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Ileal pouch–anal anastomosis—a personal experience reevaluating complications, pouch survival, and quality of life

For several decades now, ileal pouch–anal anastomosis (IPAA, or J-pouch) has been the surgical method of choice after removal of the colon and rectum. Ulcerative (UC) and indeterminate (IC) colitis as well as familial adenomatous polyposis (FAP) are considered classic indications for the procedure [3, 4, 9, 11, 17]. IPAA may also be possible in selected patients with Crohn's colitis (CC) and severe motility disorders of the colorectum in terms of slow transit constipation (STC) [18, 14]. Technical details of the operation appear solved. Relatively early in the history of its development, the J-pouch became accepted as the preferred design for pouch construction [9]. However, the type of anastomosis construction, the necessity and usefulness of postoperative temporary fecal deviation, the appropriate surgical approach, and different strategies for various underlying diseases have yet to be definitively clarified.

Irrespective of the ultimate answers to open questions, the outcomes—measured in terms of surgical results and quality of life (QOL)—are consistently considered to be satisfactory by both surgeons and patients [9]. Surprisingly, this is not diminished by the fact that perioperative morbidity associated with this demanding operation is not negligible, and that numerous complications, including those with drastic surgical consequences, occur in the long-term course [15]. As a consequence of one or even multiple complications, definitive pouch failure may result in the long term [24].

In the authors' own practice, despite a comparatively long operation period of 30 years, the surgical procedure has been kept constant since a very early fundamental change. All operations were performed by a single surgeon (KWE), who also performed the follow-up during the entire period. The goal of the follow-up offered to all patients was early detection of surgical complications, to enable their elimination in a function-preserving manner and maintenance of the best possible QOL. Herein, the authors report on their personal experience with a comparatively small but well-documented collective, in order to reevaluate a worldwide gold standard.

Patients and methods

Study design and statistics

This retrospective study includes all consecutive patients treated with IPAA by one of the authors (KWE) from 1986 to 2015. Endpoint of follow-up was December 2017 or the time of eventual death or last patient contact. Data from patient records were entered into a database in the Statistical Package for the Social Sciences (SPSS; IBM™, Armonk, NY, USA). Significance was assessed using the chi-squared or t-test. Cumulative probability rates were determined by Kaplan–Meier

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Key phrases/core sentences

- Anastomosis is the Achilles' heel of ileal pouch–anal anastomosis
- Modified Asao suture facilitates the double-stapler technique
- Continence function takes precedence over body image
- The disadvantages of loop ileostomy outweigh its benefits
- Transanal catheter decompression replaces fecal diversion
- Cumulative morbidity in the long-term course is not negligible
- Conversion surgery increases pouch survival
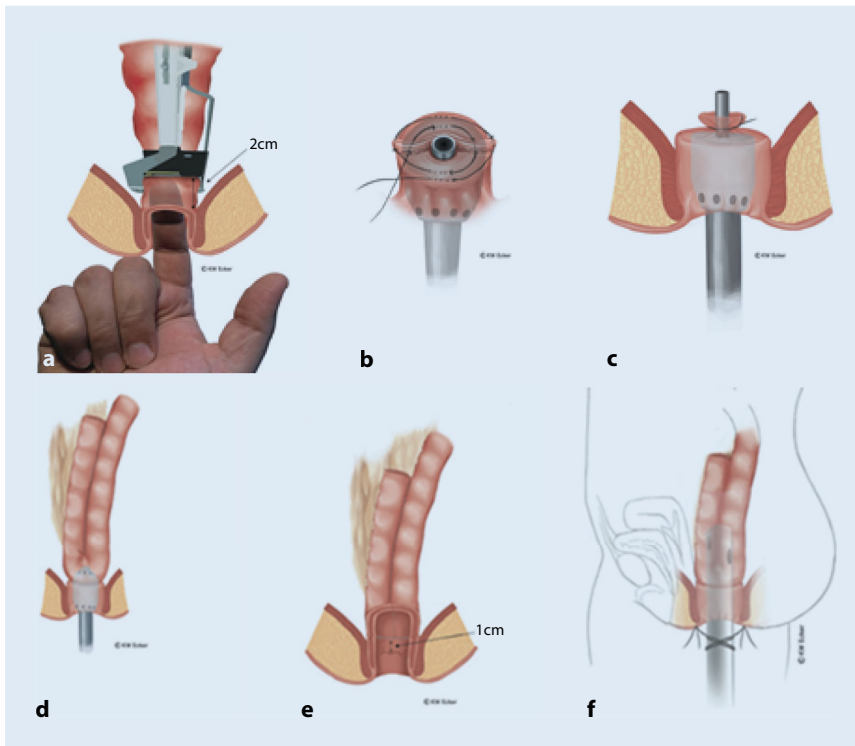- Subjectively good quality of life is objectively compromised

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Fig. 1 ▲ **a–c** Rectal resection and preparation for double-stapler anastomosis: **a** Under traction on the rectum with one hand, **a** 30-mm linear stapler is placed exactly transversely above the dentate line under control of the index finger of the other hand. After firing the device, the rectum is transected above the closed stapler with the scalpel. **b** After the head of a 31-mm circular stapler has been inserted transanally and the mandrel has been penetrated, a purse string suture is stitched in a double spiral around the linear staple suture in such a way that the outer corners (dogears) are securely grasped by the suture. **c** By pulling the purse string suture closed, both ends of the linear clamp suture can be knotted centrally around the guide mandrel, causing the dogears to disappear completely. **d–f** Establishing the anastomosis and decompressing the pouch: **d** By manually pushing up the pelvic floor with the circular stapler, any length gaps between the pouch and the anal verge can be compensated for. The device is fired, and after opening the device, any tension that may have previously been feared has equalized. **e** After removal of the device, the anastomosis can be inspected after insertion of an anal retractor. It is usually 5–10 mm oral of the dentate line and is absolutely circular in shape. Dogears are not visible. A possible suture defect can be closed transanally by sutures. **f** If the bubble test is negative, LIS can be avoided. A 30-French ileostomy catheter is transanally inserted into the pouch and fixed with sutures at the outside of the anus in such a way that the two side holes lie just above the anastomosis

analysis and log-rank testing was performed to verify statistical significance, which was set at 5% ($p < 0.05$). To evaluate QOL, patients were invited to take part in an online survey by email. The survey was based on the abbreviated version of the World Health Organization QOL assessment (WHOQOL-BREF) [13, 29] and an individual questionnaire with questions on continence function as well as occupational, sporting, sexual, and travel activities.

Inclusion criteria and scenarios for IPAA surgery

All patients with UC, IC, FAP, and STC with an indication for proctocolectomy were admitted to the IPAA procedure. Patients with definitive CC and extreme obesity were excluded. In cases of emergency and/or excessive steroid therapy, multistage procedures were performed. Thus, two main operative scenarios, each with two subscenarios, were defined for this study:

1. Primary IPAA construction: one-stage (1a) and two-stage (1b) restorative proctocolectomy

2. Secondary IPAA construction: metachronous one-stage restorative proctectomy (2a) and three-stage restorative proctocolectomy (2b)

Techniques of IPAA construction

1. Original technique (1986–1990): hand-suture of the pouch (J- or W-design), proctomucosectomy, pull-through of the pouch, and hand-suture anastomosis (= indirect anastomosis); obligatory loop ileostomy (LIS).
2. Updated technique (1990–2015): stapler construction of the pouch (J-design) and stapler anastomosis (= direct anastomosis), LIS optional (requirements for omission: perfect double-stapler anastomosis, inconspicuous bubble test, blood-dry sacral cavity), obligatory transanal decompression of the pouch by ileostomy catheter. For details see ◘ **Fig. 1**.

Results

Patients and surgery

Patient characteristics

A total of 119 patients (67 male and 52 female) were included, of whom 84 suffered from chronic inflammatory bowel disease (IBD), 77 had UC, and 7 had IC. Non-inflammatory bowel disease (non-IBD) was suffered by 35 patients, of whom 32 had FAP and 3 had STC. Nearly one quarter of the patients had cardiovascular or metabolic comorbidity, but very few suffered from diagnosis- or treatment-related disorders. While almost half of the IBD patients were on relevant steroid therapy at the time of IPAA construction, all patients with non-IBD were steroid free. This difference was statistically highly significant ($p < 0.001$). Similarly, secondary IPAA constructions performed under cortisone (10.5%) were significantly less frequent than primary IPAA constructions under cortisone (40.7%; $p < 0.001$). Patients were mostly of normal weight, with minor upward or downward deviations. With a mean age at disease onset/diagnosis of 26.1 ± 10.9 years, patients underwent surgery an average of 7.5 years

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Ileal pouch–anal anastomosis—a personal experience reevaluating complications, pouch survival, and quality of life

Abstract

Background. Ileal pouch–anal anastomosis (IPAA) is the gold standard for proctocolectomy. The present study evaluates surgical outcomes of the authors' operations over a 30-year period, including pouch survival and quality of life (QOL).
Methods. Records of patients undergoing IPAA between 1986 and 2015 were retrospectively analyzed regarding early and late complications and pouch survival. An online survey assessed QOL.
Results. Of 119 patients, 84 had chronic inflammatory bowel disease (IBD) and 35 non-inflammatory bowel disease (non-IBD). Pouch construction was simultaneous with proctocolectomy in 69% and metachronous in 31%. Double-stapler anastomosis with purse string suture was performed in 100 patients. With temporary transanal decompression by catheter insertion in all patients, loop ileostomy (LIS) was selectively omitted in 68%. Three anastomotic insufficiencies occurred both without (4.4%) and with LIS (9.4%). Perioperative morbidity for LIS closure was substantial (33.3%). In the long-term course, 36 patients (30.5%) required revision (cumulative probability after 15 years: 59.1%). IPAA was discontinued in 16 patients (13.6%), reducing cumulative continence preservation to 72.9% after 15 years. By converting the pouch to a continent ileostomy (CI) in 6 patients with uncorrectable functional complications, cumulative pouch survival reached 81.8% after 27 years. The online survey revealed significant improvements in occupation, sports, and travel vs. before proctocolectomy, but no change in sexual life. Physical, psychological, and social scores were still below the age-matched norm values. Whereas >90% were satisfied with the surgical outcome, only 3/25 had no functional improvement requests.
Conclusion. IPAA in double-stapler technique is safe, even without protective LIS. However, short- and long-term morbidity is considerable, with a non-negligible risk of continence loss. Conversion to CI for purely functional complications can significantly reduce definite pouch failure. Despite patients' high subjective satisfaction, QOL remains objectively compromised.

Keywords

Ileostomy · Postoperative complications · Intraoperative complications · Surveys and questionnaires · Colitis

Ileopouchanale Anastomose (IPAA) – individuelle Erfahrungen hinsichtlich Komplikationen, Pouchüberleben und Lebensqualität

Zusammenfassung

Hintergrund. Die ileopouchanale Anastomose (IPAA) ist Goldstandard bei der Proktokolektomie. Ziel der vorliegenden Untersuchung ist es, die chirurgischen Ergebnisse der Operationen des Autors einschließlich Pouchüberleben und Lebensqualität über 30 Jahre zu überprüfen.
Methodik. Retrospektiv wurden die Krankenunterlagen von Patienten, bei denen zwischen 1986 und 2015 eine IPAA angelegt wurde, zu Früh- und Spätkomplikationen sowie Pouchüberleben ausgewertet. Mit einer Online-Befragung wurde die Lebensqualität ermittelt.
Ergebnisse. In einer Gruppe von 119 Patienten, von denen 84 an chronisch-entzündlichen (CED) und 35 an nicht chronisch-entzündlichen Darmerkrankungen (Non-CED) litten, wurde in 69% der Pouch simultan und in 31% metachron zur Proktokolektomie angelegt. Bei 100 Patienten wurde eine Doppelstapleranastomose mit zusätzlicher Tabaksbeutelnaht durchgeführt. Bei temporärer transanaler Dekompression mittels Kathetereinlage bei allen wurde selektiv in 68% auf eine Loop-Ileostomie (LIS) verzichtet. Dabei ereigneten sich 3 Anastomoseninsuffizienzen ohne (4,4%), aber auch 3 mit (9,4%) LIS. Die perioperative Morbidität des Verschlusses der Lis war mit 33,3% beträchtlich. Im Langzeitverlauf erlitten 36 Patienten (30.5%) revisionspflichtige Komplikationen, deren kumulative Auftrittswahrscheinlichkeit bereits nach 15 Jahren 59,1% erreichte. Die IPAA musste deswegen bei 16 Patienten (13,6%) aufgehoben werden, wodurch die kumulative Kontinenzerhaltung nach 15 Jahren auf 72,9% sank. Da in 6 Fällen mit nicht korrigierbaren funktionellen Komplikationen der Pouch zur kontinenten Ileostomie (CI) konvertiert werden konnte, lag das kumulative Pouchüberleben nach 27 Jahren noch bei 81,8%. Die Online-Befragung ergab für die Bereiche Beruf, Sport und Reisen eine signifikante Verbesserung gegenüber vor der Proktokolektomie, für das Sexualleben dagegen keine Veränderung. Jedoch erreichten die physischen, psychologischen und sozialen Scores nicht die Werte der gesunden Altersgruppe. Obwohl mehr als 90% mit dem operativen Ergebnis zumindest zufrieden waren, gaben nur 3 von 25 keine funktionellen Verbesserungswünsche an.
Schlussfolgerung. Die IPAA in Doppelstaplertechnik ist auch ohne protektive LIS ein sicheres Operationsverfahren. Die Kurz- und Langzeitmorbidität ist allerdings beträchtlich, woraus ein nicht vernachlässigbares Risiko des Kontinenzverlusts resultiert. Durch Konversion zur CI bei rein funktionellen Komplikationen kann das definitive Pouchversagen deutlich verringert werden. Trotz großer subjektiver Zufriedenheit der Operierten bleibt ihre Lebensqualität objektiv kompromittiert.

Schlüsselwörter

Ileostomie · Postoperative Komplikationen · Intraoperative Komplikationen · Erhebungen und Fragebogen · Kolitis

Table 1 Patients and medical history

	Patients, *n* (%)
All patients	119 (100.0)
Male	67 (56.3)
Female	52 (43.7)
Underlying disease	
IBD	84 (70.6)
UC	77
IC	7
Non-IBD	35 (29.4)
FAP	32
STC	3
Comorbidity	
General concomitant diseases	28 (24.1)
Cardiovascular	12
Metabolic	16
Diagnosis-/treatment-related diseases	9 (7.6)
Joint problems (arthritis)	4
Desmoid formation	1
Severe steroid side effects	4
Perioperative steroids	
IBD (n = 84)	37 (44.0)
Non-IBD (n = 35)	0 (0.0)*
Primary IPAA (n = 81)	33 (40.7)
Secondary IPAA (n = 38)	4 (10.5)*
Body mass index (kg/m^2), M ± SD (111^a/119)	23.1 ± 3.6
>Normal	6
Normal	97
<Normal	8
Age information in years, M ± SD (111a/119)	
Disease onset	26.1 ± 10.9
IPAA construction	33.6 ± 10.9
IBD	34.9 ± 10.9**
Non-IBD	30.0 ± 10.5**

IBD inflammatory bowel disease, *UC* ulcerative colitis, *IC* indeterminate colitis, *Non-IBD* non-inflammatory bowel disease, *FAP* familial adenomatous polyposis, *STC* slow transit constipation, *IPAA* ileal pouch–anal anastomosis, *M* mean, *SD* standard deviation
*$p < 0.001$; **$p < 0.036$
^{a}Patients with complete data

later at a mean age of 33.6 ± 10.9 years (see ◻ Table 1).

Operative scenarios and surgical conditions

The vast majority of surgeries were elective, mainly for precancerous lesions, cancer, and resistance to conservative treatment. Only few operations were performed urgently or on an emergency basis due to toxic megacolon, mass hemorrhage, or bowel perforation. With this in mind, just over two-thirds of IPAA constructions could be performed primarily, i.e., simultaneously with proctocolectomy, of which 52 were one stage (1a) and 28 two stage (1b). In slightly less than one third of the operations, the IPAA was created secondarily, i.e., metachronously after preceding colectomy and IS, of which 16 were created metachronously in one stage (2a) and 20 in three stages (2b). By avoiding LIS in procedures 1a and 2a, anastomosis protection was achieved in the corresponding patients by transanal decompression of the pouch using an ileostomy catheter only, analogous to

the approach for continent ileostomy (CI). This involved 68 of 100 patients with direct pouch–anal anastomosis performed with the double-stapler technique. Among all 100 cases, the pouch was created in two thirds with a length between 14 and 16 cm, and the pouch–anal anastomosis was created in three quarters with a circular stapler with a diameter of 31 mm (see ◻ Table 2).

Operating key figures

In 51/119 patients (42.9%), intensive care was estimated to be necessary by the anesthesiologists, with a median stay of 3 days (1–28 days). There was no significant difference between the individual surgical procedures. However, there were significant ($p < 0.001$) differences in operating times and total length of hospital stay (LOS). The median operation time for direct anastomosis was 3:45 h (85–600 min), whereas this was almost twice as long for indirect anastomosis, at 7:35 h (275–600 min). Applying LIS as anastomotic protection by fecal deviation instead of simple transanal decompression alone increased operative time from 3:36 h (85–300 min) to 5:33 h (175–600 min). Since LIS closure required a second inpatient stay, this increased the median LOS by nearly 70%, from 23 (14–68) to 39 (14–129) days.

Early outcome

Morbidity of IPAA construction

Intraoperative complications, mostly related to severe adhesions after previous surgery, were unavoidable in 17 patients (14.3%). These were preparation-related organ injuries that could be recognized immediately and thus treated promptly and successfully. Postoperative complications were minor in 16.6% ($n = 20/119$), mainly due to mild infections and dysfunction. These either resolved spontaneously or were successfully treated conservatively.

In 19 patients (15.9%), 20 major complications requiring revision occurred in connection with IPAA construction. Of seven postoperative hemorrhages, four occurred in the pouch lumen and could be stopped endoscopically, whereas three were extraluminal and required relaparo-

Table 2 Strategic and technical operation specifics

	Patients, n (%)
Indications for colectomy (116ᵃ/119)	
Refractory to medical treatment	68 (58.6)
Intraepithelial neoplasia	30 (25.9)
Carcinoma	7 (6.0)
Toxic megacolon	7 (6.0)
Massive bleeding	2 (1.7)
Perforation	2 (1.7)
Urgency of colectomy (116ᵃ/119)	
Elective	105 (90.5)
Urgent	7 (6.0)
Emergent	4 (3.5)
Procedures (116ᵃ/119)	
Primary pouch construction	80 (69.0)
One-stage (1a)	52
Two-stage (1b)	28
Secondary pouch construction	36 (31.0)
Modified two-stage (2a)	16
Three-stage (2b)	20
Type of anastomotic protection	
Loop Ileostomy	51 (42.9)
Transanal catheter decompression	68 (57.1)
Pouch design	
J-design	114 (95.8)
WW-design	5 (4.2)
Pouch construction	
Handsewn	19 (16.0)
Stapled	100 (84.0)
Length: ≤13 cm	19
Length:14–16 cm	66
Length: ≥17 cm	15
Anastomosis construction	
Indirect (mucosectomy, handsewn)	19 (16.0)
Direct (double stapling)	100 (84.0)
Ø 28 mm/29 mm	13
Ø 31 mm	74
Ø 33 mm	1

ᵃPatients with complete data

tomy. One biliary and one pancreatic dissection lesion each could be managed by drainage and interventional stenting. Three high intestinal leaks were managed by laparotomy, whereas seven pouch–anal anastomotic leaks could be brought to healing only by leaving the extraluminal drainage and the intraluminal decompression catheter in place for a prolonged period (see ◘ Table 3).

Investigation of anastomotic insufficiencies

Anastomotic insufficiencies occurred in 5.9% ($n = 7/119$) overall. With direct anastomosis ($n = 100$) there were three anastomotic insufficiencies both with LIS ($n = 32$; 9.4%) and without LIS ($n = 68$; 4.4%). A significance test of the difference in frequency was not performed, because LIS was not applied in a randomized but rather in a selective fashion. On the other hand, it was remarkable that in non-IBD patients,

not a single insufficiency ($n = 0/35$) occurred, in contrast to the situation in IBD patients in whom all of the observed insufficiencies arose ($n = 7/84$). However, this difference failed to reach statistical significance ($p = 0.078$). In contrast, as only IBD patients could possibly be on cortisone treatment, there was a significant difference between patients with ($n = 5/37$; 13.5%) and those without ($n = 2/84$; 2.4%) cortisone treatment ($p = 0.017$).

Morbidity of LIS closure

In 51 procedures (see ◘ Table 2, type of anastomotic protection), there was only one intraoperative complication due to injury of an epigastric artery (2.0%). In contrast, the postoperative complication rate was 33.3% ($n = 17$). There were 12 minor complications, mainly wound healing and motility disorders, but also five major complications (1 severe bleeding from an epigastric vessel and four anastomotic insufficiencies).

Mortality

No patient died as a consequence of IPAA construction. The related mortality was thus 0%. However, in one case an insufficiency-related enterocutaneous fistula after LIS takedown led to uncontrollable sepsis and, consequently, to the patient's death. Therefore, the mortality of LIS closure was 2.0% ($n = 2/49$), which increased the mortality of the whole surgical sequence from 0% to 0.8% ($n = 1/119$).

Postoperative function

In the 68 patients with direct anastomosis and without LIS (scenarios 1a and 2a), postoperative function was documented at the first follow-up between 4 and 6 weeks after discharge. Mean stool frequency was 3.9 ± 1.6 per day with a median of 4 (1–7) evacuations per 24 h. Patients with non-IBD performed on average one evacuation better than patients with IBD, with no change in the median. Daytime continence performance was not impaired in any patient, with only a few women using pads at night due to minor soiling and the need of security.

Table 3 Perioperative morbidity in all 119 patients

Type of complication	Patients, n (%)
Intraoperative	17 (14.3)
Bleeding	6
Intestinal injury (small bowel, spleen)	7
Ureterovesical/genital injury	4
Postoperative minor	20 (16.8)
Surgical site infection	8
Ureterovesical/pulmonary/central venous infection	4
Motility disorder (paralytic ileus)	5
Bladder emptying disorder	3
Postoperative major	19[a] (15.9)
Bleeding, abdominal	3
Bleeding, pouch/intraluminal	4
High intestinal leaks	3
Intestinal obstruction (mechanical ileus)	1
Biliary and pancreatic injury	2
Pouch–anal anastomotic leaks	7

[a]Multiple mentions

Table 4 Surgical complications in the long-term course of 118 patients

Type of complication	Patients, n[a] (%)
General	6 (5.1)
Incisional hernia	5
Intestinal obstruction (ileus)	1
Neoplastic	5 (4.2)
Desmoids	1
Adenomas	4
Pouch	3
Small intestine	1
Inflammatory	15[a] (12.7)
Pouchitis	9
Pouch–anal/vaginal fistulas	9
Anitis/anastomositis	3
Functional	20[a] (16.9)
Evacuation problems	14
Incontinence	4
High-output syndrome	3
Total	36[a] (30.5)

[a]Multiple mentions

Long-term outcome

Complications with surgical consequences

A total of 118 patients started the long-term course with functioning IPAA. Of these patients, 36 (30.5%) suffered a total of 46 different complications. According to pathogenesis, these were assigned to four complication groups: 6 (5.1%) as general, 5 (4.2%) as neoplastic, 15 (12.7%) as inflammatory, and 20 (16.9%) as functional. The differential subdivision of the complications is shown in ◘ Table 4.

Neither the surgical scenario (1a to 2b) nor the underlying disease (IBD or non-IBD) had a significant influence on the overall numerical rates of the four complication groups. Nevertheless, dependencies in the complication subgroups were evident: neoplastic complications (desmoids, adenomas) were observed only in FAP, and inflammatory complications were observed only in UC and IC. In contrast and also independent of the surgical scenario, the technique of anastomosis and the type of anastomosis protection were of crucial importance for the occurrence of inflammatory and functional complications. After the indirect anastomosis technique, late complications were significantly more frequent than after the direct double-stapler technique (57.9%, $n = 11/19$ vs. 25.3%, $n = 25/99$; $p = 0.005$). The significance was even more pronounced upon separately considering functional complications only, with 52.6% ($n = 10/19$) vs. 10.9% ($n = 10/119$; $p = 0.001$). Moreover, after indirect anastomosis, 8/10 complications were due to an evacuation disturbance caused by a construction-related "middle ridge" prolapsing into the anal canal, which had to be surgically excised with a stapler. Correspondingly, after direct anastomosis, stenosis obstructing evacuation was found in 6/10 functional complications, which could, however, be very easily dilated. If pouch–anal anastomoses were temporarily excluded from stool passage by LIS, functional complications were significantly ($p = 0.008$) more frequent than without fecal deviation, with 27.5% ($n = 14/51$) and 8.8%, respectively ($p = 6/68$). However, anastomosis technique and fecal deviation are not independent variables, since all patients with an indirect technique received a LIS, whereas LIS was applied only selectively with a direct technique.

The cumulative risk of suffering a complication requiring surgical revision was greatest in the first 5 postoperative years, increasing linearly to 40.5%. Thereafter, the risk leveled off, reaching 59.1% after 15 years. Separate calculation for the individual complication types resulted in the following values at the 20-year timepoint: 16.9% for general, 7.2% for neoplastic, 28.2% for inflammatory, and 24.6% for functional complications (see ◘ Fig. 2).

Pouchitis

Some cases of nonspecific inflammation of the ileum reservoir (pouchitis) developed during the first postoperative years and the rate increased steadily to 24.6%
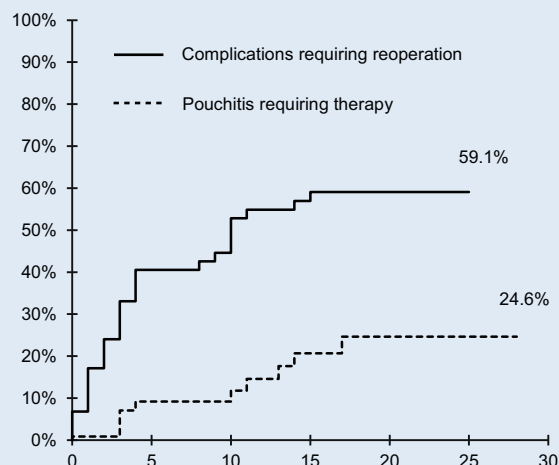
Years	0	5	10	15	20	25	30
Patients[a] (n)	118	36	27	20	12	3	3
Patients[a] (n)	118	43	35	25	15	4	0

Fig. 2 ◄ Cumulative probability of significant morbidity in the long-term course after ileal pouch–anal anastomosis. [a]Patients under observation

until the 16th year, remaining constant thereafter. Pouchitis requiring treatment was observed in only 12 of the 84 patients with IBD (crude rate: 14.3%; cumulative risk increasing up to 30.6% by the 20th year). In 9 cases (75.0%), a chronically progressive course developed, requiring pouch resection (see ◘ Fig. 2).

Pouch survival and continence preservation

During the 30-year observation period, one single patient with FAP died with preserved pouch function due to a monstrous mesenteric desmoid tumor. The pouch–anal anastomosis had to be removed in 16 of 118 patients (13.6%) due to irreparable complications. Eight patients were lost to follow-up at different timepoints with preserved pouch function. Accounting for this in the calculation, the cumulative maintenance of pouch–anal continence resulted in no statistically significant differences when comparing IBD vs. non-IBD, operative scenarios (1a vs. 1b vs. 2a vs. 2b), types of anastomotic protection (LIS vs. transanal decompression), and anastomotic technique (direct vs. indirect).

However, the examination of individual underlying diseases within the IBD and non-IBD groups was informative and interesting: whereas a similar high conti-

nence probability of 76.6 and 73.4% was still calculated for FAP and UC, respectively, after 15 years, this was already only 66.7 and 42.9% for IC and STC, respectively, after 10 years. Due to the small numbers in the latter diseases, this striking difference could not be secured as statistically significant (see ◘ Fig. 3a).

In the total collective, survival of the continence-preserving pouch decreased linearly to 72.9% in the first 15 years and then remained constant until the 27th year. However, 6 of 16 pouches in the present collective could be saved by conversion to CI. Consequently, loss of pouch–anal continence was not identical with loss of the pouch. Thus, an actual pouch survival (as IPAA or CI) of 81.8% at year 27 could be calculated (see ◘ Fig. 3b).

Long-term function and quality of life

In order to assess long-term function and QOL in the 118 patients with formerly functioning pouches, patients were contacted in November and December of 2017 and requested to complete the online questionnaire. At this time, 3 patients had died with no pouch-related diseases, 16 had had the pouch resected, and 23 had been lost to follow-up in re-

cent years. Of the remaining 75 patients, 28 (37.3%) were familiar enough with the Internet to participate. They were 56.3 ± 10.2 years old at this time.

Individual survey for function

Compared to before proctocolectomy, three individual scores improved significantly ($p < 0.001$) after the IPAA procedure: occupational activity from 2.28 ± 1.46 to 3.44 ± 1.04; sporting activity from 2.20 ± 1.32 to 3.16 ± 0.94; and travel activity from 2.36 ± 1.47 to 3.64 ± 0.81. While no significant change could be calculated for the quality of sexual life (2.88 ± 1.42 vs. 3.24 ± 1.27), a significant ($p < 0.001$) deterioration was calculated for the feeling of security (2.36 ± 0.86 vs. 1.68 ± 0.69). Against this background, 52.0% ($n = 13/25$) still reported being completely satisfied with the IPAA and 40.0% ($n = 10/25$) were satisfied most of the time. Despite this positive assessment of the surgical outcome, only 3 of 25 (12.0%) patients responding in this regard had no requests for improvement, 15 (60.0%) wished for a lower stool frequency, 10 (40.0%) for a firmer stool consistency, 11 (44.0%) for less discomfort at the anus, and only 1 (4.0%) for a longer warning period.

Comparison of quality of life with a healthy population

From the 26 questions of the WHOQOL-BREF questionnaire, the scores of the four health domains were calculated and compared with the norm values of a 50–59-year-old healthy population. The calculated physical, psychological, and social scores were 56.4 ± 11.6, 67.1 ± 12.7, and 68.0 ± 21.1, and thus significantly below the norm values of 80.3 ± 16.9, 73.8 ± 12.6, and 73.1 ± 18.2, respectively. At 77.3 ± 8.9, only the environment score was calculated to be in the order of magnitude of the norm value of 77.0 ± 13.3.

Discussion

The occasional generous referral to IPAA as the gold standard for proctocolectomy [26] suggests that strategic and technical questions pertaining to the surgical procedure have been conclusively answered and that the results, including QOL, leave
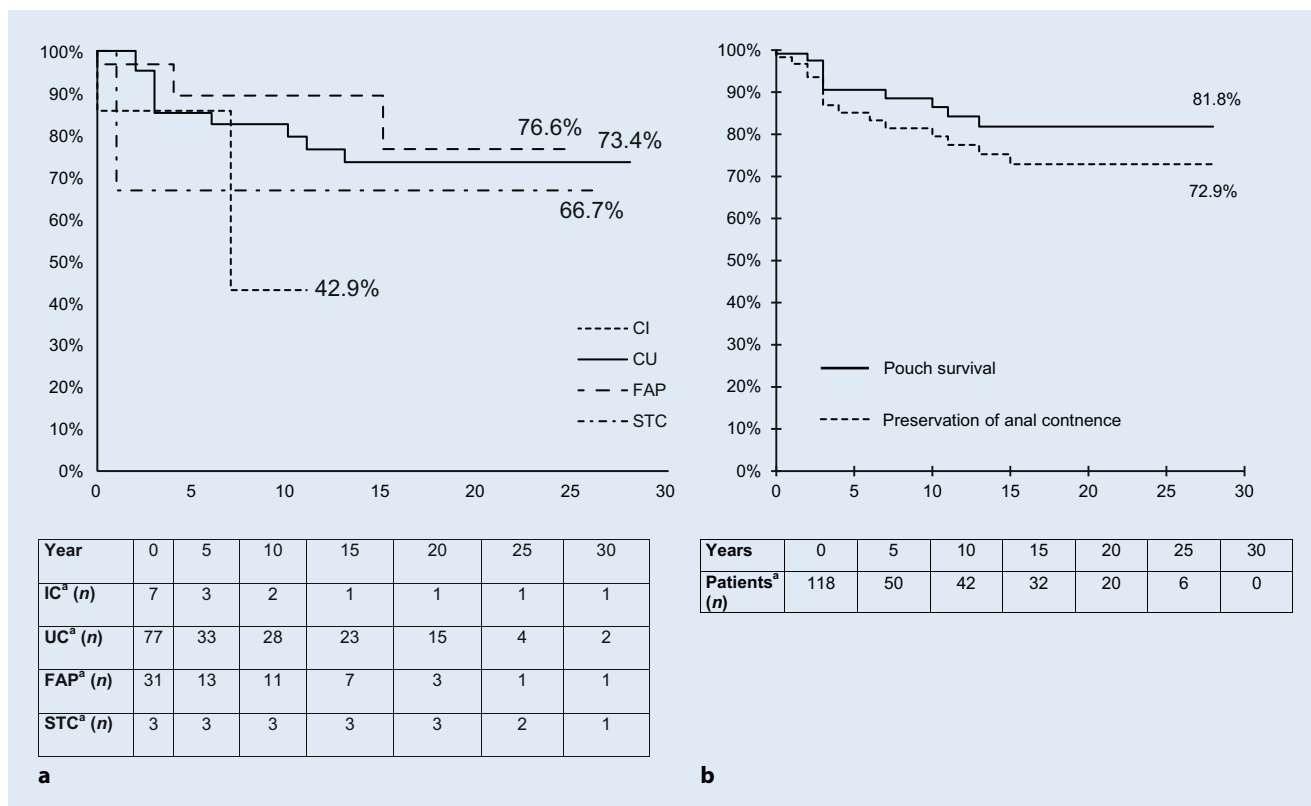
Fig. 3 ▲ **a** Cumulative probability of successful ileal pouch–anal anastomosis survival according to the underlying disease. *CI* indeterminate colitis, *CU* ulcerative colitis, *FAP* familial adenomatous polyposis, *STC* slow transit constipation. [a]Patients still under observation. **b** Cumulative probability of pouch survival versus cumulative probability of anal continence preservation in the long-term course after ileal pouch–anal anastomosis. [a]Patients under observation

no room for doubting this assessment. In fact, while the literature consistently reports very satisfactory surgical outcomes, it also recognizes not inconsiderable rates of complications and pouch failure [9, 15, 24]. This apparent contradiction runs like a thread through the literature and needs to be resolved. Therefore, the relevant parameters of the surgical procedure will be discussed against the background of personal experience.

Operational strategies and their implications

Basically, four strategic scenarios can be distinguished, which are classified as 1a–2b in the present investigation. According to five studies published up until 2016, procedure 1a is used on average in 26.7% ± 15.9%, 1b in 35.9% ± 11.6%, 2a in 31.6% ± 11.6%, and 2b in 29.0% ± 12.5% of cases [28]. Thus, one-stage operations (1a and 2a) account for 58.3% ± 10.8% internationally, with

57.1% in the current series matching this well. By justifying a multistage procedure mainly by LIS, the usefulness of fecal deviation to protect the anastomosis should be questioned.

On the one hand, analysis of partially prospectively randomized studies shows no differences in mean insufficiency rates with or without LIS, at 12.1% ± 7.7% and 12.7% ± 4.9%, respectively [28]. With an overall rate of only 5.9% in the current collective, patients in the subcollectives without LIS performed significantly better than those with LIS, which may be related to both transanal decompression and selective LIS in justified cases only (selection bias). Selective LIS only is also increasingly advocated by other authors [12, 20].

On the other hand, the specific morbidity associated with LIS closure should not be neglected. From six studies with an average cohort size of $n = 647.2 ± 853.5$, a major complication rate of 21.0% ± 12.8% can be calculated

[28]. Although the current authors experienced only about half of these, the only mortality occurred in this group. Thus, primary LIS creation seems rather disadvantageous. In contrast, secondary creation as part of the management of pelvic sepsis is undoubtedly advantageous, e.g., in the variant as a "virtual" or "ghost ileostomy" [22].

Thus, while LIS was initially considered mandatory for safety reasons, several arguments now speak against it. Finally, the trend toward single-stage surgery, which has been increasing since 1990, takes into account both patient comfort and healthcare financial resources. In this respect, the literature mainly compares the different approaches, with open surgery performing better in terms of operating time, and laparoscopy in terms of LOS [28]. In contrast—and in the authors' opinion, more appropriately—this study compared the four scenarios and found that procedures 1a and 2a performed significantly better than 1b and 2b

in terms of both operative time and LOS. Globally, therefore, even from an economic point of view, greater importance is to be attached to the scenarios than to the approaches.

Technical variants and their consequences

While pouch design has long been decided in favor of the J-pouch, the optimal anastomotic technique is still the subject of passionate debate. A review of 10 studies over the past 30 years reveals that on average, the hand-suture anastomosis after proctomucosectomy is used in 43.4% ± 16.4% and the double-stapler technique in 56.6% ± 16.4% of cases [28]. Within the studies, however, there is a trend toward preference of the double-stapler technique, which already accounts for 84.0% in the present series.

In the cited studies, there is on average no significant difference between the two techniques in terms of full continence performance (68.8% ± 22.4% vs. 74.5% ± 18.8%), bowel movements/24 h (5.3 ± 1.1 vs. 5.1 ± 1.3), stenosis (13.3% ± 5.5% vs. 14.0% ± 6.4%), and fistulas (13.5% ± 6.6% vs. 9.7% ± 5.1%). However, the machine anastomoses mostly performed better with regard to soiling or leakage, whereas they were at a significant disadvantage with regard to precancerous changes (32.0% ± 15.7% vs. 13.8% ± 8.4%). In the authors' series, the literature was outperformed in all parameters using the double-stapler technique. This is attributed to consistent application of the additional purse string suture in terms of a modified Asao suture [1]. Finally, it is only through this that the exact adjustment of the anastomosis in terms of height and configuration by resection of excess rectal mucosa, both in the circumference and in the "dogears", becomes possible. Apparently, this allows the advantages of the double-stapler technique to be combined with those of proctomucosectomy. According to a recent study, function does not deteriorate even when the anastomosis is partially intraanal [27].

Possible pitfalls of the surgical approach

Today, minimally invasive surgery is also advocated for IPAA. However, with only marginal advantages in terms of pain, complications, and LOS, clear evidence of superiority over open surgery has only been demonstrated for cosmesis [2, 28]. The goal of IPAA is not primarily the best "body image," but rather optimal preservation of continence function. In this sense, a perfect anastomosis can be called the Achilles' heel of the operation, and all other considerations should therefore be subordinate. In the case of a double-stapler anastomosis, safety and in particular the correct supraanal height are of utmost importance [7].

To ensure these goals, the authors prefer the hand-assisted technique of laparoscopic surgery as described in detail by Maartense et al. in 2004 [21]. More recently, Duraes et al. have shown that excellent cosmetic results are also possible with a completely open technique using a modified Pfannenstiel approach [8]. In contrast, completely laparoscopic procedures may potentially lead to concessions in the extent of required resection and the protection of sphincter function. According to German and European Crohn's and Colitis Organisation (ECCO) guidelines, an increase in the permissible anastomosis height from formerly just above the dentate line to up to 2 cm supraanal is now considered acceptable [6, 23]. However, because this then strictly speaking becomes an ileal pouch–rectal anastomosis, it results in limited radicality of rectal mucosal eradication, with the consequence of persistent inflammation and/or inadequate cancer prevention [28]. To avoid this, the technique of transanal total mesorectal excision (TaTME), which is becoming increasingly established in surgical oncology, is also recommended by some authors in IPAA [5]. However, it should be borne in mind that postoperative loss of function may result from reduction of sphincter pressure due to manipulation of the sphincter apparatus [28]. All innovations initiated with the best of intentions, including single-incision laparoscopic surgery (SILS) and robotics [10, 19], require careful evalu-

ation in prospective studies if they are to compete with the technically simple double-stapler method in hand-assisted laparoscopic or modified open surgery.

Patient selection and long-term fate of the pouch

Candidates for IPAA should be carefully selected [6, 23]. In practice, this theoretical recommendation requires appropriate recognition of contraindications [3, 15]. Absolute contraindications include emergency situations with high steroid treatment, deep rectal cancer, and incontinence due to sphincter damage. Relative contraindications include massive obesity, advanced age, radiotherapy, IC, and Crohn's disease (CD). If this does not eliminate patients from the outset, many contraindications can be eliminated in a staged procedure (scenarios 2a and 2b) prior to actual pouch construction.

However, CD represents an unpredictable burden, as complications and pouch failure are more frequent than in other underlying diseases [25]. Thus, on the one hand, although most patients with CD are operated on under the diagnosis of UC or IC, with the correct diagnosis only becoming apparent in the later course, on the other hand, patients with known CD are nowadays no longer excluded from IPAA in principle, if it is an isolated colonic involvement (CC) without anorectal complications [9, 18]. In the light of differential diagnoses that are not always reliable, comparison of IBD as a whole (UC, IC, and CC) with non-IBD (FAP and others) seems most likely to quantify the importance of the underlying disease for pouch fate. For example, an analysis of six studies suitable for this purpose shows that the mean crude failure rate may be about three times higher in IBD than in non-IBD (20.1% ± 16.2% vs. 6.7% ± 2.6%) [28].

Compared with these literature data, the present study has a much higher proportion of non-IBD patients (29.4% vs. 10.9% ± 4.3%) and no primary CC within the IBD group. In addition, the types of complications and the specific complication management in the current collective are also likely to be contributing factors. Thus, only in IBD are severe inflamma-

tory complications (pouch–vaginal fistulas, pouchitis) responsible for a significant proportion of definite pouch failure. In non-IBD on the other hand, there are almost exclusively functional complications (all types of continence disorders), with the pouch itself being and remaining fine. In contrast to patients with IBD, who have already learned to cope with continence disturbances before proctocolectomy, patients with non-IBD tend to have higher demands on the postoperative functional outcome. As a consequence, the surgeon may be more likely to find them to have pouch failure according to the usual definition. If, as in the authors' complication management strategy, conversion of IPAA to CI occurs instead of the final resolution of an ordinary IS, one cannot actually talk about pouch but only of continence failure in these cases. In some sense, pouch conversion is a salvage operation to avoid definitive pouch loss.

Quality of life

Quality of life assessed with appropriate instruments describes the individual limitations in everyday life after surgery in terms of a multidimensional concept. It goes without saying that the preoperative degree of suffering is an important comparative measure. Therefore, IBD patients usually give better ratings than non-IBD patients [17]. In the comparative study of QOL after proctocolectomy depending on the reconstructive procedures, best values were measured by Köhler et al. for IPAA, followed by those for CI and lastly for IS [16]. As meaningful as this result is for the surgeon to rank IPAA in the surgical procedure spectrum, it is not equally helpful for the patient who already has an IPAA. What matters to this patient is whether there is an improvement compared to the preoperative condition and the extent to which their situation compares to that of healthy peers. As in other studies [4, 9, 11], the current study was able to detect postoperative improvements in occupation, sporting ability, and travel activity because of the preserved defecation route. Therefore, the vast majority of patients expressed high global satisfaction and would choose IPAA again [4, 9, 11, 16]. Nevertheless, according to this survey, expectations for lower stool frequency and firmer stool consistency remain unfulfilled in many patients. This is not a contradiction, but rather reflects the acceptance of a compromise, in the awareness that an alternative to IPAA could mean the incontinent stoma. This compromise is also reflected in the fact that of four standardized QOL scores, only one was in agreement with the age-matched normal population, while three were calculated to be worse. Thus, a true *restitutio ad integrum* cannot be established with restorative proctocolectomy. A shortcoming of all QOL studies is that no patients with pouch failure are included.

Strengths and weaknesses of this study

The data of this study reflect one of the longest available systematic observations after IPAA. One may consider it a disadvantage to report only the experience of a single surgeon, but the results with minor modifications of an established technique maintained for decades are unique, and undoubtedly contributed to better patient outcomes.

The aforementioned changes involved the addition of purse string suture for double-stapler anastomosis and transanal catheter decompression, making one-stage surgery safely feasible in two thirds of cases. A unique feature is the conversion of IPAA to CI, to quantitatively reduce definitive pouch failure and qualitatively improve patient outcomes. Small numbers remain an issue, but the long-term follow-up and evaluation of QOL in a representative subpopulation are noteworthy.

A weakness of the study relates to the heterogeneity of the patient groups, which led to the relatively small case numbers in the subcollectives. Also, follow-up data were not actively collected over the whole 30-year period and there is a small potential that not all late complications and pouch losses are accounted for.

Conclusion

IPAA has been shown to be a safe surgical procedure, with double-stapler anastomosis producing better early and late results than hand-suture anastomosis. Selective omission of LIS is possible in the majority of operations, with a lower complication rate and improvement in postoperative function. Even with laparoscopic proctocolectomy, the J-pouch should continue to be positioned openly at the upper edge of the anal canal. It seems unlikely that further improvements in outcomes can be achieved by modifications of established surgical techniques. In contrast, increasing adoption of the conversion technique in cases of functional pouch failure is likely to increase pouch survival. QOL is consistently rated as satisfactory by patients because of the preserved defecation pathway, although improvements are desired in many areas. In this respect, it seems appropriate to replace the term "gold standard" by "procedure of choice for most patients".

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Declarations

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