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ORIGINAL ARTICLE

Temporary diverting stoma in therapy-refractory luminal colonic Crohn's disease: an alternative to immediate colorectal resection?

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Abstract

Aim: Creation of a diverting stoma in patients with Crohn's disease (CD) can counteract luminal inflammation. The clinical utility of a diverting stoma with the prospect of restoration of gastrointestinal continuity warrants further investigation. The aim of this work was to evaluate the long-term effects of creation of a diverting stoma on the disease course in patients with luminal colonic CD.

Method: In this retrospective, multicentre cohort study we investigated the disease course of patients who received a diverting stoma in the biological era. Clinical characteristics, medication use and surgical course were assessed at the time of creation of the diverting stoma and during follow-up. The primary outcome was the rate of successful and lasting reestablishment of gastrointestinal continuity.

Results: Thirty six patients with refractory luminal CD from four institutions underwent creation of a diverting stoma. Of the overall cohort, 20 (56%) patients had their gastrointestinal continuity reestablished after initial stoma creation and 14 (39%) who had their stoma reversed remained stoma-free during a median of 3.3 years follow-up (interquartile range 2.1–6.1 years). Absence of stoma reversal was associated with the presence of proctitis ($p = 0.02$). Colorectal resection after creation of a diverting stoma was performed in 28 (78%) patients, with 7 (19%) having a less extensive resection and 6 (17%) having a more extensive resection compared with the surgical plan before stoma creation.

Conclusion: A diverting stoma could potentially be an alternative to immediate definitive stoma placement in specific populations consisting of patients with luminal colonic CD, especially in the absence of proctitis.

KEYWORDS
abdominal surgery, Crohn's disease, diverting stoma, Faecal diversion, inflammatory bowel disease

A. M. van der Holst and Antonius T. Otten contributed equally.

INTRODUCTION

Crohn's disease (CD) is a chronic relapsing inflammatory disease affecting the gastrointestinal (GI) tract characterized by a globally increasing incidence [1, 2]. Treatment of CD is focused on inducing and maintaining remission of intestinal inflammation, intended to preserve a noninflammatory state and to prevent long-term disease complications [3]. Despite recent advances in medical management, such as the introduction of biological therapy, current treatment options are still accompanied by a lack of or loss of response in a considerable fraction of patients [4, 5].

Stoma placement allows for diversion of the faecal stream away from diseased bowel segments. This surgical procedure can be performed to optimize the patient's condition [6, 7]. Placement of a diverting stoma is a minimally invasive procedure compared with extensive intestinal resection, with the prospect of restoration of GI continuity once inflammation and symptoms have subsided. While faecal diversion has been demonstrated to provide temporary relief of symptoms in patients with perianal CD, successful restoration of GI continuity is only achieved in a limited number of patients [6–11].

Chronic luminal inflammation of the colon can similarly be effectively mitigated by faecal stream diversion [12–14], an effect which appears to be limited to CD [7]. Approximately 50%–70% of CD patients experience colonic involvement, with 25% requiring a colorectal resection [15, 16]. Such resection carries the risk of definitive stoma placement.

The potential clinical utility of placing a diverting stoma in patients with refractory luminal CD merits further consideration. Furthermore, the disease course before and after stoma placement may be significantly influenced by biological therapy [17]. The aim of the present study is to evaluate the long-term effect of a diverting stoma in patients with luminal colonic CD, with special attention given to successful reestablishment of GI continuity and the avoidance of a permanent stoma. Furthermore, we aim to identify factors influencing clinical response and successful restoration of GI continuity, as standardized treatment protocols after diverting stoma creation are currently lacking.

What does this paper add to the literature?

A temporary diverting stoma for refractory colonic luminal Crohn's disease, with the prospect of reestablishment of gastrointestinal continuity, could potentially be employed to not only control inflammation but also buy valuable time to optimize medical treatment and potentially avoid the need for definitive stoma placement.

METHOD

Study design and study population

A retrospective, multicentre cohort study was conducted in four medical centres in the Netherlands: Maastricht University Medical Centre (MUMC), University Medical Centre Groningen (UMCG), Isala Hospital Zwolle and Amsterdam University Medical Centre (AMC). All patients with CD who received a diverting stoma in the period 2008 to 2021 were identified using Diagnosis Treatment Combinations (DTC) and included once the criteria were met. Inclusion criteria for this study were as follows: an established diagnosis of CD existing for at least 1 year, age 18 years or over and placement of a diverting stoma for medically refractory luminal CD involving the colon (Montreal L2 or L3). Exclusion criteria were creation of a diverting stoma for the purpose of controlling perianal disease and ileal disease rather than controlling luminal colonic CD, presence of intestinal fistulas and previous colorectal resection.

Data collection

Detailed phenotypic data were collected for all patients, including patient characteristics, relevant surgical history, disease activity and routine diagnostic laboratory parameters, all of which were assessed at the time of placement of the diverting stoma. Operative details such as stoma type and pre- and postoperative complications were collected. Data regarding medication use and changes in medication prior to, during and after stoma placement were collected. Effects of the diverting stoma were assessed during follow-up through reported reduction in symptoms, mucosal healing as assessed by endoscopy, stoma related complications, restoration of GI continuity and the occurrence of additional surgical and medical intervention. Patients were followed-up from baseline until the most recent date of contact with their treating physician. If a colorectal resection was performed after stoma placement, experienced abdominal surgeons were asked to judge the required extent of resection before and after placement of the diverting stoma. An experienced inflammatory bowel disease (IBD) surgeon from each participating centre was presented with all endoscopic and radiological images that were available in the time preceding placement of the diverting stoma and was asked to define a surgical plan for resection that would have been carried out if the patient had not been defunctioned. The proposed surgical plan was then compared with the resection that was ultimately carried out, to identify a possible reduction or extension of resected segments.

Study outcomes and definitions

The primary outcome of this study was the rate of successful reestablishment of GI continuity. Secondary outcomes were the colorectal resection rate, and, in case of such resection, the extent of colorectal resection compared with the surgical plan prior to the diverting stoma. Additionally, response to faecal diversion was defined as a reduction of symptoms evident from reports made by the treating physicians.

TABLE 1 Demographic and clinical characteristics at the time of creation of a diverting stoma and medication prior to and following stoma creation (total cohort $N = 36$).

Demographics	Value
Age (years)	33 [28–43]
Female gender, *n* (%)	22 (61)
BMI > 25 kg/m^2, *n* (%)	10 (28)
BMI < 18 kg/m^2, *n* (%)	8 (22)
Smoking at time of diverting stoma creation, *n* (%)	11 (31)
Family history of IBD, *n* (%)	6 (17)
Extraintestinal disease, *n* (%)	7 (19)
Disease location	
Montreal L1, *n* (%)	0 (0)
Montreal L2, *n* (%)	23 (64)
Montreal L3, *n* (%)	13 (36)
Concomitant perianal disease, *n* (%)	3 (8)
Inflammation restricted to the proximal colon (ascending–transversum), *n* (%)	4 (11)
Inflammation restricted to the distal colon (descending–sigmoid), *n* (%)	6 (17)
Inflammation throughout all colonic segments, *n* (%)	26 (72)
Colonic luminal inflammation with rectal involvement, *n* (%)	18 (50)
Medication use 3 months prior to procedure	
Immunomodulator and biological therapy, *n* (%)	29 (81)
Immunomodulator monotherapy, *n* (%)	2 (6)
Biological monotherapy, *n* (%)	19 (53)
Biological + immunomodulator, *n* (%)	8 (22)
Steroid use, *n* (%)	23 (64)
Steroid monotherapy, *n* (%)	7 (19)
Steroid use concomitant with use of immunomodulator and/or biological, *n* (%)	16 (44)
Alterations in immunomodulator and biological therapy after diverting stoma creation	
No alterations in biological and immunomodulator therapy, *n* (%)	15 (42)
Start of or switch to new biological and/or immunomodulator therapy, *n* (%)	16 (44)
Start of immunomodulator monotherapy, *n* (%)	1 (3)
Start of immunomodulator next to unchanged biological therapy, *n* (%)	4 (11)
Start or switch of biological therapy, n (%)	11 (31)
Start or switch of biological monotherapy, *n* (%)	5 (14)
Start or switch of biological + start of immunomodulator, *n* (%)	3 (8)
Switch of biological next to unchanged immunomodulator, *n* (%)	2 (6)
Switch of both biological and immunomodulator, *n* (%)	1 (3)
Stop of medication, *n* (%)	5 (14)
Stop of biological monotherapy, *n* (%)	2 (6)
Stop of immunomodulator monotherapy, *n* (%)	1 (3)
Stop of biological + immunomodulator combination therapy, *n* (%)	1 (3)
Stop of immunomodulatory therapy, continuation of existing biological, *n* (%)	1 (3)
Laboratory measurements at time of diverting stoma creation	
Hb (mmol/L)	6.8 [6.3–7.5]
CRP (mg/L)	71.8 [37.3–121.8]
WBC (×10^9/L)	11.6 [6.8–17.6]
Albumin (g/L)	31.0 [26.0–36.8]

Note: Data are presented as median [IQR] or proportions *n* with corresponding percentages (%). Biological and immunomodulator therapy was recorded independent of steroid use.

Abbreviations: BMI, body-mass index; CRP, C-reactive protein; Hb, haemoglobin; IBD, inflammatory bowel disease; WBC, white blood cell count.

Medication use was analysed before and after stoma creation and categorized into steroids, biologicals and immunomodulators. Prestoma use of medication was defined as use of medication in the 3 months prior to stoma creation; poststoma use was defined as a switch in the medication treatment regimen from diverting stoma creation until either stoma reversal, colorectal resection or last follow-up. Outcomes were collected during a follow-up at least 1 year after diverting stoma creation.

Statistical analysis

Baseline characteristics of the study population are presented as mean ± standard deviation (SD), median with interquartile range (IQR) or as proportion *n* with corresponding percentage (%). Assessment of normality of continuous variables was performed by visual inspection of normal probability (Q–Q) plots and histograms. Differences in demographic and clinical data were compared nonparametrically using the Mann–Whitney *U*-test for continuous variables and the chi-square test or Fisher's exact test for nominal variables, as appropriate. Results were considered statistically significant when $p \leq 0.05$. Statistical analysis was conducted using the SPSS Statistics software package (v.25.0; SPSS Inc.).

RESULTS

Characteristics of the study population

A total of 36 patients who underwent placement of a diverting stoma for therapy-refractory luminal CD involving the colon were included in the study. Demographic and clinical characteristics of the study population at the time of creation of the diverting stoma are given in Table 1.

All patients had luminal inflammation of the colon, with 23 patients having colonic CD (Montreal L2) and 13 patients having concurrent inflammation in the ileum (Montreal L3). Perianal disease, concomitant with luminal colonic disease, was present in three patients (8%). In the 3 month period prior to creation of a diverting stoma, 2 (6%) patients were treated with immunomodulator monotherapy, 19 (56%) with biological monotherapy and 8 (22%) with a combination of immunomodulator and biological therapy. In total, 23 (64%) patients were treated with corticosteroids. Seven patients were treated with steroids alone and 16 were treated with steroids concomitant to existing medical therapy. The median follow-up from creation of the diverting stoma to last patient contact was 4 years (IQR 2.3–6 years)

After creation of a diverting stoma, 15 (42%) patients had no alterations in their prestoma use of biological and/or immunomodulator therapy, 16 (44%) either started or switched to new biological and/or immunomodulator therapy and 5 (14%) ceased the use of biological and/or immunomodulator therapy. A detailed overview of the exact alterations in medication is given in Table 1.

Restoration of GI continuity

Treatment outcomes after diverting stoma placement are presented in Figure 1 and Table 2. GI continuity was restored in 20 of the 36 (56%) patients after a median of 1 year (IQR 0.6–1.4 years). Fourteen out of these 20 patients (39% of the overall cohort) remained stoma-free during follow-up for a median 3.3 years (IQR 2.1–6.1 years). Of the six patients who were not stoma-free at last follow-up, five underwent colorectal resection and permanent stoma placement because of relapse of disease after follow-up for a median of 4.4 years (IQR 4.2–5.4 years). One patient had undergone a colorectal resection during a stoma reversal procedure and at a later stage after reversal underwent new stoma placement before last follow-up. Differences in demographic and clinical parameters stratified by rate of GI continuity restoration and stoma-free presentation at follow-up are presented in Tables 3 and 4, respectively.

Effects of diverting stoma placement on colorectal resection

In total, 28 (78% of the total cohort) patients underwent a (partial) colorectal resection after creation of a diverting stoma. Twelve (33%) patients required a colorectal resection in combination with definite stoma placement, without any attempt to restore GI continuity. In the group in which GI continuity was initially restored (n = 20), 16 patients needed colorectal resection before, during or after restoration of GI continuity. Four patients underwent subtotal colectomy in the period between creation of a diverting stoma and stoma reversal, and another seven patients underwent concurrent partial colorectal resection during the stoma reversal procedure. Of these seven patients, four underwent ileocaecal resection, two subtotal colectomy and one right hemicolectomy. An additional five patients required colorectal resection after stoma reversal surgery. Of these five patients, four underwent subtotal colectomy and one underwent a proctocolectomy.

When comparing the initial surgical plan before creation of a diverting stoma with the final colorectal resection after placement of a diverting stoma, 7 out of 28 patients received a less extended resection than in the initial plan, in 15 out of 28 patients the extent of resection was unaltered and in 6 out of 28 patients a more extended resection was performed.

Response to faecal diversion

After creation of a diverting stoma, reduction in symptoms was reported in 30 (83%) patients, with 13 (36%) of these patients reporting a partial reduction in symptoms and 17 (47%) experiencing

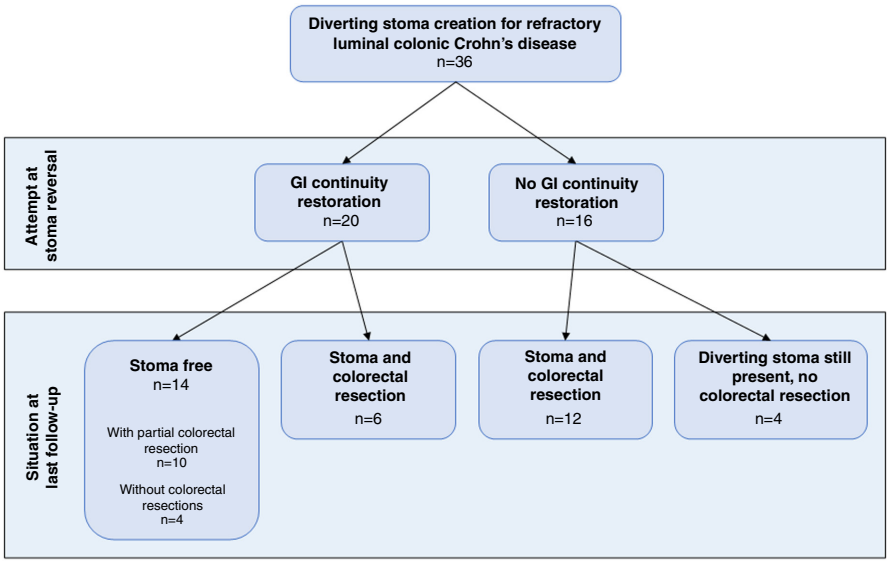

FIGURE 1 Flow diagram of surgical outcomes after diverting stoma placement. Median time until last follow-up consists of 3.3 years (interquartile range 2.1–6.1 years). GI, gastrointestinal continuity.

TABLE 2 Treatment outcomes (total cohort $N = 36$).

Outcome	Value
Follow-up (years)	4 [2.3–6]
Initial improvement during faecal diversion	
No reduction in symptoms, *n* (%)	6 (17)
Reduction in symptoms, *n* (%)	13 (36)
Absence of symptoms, *n* (%)	17 (47)
Endoscopy, *n* (%)	14 (39)
No mucosal healing, *n* (%)	6 (17)
Partial mucosal healing, *n* (%)	7 (19)
Complete mucosal healing, *n* (%)	1 (3)
(Lasting) GI continuity restoration rates	
Attempted GI continuity restoration, *n* (%)	20 (56)
Stoma free at last follow-up, *n* (%)	14 (39)
Colorectal resection surgery rates, *n* (%)	28 (78)
ICR, *n* (%)	4 (11)
Right hemicolectomy, *n* (%)	3 (8)
Left hemicolectomy, *n* (%)	1 (3)
Subtotal colectomy, *n* (%)	15 (42)
Proctocolectomy, *n* (%)	5 (14)
Difference in extension of colorectal resection compared to the initial surgical plan prediverting stoma	
No colorectal resection performed at last follow-up, *n* (%)	8 (22)
Reduced extent of initial colorectal resection plan, *n* (%)	7 (19)
Initial colorectal resection plan unchanged, *n* (%)	15 (42)
Increased extent of initial colorectal resection plan, *n* (%)	6 (17)
Type of stoma	
Loop ileostomy, *n* (%)	24 (67)
Split ileostomy, *n* (%)	8 (22)
End ileostomy, *n* (%)	3 (8)
Loop colostomy transversum, *n* (%)	1 (3)
Postoperative complications after diverting stoma creation, *n* (%)	3 (8)
Fever of undetermined origin, *n* (%)	2 (6)
Ileus, *n* (%)	1 (3)
Postoperative complications after stoma reversal, *n* (%)	2 (6)
Ileus, *n* (%)	1 (3)
Internal bleeding, *n* (%)	1 (3)
Stoma morbidity, *n* (%)	5 (14)
Abscess requiring drainage, *n* (%)	2 (6)
Anxiety, *n* (%)	1 (3)
Peristomal infiltrate, *n* (%)	1 (3)
Stoma torsion, *n* (%)	1 (3)

Note: Data are presented as median [IQR] or proportions *n* with corresponding percentages (%).

Abbreviations: GI. Gastrointestinal; ICR, ileocecal resection.

a complete absence of symptoms. Six patients (17%) did not show any signs of clinical improvement. Endoscopic data after creation of a diverting stoma were available for 14 patients. Mucosal healing on endoscopy was observed in eight patients, with seven patients showing partial healing and one patient achieving complete mucosal healing. Differences in demographic and clinical parameters stratified by response are presented in Table 5. Fourteen (39%) patients showed a reduction in symptoms after placement of a diverting stoma yet did not have their GI continuity restored.

Factors influencing the response to faecal diversion, restoration of GI continuity and colorectal resection

Tables 3, 4 and 5 show the factors influencing treatment outcomes. Sixteen (44%) patients started or switched to new biological and/or immunomodulator therapy after creation of a diverting stoma. Eleven out of 16 patients with altered treatment regimens had their GI continuity restored ($p = 0.15$). Seven out of eight patients in whom new immunomodulator therapy was introduced, either in combination with biological therapy or as monotherapy, had their GI continuity restored ($p = 0.02$) and six patients remained stoma-free to last follow-up ($p = 0.04$). Out of 11 patients who started or switched to a new biological agent, either in combination with immunomodulator therapy or as monotherapy, seven had their GI continuity restored ($p = 0.52$) and four remained stoma-free to last follow-up ($p = 0.84$).

The presence of mucosal inflammation in the rectum was identified as a risk factor for absence of restoration of GI continuity. Seventeen per cent of patients with proctitis were stoma-free at follow-up ($p = 0.02$). All four patients with inflammation limited to the right side of the colon had a stoma-free presentation at follow-up ($p = 0.02$). A baseline increased C-reactive protein (CRP (mg/L)) [97 (IQR 59–214) vs. 56 (IQR 31–93), $p = 0.16$] and white blood cell count (WBC (×10^9/L)) [15.9 (7.1–20.7) vs. 8.0 (6.6–13.6), $p = 0.13$] showed a trend towards the absence of restoration of GI continuity and the need for permanent faecal diversion.

Complications of stoma-related surgery and stoma morbidity

Three (8%) patients developed postoperative complications after creation of a diverting stoma and were subsequently readmitted to hospital within 30 days. One patient developed an ileus and two had fever of unknown origin.

Stoma morbidity was reported in five (14%) patients. One of them developed a peristomal infiltrate, another developed stoma torsion, one developed anxiety symptoms provoked by the stoma and two developed a peristomal abscess that required drainage.

After stoma reversal ($n = 20$), two patients developed complications and were readmitted to hospital within 30 days. One patient developed internal bleeding for which reoperation was necessary and one patient developed an ileus, which was treated

TABLE 3 Differences in demographic and (preoperative) clinical parameters between patients who eventually did or did not have their GI continuity restored after creation of a diverting stoma.

Parameter	GI continuity restored ($n = 20$)	GI continuity not restored ($n = 16$)	p-value
Age (years)	33 [25–46]	35 [28–41]	0.55
Female gender, *n* (%)	11 (55.0)	11 (68.8)	0.40
BMI > 25 kg/m^2, *n* (%)	5 (25.0)	5 (31.3)	0.68
BMI < 19 kg/m^2, *n* (%)	5 (25.0)	3 (18.8)	0.65
Disease duration (days)	1449 [200–2596]	3128 [1489–4385]	**0.03**
Ongoing smoking, *n* (%)	5 (25)	0 (0)	**0.03**
Family history of IBD, *n* (%)	3 (15.0)	3 (18.8)	0.76
Extraintestinal disease, *n* (%)	3 (15.0)	4 (25.0)	0.45
Disease location			
Montreal L2, *n* (%)	13 (65.0)	10 (62.5)	0.87
Montreal L3, *n* (%)	7 (35.0)	6 (37.5)	0.87
Concomitant perianal disease, *n* (%)	1 (5.0)	2 (12.5)	0.42
Inflammation restricted to the proximal colon (ascending–transversum), *n* (%)	4 (20.0)	0 (0.0)	0.06
Inflammation restricted to the distal colon (descending–sigmoid), *n* (%)	2 (10.0)	4 (25.0)	0.23
Inflammation throughout all colonic segments, *n* (%)	14 (70.0)	12 (75.0)	0.74
Colonic luminal inflammation with rectal involvement, *n* (%)	7 (35.0)	11 (68.8)	**0.04**
Preoperative immunomodulator and biological therapy			
Immunomodulator monotherapy, *n* (%)	2 (10.0)	0 (0.0)	0.19
Biological monotherapy, *n* (%)	9 (45.0)	10 (62.5)	0.30
Biological + immunomodulator, *n* (%)	5 (25.0)	3 (18.8)	0.65
Laboratory measurements			
Hb (mmol/L)	6.8 [6.3–7.5]	6.6 [6.3–7.5]	0.80
CRP (mg/L)	97 [59–214]	56 [31–93]	0.16
WBC (×10^9/L)	15.9 [7.1–20.7]	8.0 [6.6–13.6]	0.13
Albumin (g/L)	31 [26–35]	33 [23–38]	0.71
Initial response to faecal diversion			
Reduction in symptoms, *n* (%)	6 (30)	7 (43.8)	0.39
Complete absence of symptoms, *n* (%)	10 (50)	7 (43.8)	0.71
Mucosal healing during endoscopy, *n* (%)	5 (25.0)	3 (18.8)	0.28
Alterations in immunomodulator and biological therapy after diverting stoma creation			
No alterations in immunomodulator and biological therapy, *n* (%)	7 (35.0)	8 (50)	0.36
Start of or switch to new biological and/or immunomodulator therapy, *n* (%)	11 (55.0)	5 (31.3)	0.15
Stop of medication, *n* (%)	2 (10.0)	3 (18.8)	0.45

Note: Data are presented as median [IQR] or proportions *n* with corresponding percentages (%).

Abbreviations: BMI, body-mass index; CRP, C-reactive protein; GI, gastrointestinal; Hb, haemoglobin; IBD, inflammatory bowel disease; WBC, white blood cell count.

conservatively. Two patients were admitted within 30 days of stoma reversal to receive a permanent stoma due to recurrence of disease. No patient deaths and no colorectal malignancies were reported during follow-up.

DISCUSSION

In this multicentre retrospective study investigating the long-term outcome of creation of a diverting stoma on the course of refractory

TABLE 4 Differences in demographic and (preoperative) clinical parameters between patients who eventually remained stoma-free after restoration of GI continuity and patients who did not undergo restoration of GI continuity or received stoma after initial reversal.

Parameter	Stoma-free at follow-up ($n = 14$)	Stoma not reversed or stoma replacement after initial reversal ($n = 22$)	p-value
Age (years)	33 [22–47]	35 [28–42]	0.52
Female gender, *n* (%)	7 (50.0)	15 (68.2)	0.28
BMI > 25 kg/m^2, *n* (%)	5 (35.7)	5 (22.7)	0.40
BMI < 19 kg/m^2, *n* (%)	2 (14.3)	6 (27.3)	0.36
Disease duration (days)	975 [81–2551]	2877 [1418–4107]	**0.01**
Ongoing smoking, *n* (%)	3 (21.4)	2 (9.1)	0.30
Family history of IBD, *n* (%)	3 (21.4)	3 (13.6)	0.54
Extraintestinal disease, *n* (%)	3 (21.4)	4 (18.2)	0.81
Disease location			
Montreal L2, *n* (%)	8 (57.1)	15 (68.2)	0.50
Montreal L3, *n* (%)	6 (42.9)	7 (31.8)	0.50
Concomitant perianal disease, *n* (%)	1 (7.1)	2 (9.1)	0.84
Inflammation restricted to the proximal colon (ascending–transversum), *n* (%)	4 (28.6)	0 (0)	**>0.01**
Inflammation restricted to the distal colon (descending–sigmoid), *n* (%)	1 (7.1)	5 (22.7)	0.22
Inflammation throughout all colonic segments, *n* (%)	9 (64.3)	17 (77.3)	0.40
Colonic luminal inflammation with rectal involvement, *n* (%)	3 (21.4)	15 (68.2)	**>0.01**
Preoperative immunomodulator and biological therapy			
Immunomodulator monotherapy, *n* (%)	2 (14.3)	0 (0.0)	0.07
Biological monotherapy, *n* (%)	7 (50.0)	12 (54.5)	0.79
Biological + immunomodulator, *n* (%)	3 (21.4)	5 (22.7)	0.93
Laboratory measurements			
Hb (mmol/L)	6.9 [6.3–7.7]	6.6 [6.1–7.4]	0.49
CRP (mg/L)	97 [59–214]	53 [30–78]	0.05
WBC (x10^9/L)	15.9 [7.1–20.7]	8.0 [6.6–13.6]	0.13
Albumin (g/L)	31 [26–36]	33 [23–38]	0.74
Initial response to faecal diversion			
Reduction in symptoms, *n* (%)	4 (28.6)	9 (40.9)	0.45
Complete absence of symptoms, *n* (%)	6 (42.9)	11 (50.0)	0.68
Mucosal healing during endoscopy, *n* (%)	4 (28.6)	4 (18.1)	0.20
Alterations in biological and immunomodulator therapy after diverting stoma creation			
No alterations in biological and immunomodulator therapy, *n* (%)	4 (28.6)	11 (50)	0.20
Start of or switch to new biological and/or immunomodulator therapy, *n* (%)	8 (57.1)	8 (36.4)	0.22
Stop of medication, *n* (%)	2 (14.3)	3 (13.6)	0.96

Note: Data are presented as median [IQR] or proportions *n* with corresponding percentages (%).

Abbreviations: BMI, body-mass index; CRP, C-reactive protein; Hb, haemoglobin; IBD, inflammatory bowel disease; WBC, white blood cell count.

luminal colonic CD we obtained a couple of findings that could guide clinical implementation of a diverting stoma as a potential treatment modality in these patients. We found that 56% of patients with refractory luminal colonic CD had their GI continuity reestablished after creation of a diverting stoma, with 70% of these patients remaining stoma-free up to last follow-up. Thus, in this cohort, the chance of lasting restoration of GI continuity after creation of a diverting stoma due to colonic luminal CD is 38% at a median of 3.3 years' follow up. Importantly, we identified that a colonic inflammation pattern in which the rectum is affected is significantly

TABLE 5 Differences in demographic and (preoperative) clinical parameters between patients showing complete absence of symptoms, partial reduction in symptoms or no reduction in symptoms after creation of a diverting stoma.

Parameter	Absence of symptoms ($n = 17$)	Reduction in symptoms ($n = 13$)	No reduction in symptoms ($n = 6$)	p-value
Age (years)	32 [27–43]	35 [33–50]	31 [22–38]	0.19
Female gender, *n* (%)	13 (76.5)	8 (61.5)	1 (16.7)	**0.04**
BMI > 25 kg/m^2, *n* (%)	4 (23.5)	5 (38.5)	1 (16.7)	0.53
BMI < 19 kg/m^2, *n* (%)	4 (23.5)	4 (30.8)	0 (0)	0.32
Disease duration (days)	2529 [742–5360]	2314 [1244–4152]	1148 [582–2465]	0.31
Ongoing smoking, *n* (%)	1 (5.9)	4 (30.8)	0 (0)	0.08
Family history of IBD, *n* (%)	2 (11.8)	2 (15.4)	2 (33.3)	0.47
Extraintestinal disease, *n* (%)	2 (11.8)	3 (23.1)	2 (33.3)	0.48
Disease location				
Montreal L2, *n* (%)	11 (64.7)	8 (61.5)	4 (66.7)	0.97
Montreal L3, *n* (%)	6 (35.3)	5 (38.5)	2 (33.3)	0.97
Concomitant perianal disease, *n* (%)	2 (11.8)	0 (0.0)	1 (16.7)	0.37
Inflammation restricted to the proximal colon (ascending–transversum), *n* (%)	2 (11.8%)	2 (15.4)	0 (0)	0.69
Inflammation restricted to the distal colon (descending–sigmoid), *n* (%)	2 (11.8)	3 (23.1)	1 (16.7)	0.72
Inflammation throughout all colonic segments, *n* (%)	13 (76.5)	8 (61.5)	5 (83.3)	0.53
Colonic luminal inflammation with rectal involvement, *n* (%)	10 (58.8)	6 (46.2)	2 (33.3)	0.53
Preoperative immunomodulator and biological therapy				
Immunomodulator monotherapy, *n* (%)	1 (5.9)	1 (7.7)	0 (0)	0.79
Biological monotherapy, *n* (%)	12 (70.6)	3 (23.1)	4 (66.7)	**0.03**
Biological + immunomodulator, *n* (%)	2 (11.8)	5 (38.5)	1 (16.7)	0.21
Laboratory measurements				
Hb (mmol/L)	6.9 [6.3–7.7]	6.6 [5.7–6.9]	6.7 [6.5–7.3]	0.48
CRP (mg/L)	65 [28–108]	85 [50–169]	137 [38–223]	0.45
WBC (×10^9/L)	9.7 [6.4–14.1]	15.0 [7.6–21.4]	12.3 [5.2–122.3]	0.59
Albumin (g/L)	31 [28–38]	26 [20–38]	31 [30–NA]	0.63
Alterations in biological and immunomodulator therapy after diverting stoma creation				
No alterations in biological and immunomodulator therapy, *n* (%)	10 (58.8)	3 (23.1)	2 (33.3)	0.13
Start of or switch to new biological and/or immunomodulator therapy, *n* (%)	6 (35.3)	7 (53.8)	3 (50.0)	0.57
Stop of medication, *n* (%)	1 (5.9)	3 (23.1)	1 (16.7)	0.39

Note: Data are presented as median [IQR] or proportions *n* with corresponding percentages (%).

Abbreviations: BMI, body-mass index; CRP, C-reactive protein; Hb, haemoglobin; IBD, inflammatory bowel disease; WBC, white blood cell count.

associated with failure to restore GI continuity. These findings suggest that an indication based on disease location could increase the chances of successful and lasting reestablishment of GI continuity after faecal diversion.

Historically, this procedure has been extensively leveraged to control both luminal and perianal CD and to optimize the patient's condition [6, 7]. Studies performed in the prebiological era, investigating the effect of creation of a diverting stoma on the disease

course of refractory colonic luminal CD, report rates of restoration of GI continuity varying from 7% to 54% [7, 12, 18–20]. Stoma-free survival rates reported by studies carried out in the biological era also vary greatly, from 0%to 50% [21–26]. The largest recent retrospective study investigating the effects of faecal diversion on luminal colonic CD in a population largely treated with biologicals reported a rate of restoration of GI continuity of 18.9% [24]. While these data suggest that a diverting stoma is rather a bridge to more definitive surgery, our data show that a diverting stoma might lead to lasting stoma-free survival in over a third of patients with refractory luminal colonic CD. In the absence of rectal inflammation, this fraction increases to 61% of patients. In other case series investigating distal CD, proctitis was also identified as a predictor of unsuccessful stoma reversal after faecal diversion [8, 25, 27]. Additionally, all four patients with inflammation restricted to their proximal colon underwent a successful and lasting stoma reversal procedure. It is possible that the patients with right-sided Crohn's colitis are a different population from those with more extensive colonic involvement, reacting differently to the creation of a diverting stoma. However, the limited number of these patients in this cohort does not directly justify any definite conclusion.

The introduction of biological therapy does not seem to have instigated a dramatic shift in treatment outcomes after faecal diversion in CD [21, 23]. A recent study investigating the effects of faecal diversion on perianal CD did report that biological therapy was associated with restoration of GI continuity [9]. In our cohort, biological therapy before and after a diverting stoma did not significantly influence outcomes. However, introduction of a new immunomodulator agent, either in combination with a biological or as monotherapy, was associated with lasting reestablishment of GI continuity. This finding might suggest that optimization of medical therapy after a diverting stoma might improve outcomes. The question remains whether a synergetic effect of a switch in medical treatment and faecal diversion, or inadequate medical treatment prior to stoma placement caused to these observed improvements in treatment outcomes. These findings do suggest that a temporary stoma can be employed to buy time to establish optimization of the medical treatment regimen and incidentally can provide the patient with a period to adapt to the prospect of a definitive stoma while reestablishment of GI continuity is still a viable option. Additionally, a trend was observed of relatively lower levels of baseline WBC and CRP with higher numbers of stoma reversals, suggesting a potential role for inflammatory biomarkers to guide initiation of treatment with a diverting stoma.

Although a considerable number of patients benefit from (ileo) colonic resection, resection of the inflamed bowel segments is rarely curative in patients with CD. Patients are at risk of multiple reoperations and, ultimately, 25%–30% of CD patients require definitive stoma placement [11, 28]. Permanent stoma placement and subsequent stoma morbidity have a negative and lasting impact on the psychological well-being of patients [29, 30]. Considering that the peak incidence of onset of CD lies between 20 and 39 years [2], stoma placement greatly impacts a considerable part of a patient's life. A temporary diverting stoma as an alternative to immediate colorectal resection with permanent stoma placement could be an important and more patient-friendly treatment modality worthy of further exploration.

Even though 39% of patients did not require permanent stoma placement, it is important to acknowledge that only 11% attained reestablishment of GI continuity in the complete absence of colorectal resection; an additional 11% of patients did not undergo colorectal resection but their diverting stoma was not yet reversed at follow-up. Considering the overall colorectal resection rate of 78% in this cohort, patients with CD having luminal colonic disease are still at high risk of surgical intervention after creation of a diverting stoma. However, 19% of patients underwent colorectal resection to a reduced extent compared with the initial resection planned before creation of a diverting stoma. These findings, while also considering the 22% of patients who did not undergo colorectal resection, suggest that 41% of patients in the overall cohort benefited from creation of a diverting stoma with respect to a reduced extent or avoidance of resection. These findings should be interpreted cautiously, as 17% of patients in this cohort ended up with a more extensive resection.

In 39% of patients there was no attempt to restore GI continuity despite clinical improvement. A noticeable absence of active stoma reversal plans was present in most of these patients. There is little evidence for the optimal timing of stoma reversal after creation of a diverting stoma, and currently there are no protocols that offer guidance to the treating physician [31, 32]. The argument for refraining from reestablishment of GI continuity is not well documented, but the appreciated clinical remission and patient satisfaction with the situation seem to play an important role. Reported reasons to postpone stoma reversal in our cohort were a wish for pregnancy in women and acceptance of the stoma after living with a diverting stoma for an extended period of time. However, future decision-making related to restoration of GI continuity may be hampered by the occurrence of diversion colitis. Biochemical changes and a shift towards aerobic gut microbiota in excluded bowel segments may trigger inflammatory processes, easily mistaken for CD [33–35]. Diversion colitis occurs in 90% of patients with preexisting IBD, leading to symptoms such as abdominal pain and rectal bleeding in a third of patients [33]. Diversion colitis is estimated to occur 6 months to 3 years after creation of a diverting stoma and can be resolved by the restoration of GI continuity [36]. The optimal effect of faecal diversion on the CD disease course is reached within a year, after which its effects start to diminish [19]. These findings suggest that, in the case of complete remission, further delay of stoma reversal would offer no additional advantage. This underlines the need for a standardized protocol describing active stoma reversal plans.

Several limitations of this study warrant recognition. For example, the relatively small study cohort, the retrospective design, the relative lack of endoscopic data and the absence of a standardized treatment protocol after placement of a diverting stoma limited the collection of follow-up data that might have been accessible in a prospective study design with standardized treatment decisions.

Clinical response parameters were based on doctors' notes in electronic patient files, and therefore lack the objective and reproducible assessment that disease scores (i.e. Crohn's Disease Activity Index) and clinical laboratory parameters (i.e. faecal calprotectin, CRP) bring. However, as there was no loss to follow up, it is likely that the current results constitute a representative outcome of daily clinical practice.

In conclusion, diversion of the faecal stream by means of a diverting stoma might be an alternative to immediate placement of a permanent stoma in patients with refractory luminal colonic CD, especially in the absence of proctitis. Faecal diversion in combination with an optimized medical treatment regimen might improve treatment outcomes. A temporary diverting stoma could be considered as a viable treatment option in a specific subgroup of patients with refractory luminal colonic CD. Future studies based on larger numbers of patients, enabling a carefully considered decision protocol, are warranted to further establish the role of placement of a diverting stoma as a potential treatment modality in luminal colonic CD.

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DATA AVAILABILITY STATEMENT

The dataset(s) used for the current study are available from the corresponding author upon reasonable request

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ETHICS STATEMENT

Medical ethical approval was obtained in all participating hospitals (ref no. 2018/0777). The study was conducted according to the principles of the Declaration of Helsinki (2013).

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REFERENCES

1. Torres J, Mehandru S, Colombel JF, Peyrin-Biroulet L. Crohn's disease. Lancet. 2017;389(10080):1741–55.
2. Ng SC, Shi HY, Hamidi N, Underwood FE, Tang W, Benchimol EI, et al. Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: a systematic review of population-based studies. Lancet. 2017;390(10114):2769–78.
3. Torres J, Bonovas S, Doherty G, Kucharzik T, Gisbert JP, Raine T, et al. ECCO guidelines on therapeutics in Crohn's disease: medical treatment. J Crohn's Colitis. 2020;14:4–22.
4. Frolkis AD, Dykeman J, Negrón ME, Debruyn J, Jette N, Fiest KM, et al. Risk of surgery for inflammatory bowel diseases has decreased over time: a systematic review and meta-analysis of population-based studies. Gastroenterology. 2013;145(5):996–1006.
5. Bernstein CN, Loftus EV Jr, Ng SC, Lakatos PL, Moum B. Hospitalisations and surgery in Crohn's disease. Gut. 2012;61(4):622–9.
6. McIlrath DC. Diverting ileostomy or colostomy in the management of Crohn's disease of the colon. Arch Surg. 1971;103(2):308–10.
7. Harper PH, Truelove SC, Lee EC, Kettlewell MG, Jewell DP. Split ileostomy and ileocolostomy for Crohn's disease of the colon and ulcerative colitis: a 20 year survey. Gut. 1983;24(2):106–13.
8. Singh S, Ding NS, Mathis KL, Dulai PS, Farrell AM, Pemberton JH, et al. Systematic review with meta-analysis: faecal diversion for management of perianal Crohn's disease. Aliment Pharmacol Ther. 2015;42(7):783–92.
9. McCurdy JD, Reid J, Yanofsky R, Sinnathamby V, Medawar E, Williams L, et al. Fecal diversion for perianal Crohn disease in the era of biologic therapies: a multicenter study. Inflamm Bowel Dis. 2022;28(2):226–33.
10. Burke JP. Role of fecal diversion in complex Crohn's disease. Clin Colon Rectal Surg. 2019;32(4):273–9.
11. Adamina M, Bonovas S, Raine T, Spinelli A, Warusavitarne J, Armuzzi A, et al. ECCO guidelines on therapeutics in Crohn's disease: surgical treatment. J Crohn's Colitis. 2020;14(2):155–68.
12. Edwards CM, George BD, Jewell DP, Warren BF, Mortensen NJ, Kettlewell MG. Role of a defunctioning stoma in the management of large bowel Crohn's disease. Br J Surg. 2000;87(8):1063–6.
13. Harper PH, Lee EC, Kettlewell MG, Bennett MK, Jewell DP. Role of the faecal stream in the maintenance of Crohn's colitis. Gut. 1985;26(3):279–84.
14. Watanabe Y, Mizushima T, Okumura R, Fujino S, Ogino T, Miyoshi N, et al. Fecal stream diversion changes intestinal environment, modulates mucosal barrier, and attenuates inflammatory cells in Crohn's disease. Dig Dis Sci. 2022;67(6):2143–57.
15. Lo B, Vester-Andersen MK, Vind I, Prosberg M, Dubinsky M, Siegel CA, et al. Changes in disease behaviour and location in patients with Crohn's disease after seven years of follow-up: a Danish population-based inception cohort. J Crohn's Colitis. 2018;12(3):265–72.
16. Wintjens D, Bergey F, Saccenti E, Jeuring S, van den Heuvel T, Romberg-Camps M, et al. Disease activity patterns of Crohn's disease in the first ten years after diagnosis in the population-based IBD South Limburg cohort. J Crohn's Colitis. 2021;15(3):391–400.
17. Coscia M, Gentilini L, Laureti S, Gionchetti P, Rizzello F, Campieri M, et al. Risk of permanent stoma in extensive Crohn's colitis: the impact of biological drugs. Colorectal Dis. 2013;15(9):1115–22.
18. Winslet MC, Andrews H, Allan RN, Keighley MR. Fecal diversion in the management of Crohn's disease of the colon. Dis Colon Rectum. 1993;36(8):757–62.
19. Burman J, Thompson H, Cooke W, Williams JA. The effects of diversion of intestinal contents on the progress of Crohn's disease of the large bowel. Gut. 1971;12(1):11–5.
20. Oberhelman HA Jr, Kohatsu S, Taylor KB, Kivel RM. Diverting ileostomy in the surgical management of Crohn's disease of the colon. Am J Surg. 1968;115(2):231–40.
21. Bafford AC, Latushko A, Hansraj N, Jambaulikar G, Ghazi LJ. The use of temporary fecal diversion in colonic and perianal crohn's disease does not improve outcomes. Dig Dis Sci. 2017;62(8):2079–86.
22. Mennigen R, Heptner B, Senninger N, Rijcken E. Temporary fecal diversion in the management of colorectal and perianal Crohn's disease. Gastroenterol Res Pract. 2015;2015:286315.

23. Martí-Gallostra M, Myrelid P, Mortensen N, Keshav S, Travis SP, George B. The role of a defunctioning stoma for colonic and perianal Crohn's disease in the biological era. Scand J Gastroenterol. 2017;52(3):251–6.
24. Lightner AL, Buhulaigah H, Zaghiyan K, Holubar SD, Steele SR, Jia X, et al. Is intestinal diversion an effective treatment for distal Crohn's disease? Inflamm Bowel Dis. 2022;28(4):547–52.
25. Müller C, Bergmann M, Stift A, Argeny S, Speake D, Unger L, et al. Restoration of intestinal continuity after stoma formation for Crohn's disease in the era of biological therapy: a retrospective cohort study. Wien Klin Wochenschr. 2020;132(1–2):12–8.
26. Russell TA, Dawes AJ, Graham DS, Angarita SAK, Ha C, Sack J. Rescue diverting loop ileostomy: an alternative to emergent colectomy in the setting of severe acute refractory IBD-colitis. Dis Colon Rectum. 2018;61(2):214–20.
27. Gu J, Valente MA, Remzi FH, Stocchi L. Factors affecting the fate of faecal diversion in patients with perianal Crohn's disease. Colorectal Dis. 2015;17(1):66–72.
28. Lapidus A, Bernell O, Hellers G, Löfberg R. Clinical course of colorectal Crohn's disease: a 35-year follow-up study of 507 patients. Gastroenterology. 1998;114(6):1151–60.
29. Kasparek MS, Glatzle J, Temeltcheva T, Mueller MH, Koenigsrainer A, Kreis ME. Long-term quality of life in patients with Crohn's disease and perianal fistulas: influence of fecal diversion. Dis Colon Rectum. 2007;50(12):2067–74.
30. Knowles SR, Wilson J, Wilkinson A, Connell W, Salzberg M, Castle D, et al. Psychological well-being and quality of life in Crohn's disease patients with an ostomy: a preliminary investigation. J Wound Ostomy Cont Nurs. 2013;40(6):623–9.
31. Goldberg M, Aukett LK, Carmel J, Fellows J, Folkedahl B, Pittman J, et al. Management of the patient with a fecal ostomy: best practice guideline for clinicians. J Wound Ostomy Cont Nurs. 2010;37(6):596–8.
32. Taylor C, Morgan L. Quality of life following reversal of temporary stoma after rectal cancer treatment. Eur J Oncol Nurs. 2011;15(1):59–66.
33. Tominaga K, Kamimura K, Takahashi K, Yokoyama J, Yamagiwa S, Terai S. Diversion colitis and pouchitis: a mini-review. World J Gastroenterol. 2018;24(16):1734–47.
34. Beamish EL, Johnson J, Shaw EJ, Scott NA, Bhowmick A, Rigby RJ. Loop ileostomy-mediated fecal stream diversion is associated with microbial dysbiosis. Gut Microbes. 2017;8:467–78.
35. Kleinwort A, Döring P, Hackbarth C, Heidecke CD, Schulze T. Deviation of the fecal stream in colonic bowel segments results in increased numbers of isolated lymphoid follicles in the submucosal compartment in a novel murine model of diversion colitis. Biomed Res Int. 2017;2017:5265969.
36. Korelitz BI, Cheskin LJ, Sohn N, Sommers SC. The fate of the rectal segment after diversion of the fecal stream in Crohn's disease: its implications for surgical management. J Clin Gastroenterol. 1985;7:37–43.

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