period group, surgical recurrence, located at the site of entero-colonic anastomosis, occurred in one patient 106 mo after surgery. (The patient underwent endoscopic balloon dilatation at 65 mo after surgery and surgical recurrence occurred at 41 mo after the endoscopic balloon dilatation.) The cumulative surgical recurrence-free rate in the early-period group was 100% at 5 y and 86% at 10 y after surgery. There were another three patients who required reoperation due to other lesions in the early-period group; the lesion was in the small intestine in two patients, and the colon and small intestine in one patient; they underwent reoperation at 11, 18, and 29 mo after surgery, respectively. The cumulative reoperation-free rate (including reoperation for other than Sasaki-W anastomotic recurrence) in the early-period group was 82% at 2 y, 72% at 5 y, and 60% at 10 y after surgery, respectively (Figure 5). In the late-period group, no patient required reoperation during a median follow-up of 14 mo.

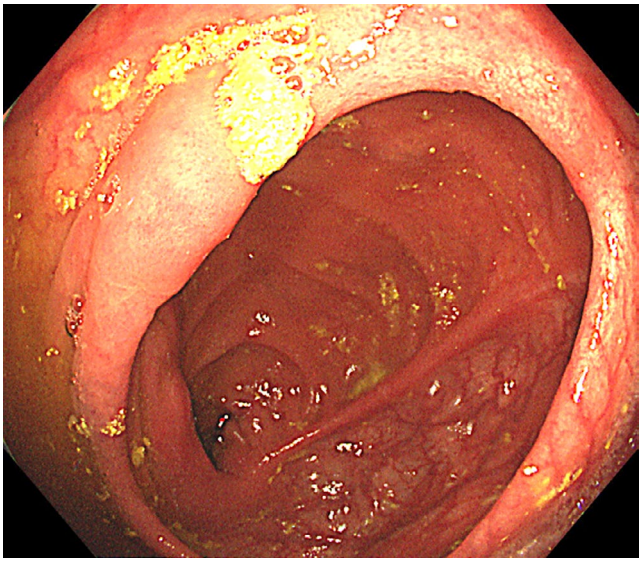

FIGURE 3 Endoscopic findings of the anastomosis at 1 y after surgery (ileocolonic anastomosis)

4 | DISCUSSION

Medical therapy, such as biologic agents for CD is progressing, but the cumulative risk of surgery is still high.[2] A recent Japanese, multicenter study showed that the 5- and 10-y cumulative risk of second surgery-free was 70.6% and 45.1% before the biologic era, and 81.5% and 59.1% after the biologic era, respectively.[4] Recurrence of CD frequently occurs at the previous anastomotic site; therefore, whether the type of anastomosis can reduce surgical recurrence has been discussed.[9–11,14–17] The most popular type of anastomosis for CD is a hand-sewn end-to-end anastomosis (HEEA) or a stapled side-to-side anastomosis (SSSA). Although there have been several studies comparing the outcome of HEEA with SSSA, the results were heterogeneous, and there is still no full consensus on which type of anastomosis is superior in terms of surgical recurrence.[11] Recently, Kono et al[9] developed a new anastomotic technique, antimesenteric functional end-to-end handsewn (Kono-S) anastomosis. They reported that the cumulative surgical recurrence-free rate for Kono-S anastomosis was 98.6% at 5 and 10 y after surgery, for 144 Japanese CD patients with a median follow-up of 65 mo.[10] These good results encouraged the hypothesis that the type of anastomosis could reduce surgical recurrence.

In the present study, the surgical technique and outcomes of a new type of hand-sewn anastomosis for CD, named the Sasaki-W anastomosis, were presented. The surgical technique was safe, and the rate of surgical recurrence was sufficiently low compared with the previous studies.[4,7] The concept of the Sasaki-W anastomosis is not only to obtain a smooth, wide anastomotic shape, but is also to preserve the peripheral circulation of the intestine. We previously investigated the microangiographic appearance of the small and large intestines in cadaver specimens and reported that anastomotic vessels between the submucosal arteries in the mesenteric side of the small intestine were poor in comparison with those in the antimesenteric side.[18] These findings indicate that the mesenteric side of the small intestine is more susceptible to ischemia due to its poor vasoarchitecture, which may lead to longitudinal ulceration along

TABLE 1 Characteristics of patients who underwent Sasaki-W anastomosis

	Total	Early period (Aug. 2009–Jan. 2012)	Late period (Sep. 2016–Mar. 2020)	*P* value
Number of patients	49	13	36	
Number of Sasaki-W anastomoses	52	15	37	
Sex, male	36 (73%)	9 (69%)	27 (75%)	.686
Active smoker	19 (39%)	8 (62%)	11 (31%)	.049*
Age at the time of				
Diagnosis of CD (y)	23 (7–60)	25 (14–43)	22 (7–60)	.217
Surgery (y)	34 (17–64)	37 (24–61)	33 (17–64)	.342
Location of disease[a]				
Ileal type	12 (24%)	1 (8%)	11 (31%)	<.001* (Ileo/Colonic vs Ileocolonic)
Colonic type	2 (4%)	0 (0%)	2 (6%)	
Ileocolonic type	35 (71%)	12 (92%)	23 (64%)	
Behavior of disease[a]				
Stricturing type	23 (47%)	4 (31%)	19 (53%)	.173
Penetrating type	26 (53%)	9 (69%)	17 (46%)	
Indications for surgery				
Stenosis	47 (96%)	12 (92%)	35 (97%)	.443
Fistula	12 (24%)	5 (38%)	7 (19%)	.172
Abscess	6 (12%)	0 (0%)	6 (17%)	.116
Perforation	1 (2%)	1 (8%)	0 (0%)	.093
Bleeding	1 (2%)	1 (8%)	0 (0%)	.093
Preoperative medication				
5-aminosalicylic acid	33 (67%)	11 (84%)	22 (61%)	.112
Enteral nutrition	23 (47%)	5 (38%)	18 (50%)	.350
Total parenteral nutrition	9 (18%)	3 (23%)	6 (17%)	.446
Anti-TNF-α therapy	22 (45%)	5 (38%)	15 (41%)	.554
Anti-IL12/23 therapy	2 (4%)	0 (0%)	2 (6%)	.536
Azathioprine	13 (27%)	2 (15%)	11 (31%)	.249
Budesonide	4 (8%)	0 (0%)	4 (11%)	.278
Prednisolone	2 (4%)	1 (8%)	1 (3%)	.464
Times of bowel surgery				
Initial	30 (61%)	7 (54%)	23 (64%)	.203
2nd	7 (14%)	1 (8%)	6 (17%)	
3rd	8 (16%)	2 (15%)	6 (17%)	
4th	3 (6%)	2 (15%)	1 (3%)	
8th	1 (2%)	1 (8%)	0 (0%)	
Previous bowel surgery	19 (39%)	6 (46%)	13 (36%)	.524
Bowel surgery: 4 or more times	4 (8%)	3 (23%)	1 (3%)	.022*
Length of time since last surgery (among patients who had previous surgery) (mo)	93 (27–193) (n = 19)	45 (27–84) (n = 6)	112 (30–193) (n = 13)	.004*

[a]Montreal classification.

*$P < .05$.

the mesenteric side of the small intestine in CD. The Sasaki-W anastomosis avoids anastomosis with the site of the mesenteric attachment by 180-degree rotation of the bowel; therefore, the peripheral circulation of the intestine can be preserved.

The merits of the Sasaki-W anastomosis are as follows: (a) the anastomotic shape is smooth and sufficiently wide; (b) bowel caliber differences can be adjusted by the cutback procedure; (c) assessment of the presence of residual mucosal disease at the site

TABLE 2 Surgical results of Sasaki-W anastomosis and postoperative medications

	Total	Early period (Aug. 2009-Jan. 2012)	Late period (Sep. 2016-Mar. 2020)	*P* value
Number of patients	49	13	36	
Number of Sasaki-W anastomoses	52	15	37	
Operative time (min)[a]	210 (104–366)	225 (142–366)	208 (104–344)	.217
Estimated blood loss (ml)[a]	139 (16–1448)	375 (30–1448)	117 (16–629)	.342
Site of anastomosis				
Entero-entero anastomosis	15 (29%)	7 (47%)	8 (22%)	.246
Entero-colonic anastomosis	31 (60%)	6 (40%)	25 (68%)	
Entero-rectal anastomosis	4 (8%)	1 (7%)	3 (8%)	
Colo-colonic anastomosis	2 (4%)	1 (7%)	1 (3%)	
Length of cutback-incision (cm)[a]				
Proximal side	4.0 (2.0–6.0)	Not assessed	4.0 (2.0–6.0)	NA
Distal side	3.0 (2.0–5.0)	Not assessed	3.0 (2.0–5.0)	
Intraoperative complications	0 (0%)	0 (0%)	0 (0%)	1.000
Short-term complications (<30 d)	4 (8%)	1 (8%)	3 (8%)	.942
Mortality	0 (0%)	0 (0%)	0 (0%)	1.000
Postoperative hospital stay (d)[a]	14 (8–40)	19 (10–29)	13.5 (8–40)	.096
Postoperative medication				
5-aminosalicylic acid	36 (73%)	11 (85%)	25 (69%)	.249
Enteral nutrition	18 (37%)	5 (38%)	13 (36%)	.567
Anti-TNF-α therapy	39 (80%)	12 (92%)	27 (75%)	.184
Anti-IL12/23 therapy	5 (10%)	0 (0%)	5 (14%)	.198
Azathioprine	14 (29%)	3 (23%)	11 (31%)	.449

NA, not applicable.
[a]Median (range).

TABLE 3 Postoperative surgical recurrence of Sasaki-W anastomosis

	Total	Early period (Aug. 2009--Jan. 2012)	Late period (Sep. 2016-Mar. 2020)	*P* value
Number of patients	49	13	36	
Number of Sasaki-W anastomoses	52	15	37	
Postoperative follow-up periods (mo)[a]	21 (1–136)	107 (1–136)	14 (1–44)	.001*
Surgical recurrence at the site of Sasaki-W anastomosis	1 (2%)	1 (7%)	0 (0%)	NA
Reoperation including for other than Sasaki-W anastomotic recurrence	4 (8%)	4 (31%)	0 (0%)	.032

NA, not applicable.
[a]Median (range).
*$P < .05$.

of anastomosis is easy to perform by the cutback procedure; (d) sufficient full-thickness suture for fragile bowel can be performed without narrowing the lumen, which may be safer than layer-to-layer suture in terms of postoperative anastomotic leakage; (e) hand-sewn anastomosis without residual foreign material such as staples; (f) physiologic isoperistaltic anastomosis without a blind loop; (g) peripheral circulation can be preserved by avoiding anastomosis with the site of the mesenteric attachment, where ulceration is likely to occur; and (h) the surgical technique is simple and easy. Different from the Kono-S anastomosis, the Sasaki-W anastomosis is a physiological isoperistaltic anastomosis, no blind loop, and no use of residual foreign material such as staples.

In the present study, patients were divided into an early-period group and a late-period group because the patients' characteristics

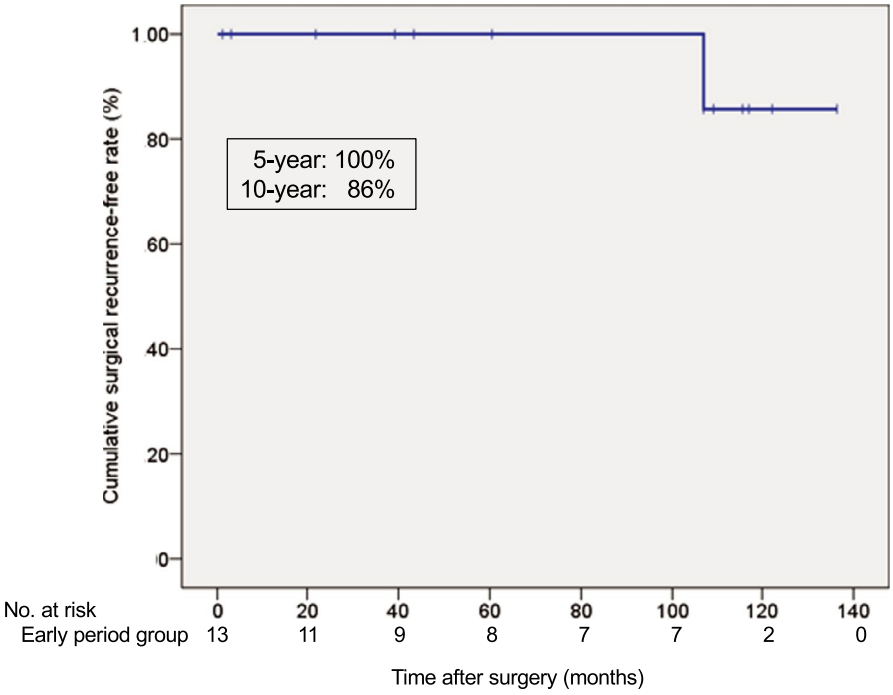

FIGURE 4 Cumulative surgical recurrence-free rate in the early-period group

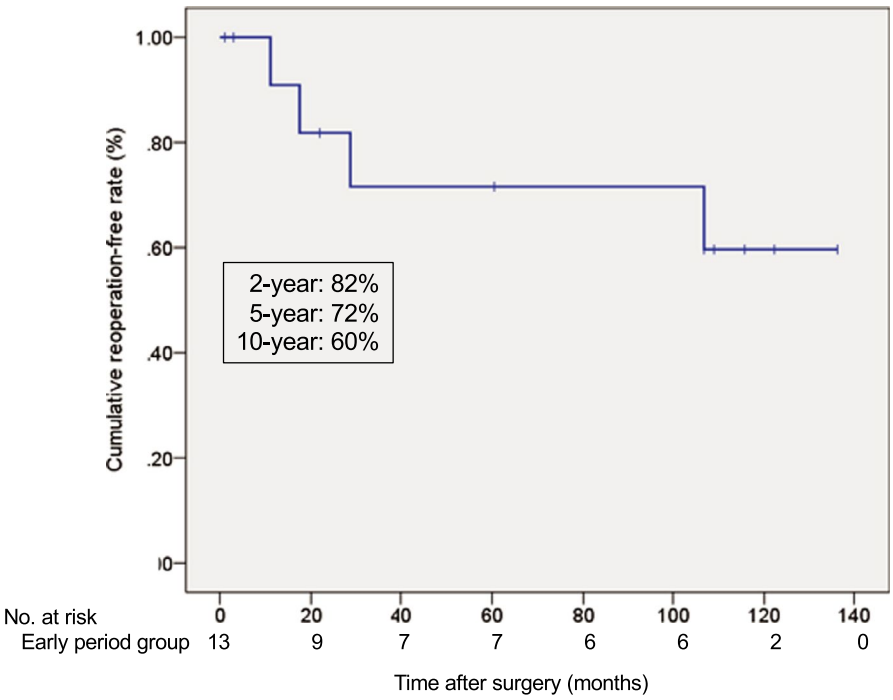

FIGURE 5 Cumulative reoperation-free rate in the early-period group

differed between the two groups. Several risk factors associated with postoperative recurrence of CD are well known, such as active smoking, ileocolonic type CD, multiple surgeries, penetrating type CD, and young age.[19–24] Because patients in the early-period group were mainly selected from cases considered to have risk factors for recurrence, they had significantly more risk factors, such as active smoking, ileocolic type CD, and multiple surgeries (four or more times), compared with the patients in the late-period group. There were three patients in the early-period group who required reoperation within short periods after surgery due to other lesions of Sasaki-W anastomosis, which indicate that medical treatment should be applied by paying attention to the appearance of a recurrent lesion, not only in the anastomotic site but also in other than the anastomotic site, especially in the high-risk group. Although three patients in the early-period group required reoperation within short periods after surgery due to other lesions, surgical recurrence occurred in only one patient, and the cumulative anastomotic surgical recurrence-free rate was sufficiently low in both groups. The

good results suggest that the Sasaki-W anastomosis can be effective in reducing the risk of surgical recurrence for CD patients.

Finally, the limitations of the present study need to be addressed. Because this was a retrospective study, and the data of postoperative endoscopy were heterogeneous in terms of examination timing or modality (conventional colonoscopy or capsule endoscopy), endoscopic recurrence was not assessed. Another issue is that the follow-up period was relatively short in the late-period group, whereas long-term results can be assessed in the early group. To resolve these issues, it is necessary to assess the long-term outcomes in the late-period group with scheduled endoscopy in the future.

5 | CONCLUSION

The Sasaki-W anastomosis is safe, and the surgical recurrence rate is sufficiently low. Although long-term study is needed, this technique can be a reasonable operative option after intestinal resection for CD.

DISCLOSURES

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Conflict of Interest: The authors have no conflicts of interest to disclose for this study.

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SUPPORTING INFORMATION

A portion of the data from the present study was presented at the 58th Annual Meeting of the Society for Surgery of the Alimentary Tract (SSAT, DDW), May 6–9, 2017, Chicago, IL, Asian Organization for Crohn's & Colitis 2018 (AOCC 2018), June 21–23, 2018, Shanghai, China, and the 18th Annual meeting of the Japanese Society of Gastroenterological Surgery (JDDW 2020), November 5–8, 2020, Kobe, Japan.

Additional supporting information may be found online in the Supporting Information section.

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