
Stapled Ileoanal Anastomosis for Ulcerative Colitis and Familial Polyposis Without a Temporary Diverting Ileostomy

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Between March 1989 and August 1990, we performed 21 stapled J pouch ileoanal procedures (20 ulcerative colitis [UC], 1 familial polyposis [FP]) without an ileostomy in 19, of whom 13 were taking prednisone and eight underwent semi-emergent surgery for uncontrollable bleeding. During the same time, an additional four patients required a standard ileoanal procedure. The results of anal manometry and clinical function were compared to 25 patients who had previously undergone mucosal stripping and a sutured J pouch ileoanal anastomoses with a temporary diverting ileostomy between October 1982 and August 1990. During this same time period, an additional 19 patients underwent an anti-peristaltic reversed J pouch and 18 an S pouch, for a total of 83 ileoanal procedures. The reversed J pouch had a lower stool frequency than a standard J pouch but had an unacceptable incidence of complications and problems with pouch emptying. The S pouch had a stool frequency similar to the standard J pouch but provided greater length in patients with a short mesentery. Stapled J pouch ileoanal patients had a better ($p < 0.02$) maximum anal sphincter resting pressure (46 ± 11 versus 34 ± 12 mmHg), fewer ($p < 0.05$) night-time accidents (22% versus 68%), daytime (17% versus 55%) or night-time (28 versus 61%) spotting, or use of a protective pad at night (11% versus 42%) than nonstapled J pouch ileoanal patients. Stool frequency was similar in the two groups. All but one UC patient had residual disease at the anastomosis. Anal mucosa between the dentate line and stapled anastomosis was 1.8 ± 1.3 cm (range, 0 to 3.5 cm). Complications in the nonstapled J pouch group included 4 pouches excised (2 for complications, 2 for excessive stool frequency), 1 pelvic abscess, 2 stenosis requiring dilation under anesthesia, 1 enterocutaneous fistula after ileostomy closure, 1 ileostomy site hernia, and 2 small bowel obstructions. Of the 65 patients who underwent ileostomy closure in the entire series, 8 (12%) developed a complication requiring surgical intervention. Complications in the stapled group included 1 anastomotic leak, 1 pouch leak, and 1 pelvic abscess. Patients were managed successfully with drainage (all 3) and diverting ileostomy (1). One patient developed stenosis requiring dilation under anesthesia. The stapled J pouch ileoanal anastomosis is a simpler, safer procedure with less tension than a standard handsewn J pouch

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but leaves a very small cuff of residual disease. It provides significantly better stool control and may obviate the need for an ileostomy with its complications.

ALTHOUGH THE ILEOANAL procedure originally was proposed by Nissen in 1933¹ and further evaluated by Ravitch and Sabiston² in 1947, it was not until the late 1970s that the procedure began to achieve clinical popularity.³⁻⁵ Although children seem to tolerate a straight ileoanal procedure,⁶ most studies have shown that construction of an ileal pouch is necessary to decrease stool frequency to an acceptable number in adults.^{7,8} Martin and Fischer^{8,9} initially demonstrated improved stool control when the anal transition zone was left intact with the mucosal stripping begun 1 to 2 cm above the dentate line. Recent British studies proposed that the ileoanal procedure can be done more safely and expeditiously, and provide significantly better stool control, using a stapled technique.¹⁰⁻¹³ Kmiot and Keighley¹² suggested that the operation might be performed without a diverting, protective ileostomy, except in steroid-dependent patients. Our first stapled ileoanal procedure appeared to be similar to a low anterior resection, where a diverting ostomy is rarely used. Because an ileostomy and its subsequent closure also have been associated with significant risks of complications,¹⁴ it seemed appropriate to perform the operation without a diverting ileostomy when the situation warranted it.

Materials and Methods

Total abdominal colectomy with a mucosal proctectomy and ileal pouch-anal anastomosis was initiated at

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the Medical College of Virginia in October 1982. As of September 1990 we had performed 83 ileoanal procedures. The operation was initially constructed using the J pouch developed by Utsunomiya¹⁵ and popularized at the Mayo Clinic.^{7,16} Because of problems with excessive stool frequency and incontinence in some patients with a standard J pouch, a reversed J pouch with an antiperistaltic 'spout' was constructed in 19 patients. The S pouch, developed by Parks et al.,⁴ was used in 18 patients, especially if there was tension in bringing either the J pouch or reversed J pouch to the dentate line of the anal canal for anastomosis. Thus the handsewn ileoanal anastomoses included 25 J, 19 reversed J, and 18 S pouches.

As a result of the British studies demonstrating improved continence using a stapled ileoanal procedure with preservation of the anal canal,¹⁰⁻¹³ all patients referred for total colectomy for ulcerative colitis or familial polyposis after March 1989 were considered for this operation. From this date to September 1990, 21 patients underwent the stapled ileoanal procedure, of whom 20 had ulcerative colitis and one familial polyposis. After the first case in which the operation appeared to be as safe as a standard low anterior resection, we decided to perform the procedure without a diverting, protective ileostomy when there had been no technical problems.

Nonstapled Operative Procedure

The total abdominal colectomy, mucosal proctectomy was performed in a standard fashion, with the rectum dissected toward the *levator ani* muscles from an abdominal approach and the mucosal stripping begun at the dentate line from the perineal approach.⁷ In contrast to the stapled technique, no effort was made to expose the *levator ani* muscles. The rectum was not everted during this dissection and every effort was made to avoid excessive stretch or injury to the anal sphincter muscles. Before dissection the rectum was irrigated with 1000 mL 1% neomycin solution. Exposure for the mucosal dissection was aided with the use of Gelpi retractors placed perpendicular to each other at the anal verge and injecting the submucosal tissues with saline containing 1:100,000 epinephrine.

The ileum was transected immediately proximal to the ileocecal valve with an ILA-52[®] stapler (3-M Corp., St. Paul, MN). Each limb of the J pouch was 15 cm long and a side-to-side anastomosis constructed with several applications of the ILA-52 stapler (15 patients) or a two-layer, running 2-0 polyglycolic acid suture (10 patients). The pouch was anastomosed to the dentate line of the anal canal with several interrupted 2-0 polyglycolic acid sutures. A flat, 10-mm Jackson-Pratt[®] drain (American V. Mueller Corp., Chicago, IL) was placed on either side of the ileal pouch and brought out through stab wounds in both lower quadrants above the inguinal ligament. Each

drain was removed when it produced less than 10 mL of fluid for two 8-hour nursing shifts or if a pelvic radiograph revealed it to have become displaced out of the pelvis into the general peritoneal cavity.

In an attempt to reduce stool frequency, an antiperistaltic reversed J pouch was constructed in 19 patients. A standard J pouch was constructed as described and the ileum transected 5 cm proximal to the pouch after the mesentery was divided as far proximally as possible. The pouch was rotated 180 degrees and anastomosed to the afferent ileum; the efferent ileum was anastomosed to the dentate line. This procedure required a greater mesenteric mobility than the standard J pouch. An S pouch was constructed in 18 patients either to study the effect of a greater pouch compliance on stool frequency (12 patients) or because it provided greater mesenteric length if a standard J pouch ileoanal anastomosis was under too much tension (six patients). The S pouch was handsewn with three 10-cm ileal limbs and 2 cm of efferent ileum anastomosed to the dentate line.

In all instances a modified loop ileostomy was brought out in the right lower quadrant with the functional stoma constructed using an everted Brooke technique and the nonfunctional stoma placed at skin level. The ileostomy was closed after a barium enema documented healing of the ileoanal pouch and there was no evidence of stricture or sinus tract at the ileoanal anastomosis. This ranged from 4 to 60 weeks, with a median of 7 weeks after the ileoanal procedure.

Stapled Operative Procedure

The total abdominal colectomy and proctectomy were performed in a manner similar to the nonstapled procedure, except that a meticulous effort was made to dissect the rectum down to the *levator ani* muscles. A Roticulator[®] 30 disposable surgical stapler (Auto Suture Co., Norwalk, CT), using 3.5-mm staples, was placed across the rectum as close to the *levator ani* muscles as possible; this was aided by pulling the rectum proximally and having an assistant push the perineum superiorly using a closed fist (Fig. 1). After closing the Roticulator[®] stapler, the operating surgeon donned an additional glove and inserted an index finger into the anal canal to be certain that the stapler was close to the anal verge (and dentate line). If it was not, additional dissection of the rectum was undertaken and the above maneuvers repeated until its placement was considered satisfactory.

The J pouch was constructed with two 15-cm limbs using two applications of an ILA-100[®] (3-M Corp.) stapler placed through the apex of the pouch (Fig. 2). A 2-0 polypropylene purse-string suture then was placed at the apical opening of the J pouch and the anvil of the disposable Premium CEEA[®] 31 (Auto Suture Co., Norwalk, CT) was inserted within the pouch and the purse-string suture tied

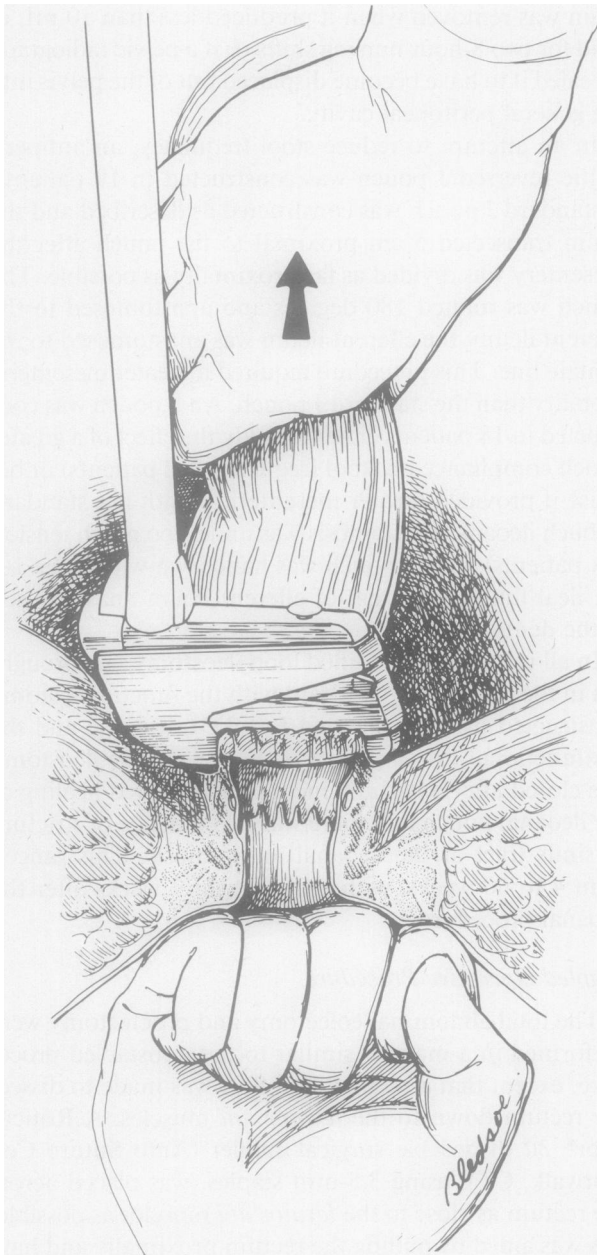


FIG. 1. Roticulator® 30 stapler with 3.5-mm staples placed across the rectum as close to *levator ani* muscles as possible with the rectum pulled proximally and the perineum pushed superiorly.

down. A Premium CEEA® 28 stapler was used in the first patient but subsequent experience documented that a 31-mm stapler could be used routinely if a sufficiently large opening was made in the apex of the J pouch.

The Premium CEEA® 31 was placed into the anal canal with the needle inserted on the central bar but retracted into the stapler. The needle then was advanced, taking care to place it through or as close to the Roticulator® 30 staple line as possible (Fig. 3). The needle was removed and the CEEA® 31 anvil within the J pouch connected

to the CEEA® 31 stapler, taking care to bring the J pouch into the pelvis without twisting (Fig. 4). The CEEA® 31 stapler was closed and fired once, as hard as possible, when the green dot was visualized in the handle (Fig. 5). The CEEA® 31 handle was unscrewed three full turns and the stapler firmly, but gently, removed. This was difficult at times because four rows of staples (one on either side of the J pouch and one on either side of the anal stump) were crossed and transected with the CEEA® 31 instrument. The CEEA® 31 then was examined for intact 'doughnuts,' taking care to do so before removing them from the instrument, because the doughnuts will pull apart with excessive traction at the staple lines. The doughnut on the anal side of the anastomosis was routinely sent for pathologic examination. The ileal mesentery usually was taughly applied to the retroperitoneal tissues. The mesentery was sutured to the posterior peritoneum in one patient to prevent an internal hernia. Jackson-Pratt® drains were placed as in the nonstapled ileoanal patients.

A #28 red rubber tube then was inserted into the ileal pouch from below and 100 to 200 mL saline darkly colored with methylene blue were instilled with the afferent limb digitally occluded, searching for leaks at the ileoanal or the J pouch anastomoses. An adult-sized sigmoidoscope then was inserted to evaluate the anastomosis and to measure its distance from the dentate line.

After our first case using the stapled technique, a diverting ileostomy was not constructed if the ileoanal or J pouch anastomoses were considered to be perfect. Furthermore no nasogastric tube was inserted unless the patient developed postoperative abdominal distension or nausea and vomiting. Once the patient began passing flatus, the diet was rapidly advanced: warm clear liquids followed by a general diet the next day and discharged the following day. The median postoperative hospitalization was 9 days.

If the stapling technique was not feasible for anatomic or technical reasons, a standard mucosectomy was performed and the ileal pouch anastomosed to the dentate line with interrupted 2-0 polyglycolic acid sutures. The ileal pouch was not constructed until it was determined whether a J pouch could be anastomosed without excessive tension; if not a hand-sewn S pouch was constructed because it provided greater length.

Measurement of Anal Sphincter Pressures

Anal manometry was performed with a pneumohydraulic capillary perfusion system, using a Statham® pressure transducer (Gould Inc., Oxnard, CA) connected to a Hewlett Packard® recording system (Palo Alto, CA). A triple lumen poly-vinyl catheter with an external diameter of 4.8 mm was used with two orifices located 3 cm apart and positioned radially in the axis of the two. The per-

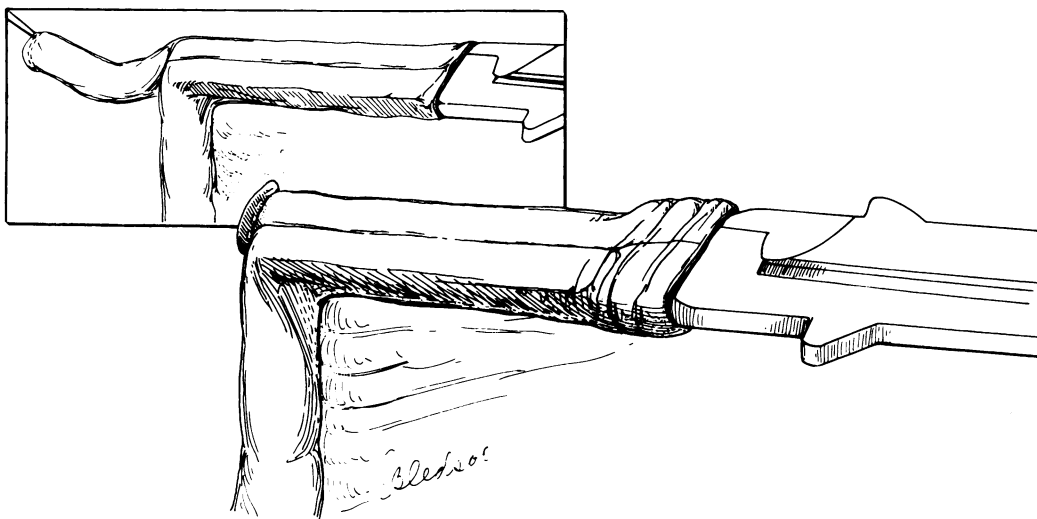


FIG. 2. Construction of J pouch with 15-cm limbs using two applications of ILA-100® stapler.

fusion rate was 0.5 mm/minute. The central lumen was attached to a balloon with a 150-mL maximum volume, which was used to distend the ileal pouch. The catheter was passed into the pouch and withdrawn through the anal sphincter using the standard pull-through method with the orifices positioned to record the maximum resting pressure of the anal sphincter. The patient then was asked to voluntarily squeeze the anal sphincter and maintain the squeeze for as long as possible. The balloon was inflated and deflated in increments of 10 mL of air and the patient asked to report the onset of rectal sensation during incremental distention. The resting sphincter pressure was defined as the mean of the resting pressures from each port during two successive station pull-through. With the catheter positioned in the sphincter to record the maxi-

mum resting pressure, the mean of three successive maximum squeeze pressures was recorded.

Patient Questionnaire

Patients were sent a questionnaire by mail and asked to return the completed form to the nurse practitioner. Questions relevant to this report included the most, least, and average number of daytime stools; the most, least, and average number of night-time stools; the number of accidents during the day or night; the frequency of spotting (defined as soilage the size of a quarter) during the day or night; the need to wear a perineal pad; and the necessity of using medications such as Immodium® (McNeil Consumer Products, Ft. Washington, PA) or powdered fiber supplements (e.g., Metamucil® [Procter & Gamble, Cincinnati, OH]) to thicken the stool.

Evaluation of Postoperative Rectal Bleeding

All patients who complained of postoperative bloody diarrhea underwent outpatient examination with a rigid pediatric sigmoidoscope or disposable anoscope. Pouchitis was defined as bloody diarrhea associated with inflammation of the ileal pouch, which responded to oral antibiotic therapy with either metronidazole 250 mg twice daily or Bactrim-DS® twice daily. Residual ulcerative colitis of the anal canal was defined as inflammation (friable, bleeding tissue) of the anal canal between the dentate line and the anastomosis in the stapled ileoanal patients.

Data Analysis

All data are expressed as mean \pm standard deviation and were analyzed by analysis of variance using the Statistical Analysis System (Cary, NC) program. Percentage differences between patient groups were compared using Fisher's exact test. A difference was considered significant at $p < 0.05$.

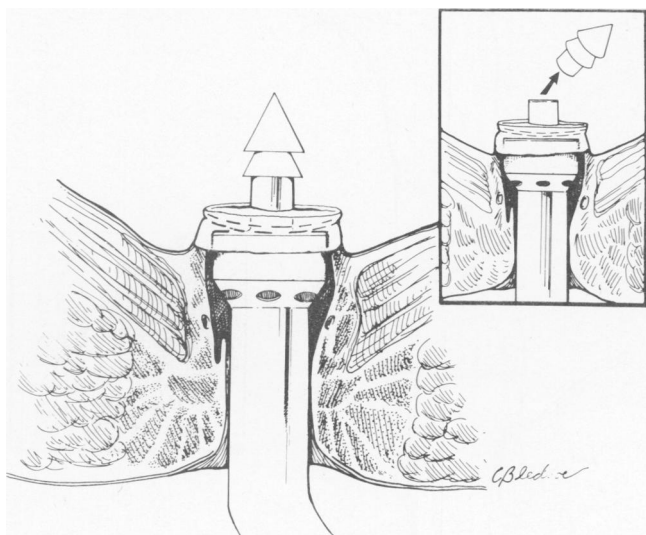


FIG. 3. Insertion of the Premium CEEA® 31 stapler through the anus with the needle passing through the rectal cuff as close to the Roticulator® staple line as possible. Insert shows removal of the detachable needle from the CEEA® 31 stapler.

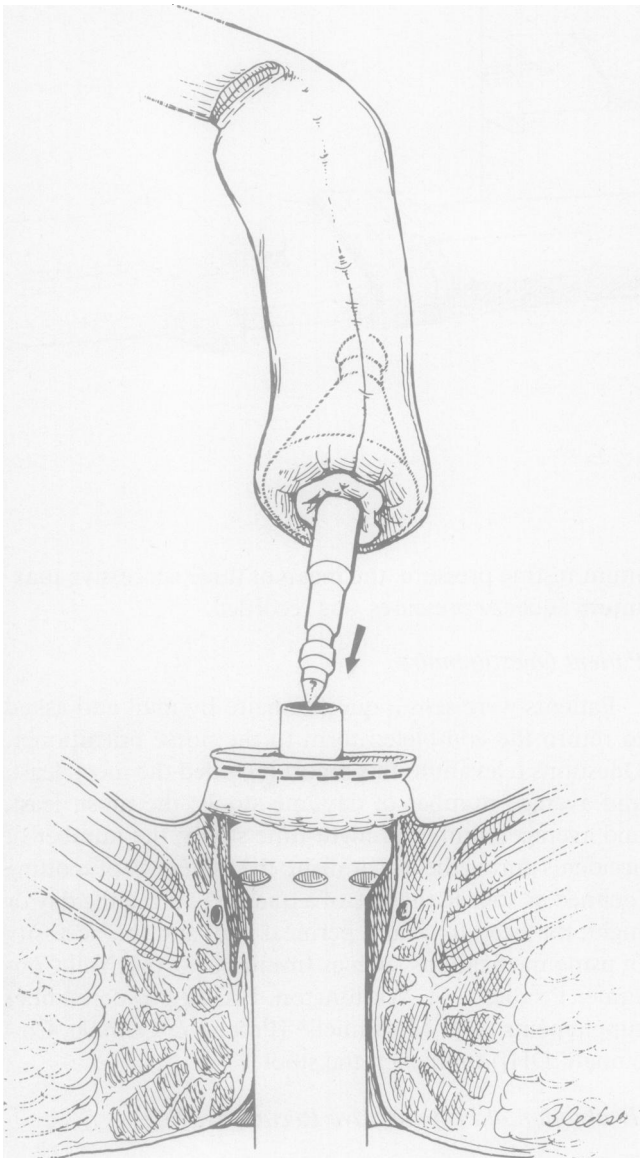


FIG. 4. Connection of the J pouch to the anus with the Premium CEEA® 31 anvil held in the pouch with 2-0 polypropylene purse-string suture.

Results

Although the antiperistaltic reversed J pouch provided significantly less stools per day than a standard handsewn J pouch (4.8 ± 1.8 versus 7.0 ± 3.3 , $p < 0.05$), it had an unacceptable incidence of problems with evacuation and the need for pouch catheterization to achieve adequate emptying, as well as a number of serious complications, which in two instances were life threatening (Table 1). For these reasons the reversed J pouch procedure was abandoned. Stool frequency with the S pouch (8.1 ± 3.6) was not significantly different than the standard J pouch. Furthermore five of the S pouch patients also needed to use a silastic catheter to achieve adequate evacuation.

Therefore the S pouch was used only when a J pouch provided inadequate length.

As of March 1989, all patients were considered to be candidates for the stapled ileoanal procedure with preservation of the anal canal. In two patients the operation could not be performed because the Roticulator® 30 instrument could not be placed below pre-existing diseased tissue, a large polyp in one patient with familial polyposis and a rectovaginal fistula in a patient with ulcerative colitis. The stapled technique had to be abandoned in two patients because of technical complications, disruption of the Roticulator® 30 staple line during insertion of the CEEA® instrument per anus and injury to the anal canal at the level of the *levator ani* muscle that prevented application of the Roticulator® stapler. In each of these four patients, a mucosal stripping to the dentate line was performed with a hand-sewn ileoanal J pouch in one patient and S pouch in three obese patients, because of the need for additional length. Ileoanal anastomotic tension was never a problem when the stapled technique was used.

Stool Control

The stapled ileoanal J pouch patients had significantly better maximum resting anal sphincter pressures (Fig. 6) and stool control (Fig. 7), especially at night (Fig. 8), than did those who underwent mucosectomy and a sutured ileoanal anastomosis at the dentate line. There were no differences in mean or maximal squeeze pressures between

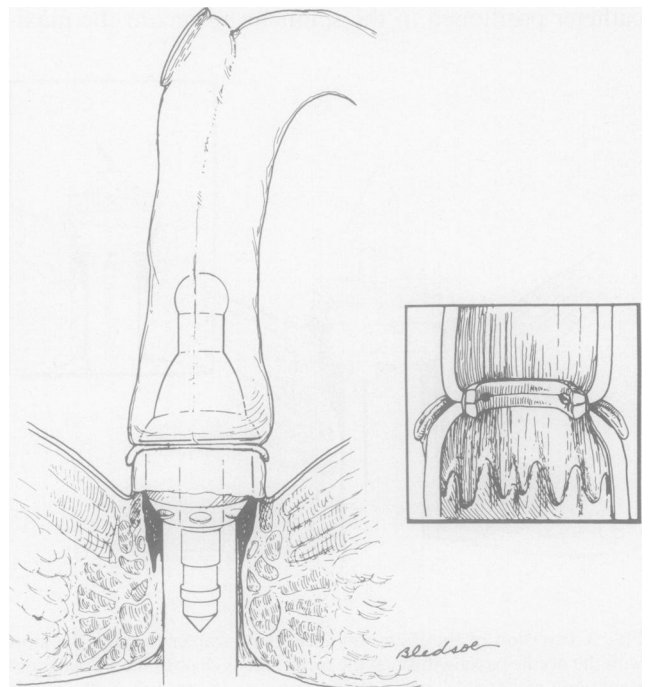


FIG. 5. Completed stapled ileoanal anastomosis. Insert shows the proximity of anastomosis to the dentate line.

TABLE 1. Complications After Ileoanal Anastomosis

Complication	Stapled J (n = 21)	Nonstapled J (n = 25)	Reversed J (n = 19)	S (n = 18)
Cuff abscess, sinus tract, leak	2	2	2	3
Pouch–buttock fistula	1*	—	2	1
Pouch–vaginal fistula	—	—	—	2
Pelvic abscess	1	1	1	1
Stenosis	1	2	2	3
Small bowel obstruction	—	2	1	—
Pouchitis	4	5	4	4
Inflammation of the anal canal	3	—	—	—
Pouch removed	—	4	1	1

* Occurred in same patient who had an anastomotic leak.

the two groups. None of the sutured patients and only one of the stapled patients had receptive relaxation noted with anal manometry. This was our first patient, who had the longest residual anal canal (3.5 cm) in the series. There were significantly fewer accidents or spotting at night in the stapled group and only one stapled patient wore a perineal pad at night, in contrast to 42% of the nonstapled patients (Fig. 8).

Stool Frequency

There was no significant difference in stool frequency between the two groups. The usual numbers of stools per 24 hours were 7.0 ± 3.3 (5.3 ± 2.6 in the day, 1.6 ± 1.5

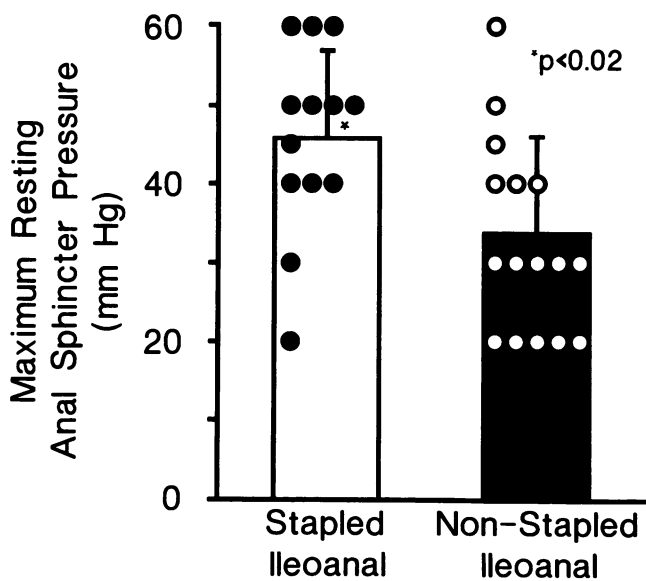


FIG. 6. Bar graph demonstrating significantly higher maximum resting anal sphincter pressure with stapled anastomosis (n = 13), as compared to mucosectomy with ileoanal anastomosis sutured at the dentate line (n = 16).

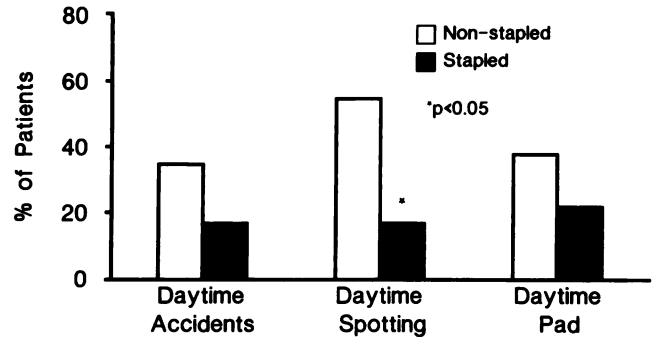


FIG. 7. Bar graphs demonstrating only significantly less daytime spotting with stapled anastomosis as compared to mucosectomy with J pouch sutured to the dentate line.

at night) in the nonstapled group and 7.9 ± 2.6 (5.8 ± 1.8 in the day, 2.1 ± 1.4 at night) in the stapled group. There were also no significant differences between the two groups in the most (12.0 ± 4.2 nonstapled versus 13.1 ± 4.4 stapled) or least (4.5 ± 2.1 nonstapled versus 5.0 ± 1.9 stapled) total number of stools per day. More of the stapled patients (50%) than nonstapled (20%) patients were taking Imodium® to decrease stool frequency ($p < 0.05$). Approximately one half of each group were using Metamucil® to thicken the stool. The slightly increased number of stools and greater use of Imodium® in the stapled group may have been due to the shorter time interval between their surgery and assessment as compared to the nonstapled group, in which some of the patients had undergone surgery up to 8 years previously.

Residual Disease

Every attempt was made to dissect the rectum as close to the levator ani muscle as possible in the stapled group. This technique improved with experience. In the first patient, the distance between the dentate line and the anastomosis was 3.5 cm. All but one patient had evidence of residual disease in the anal canal at the anastomosis, as

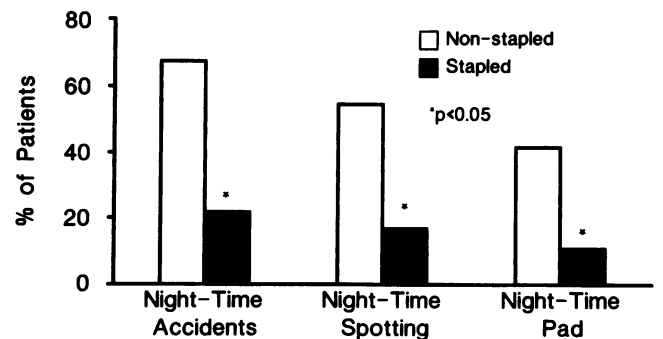


FIG. 8. Bar graphs showing significantly better night-time stool control with stapled ileoanal anastomosis as compared to mucosectomy with J pouch sutured to the dentate line.

noted both by pathologic examination of the anal 'doughnut' and by anoscopy. The length of the anal canal between the anastomosis and the dentate line measured at postoperative anoscopy averaged 1.8 ± 1.3 cm (range, 0 to 3.5 cm).

Three patients had symptoms attributable to acute inflammation in the diseased anal canal. This lasted approximately 6 months in one patient, responded to 0.5 steroid enema twice daily, and has been in remission for the past 12 months. The other two patients' symptoms of bleeding and burning were relieved with 0.5 Rowasa® (Reed-Rowell, Marietta, GA) enema daily. Each of these patients had severe refractory ulcerative colitis with bleeding before their stapled ileoanal procedures. The five other patients who underwent the stapled ileoanal procedure for fulminant colitis have not had symptoms attributable to inflammation of the anal canal.

Stapled ileoanal procedures were performed for three patients with severe dysplasia; mild dysplasia was noted at the margin of the anastomosis in one of these patients. There was no evidence of dysplasia in the rectal 'doughnuts' of the other 20 stapled ileoanal patients.

Pouchitis

Four of the stapled ileoanal patients have had symptoms of pouchitis (Table 1) that were associated with inflammation of the ileal pouch on endoscopy and responded to metronidazole (250 mg twice daily) in three and Bactrim-DS® (Roche Laboratories, Nutley, NJ) twice daily in one; one of these patients requires metronidazole therapy on alternating 2-week intervals for recurrent symptoms of pouchitis. Five of the nonstapled ileoanal J pouch patients have developed pouchitis (Table 1); all have responded to metronidazole or Bactrim-DS®. One patient has had frequent, recurrent episodes necessitating antibiotic therapy on alternating 2-week intervals for the past 4 years.

Ileostomy Use and Complications: Stapled Group

The procedure was performed without a covering ileostomy in all but 2 of the 21 patients. They were the first patient who underwent the procedure and the 14th patient, in whom a leak was identified at the anastomosis after instillation of methylene blue. Each of these patients subsequently underwent ileostomy closure after a barium enema demonstrated satisfactory healing of the pouch and the ileoanal anastomosis.

Of the patients who did not have fecal diversion, 13 were taking prednisone, and eight underwent semi-urgent surgery for uncontrollable bleeding. One of these patients also was severely malnourished (albumin, 2.2 g/dL) and developed a leak at the ileoanal anastomosis on the fourth postoperative day manifested by fever, tachycardia, and abdominal pain (Table 1). He underwent emergency con-

struction of a diverting ileostomy and abdominal irrigation with a subsequent uneventful recovery. An abscess developed in his right buttock, which was drained and noted to communicate with the ileoanal anastomotic disruption. The fistula appeared to resolve with local wound care and the anastomosis appeared intact on barium enema so that the ileostomy was closed. Six months later the ileoanal pouch–buttock fistula recurred, with periodic drainage of gas and stool, refractory to local wound care, and necessitating ileostomy reconstruction and surgical debridement of the fistula.

The one patient with familial polyposis who had undergone the stapled technique developed a leak from the stapled J pouch itself (not the ileoanal anastomosis) immediately after removal of a Jackson-Pratt® suction catheter, which was manifested by severe pain and stool noted in the remaining suction catheter. The patient was explored, but severe adhesions prevented construction of an ileostomy. The patient was fed with total parenteral nutrition with subsequent healing of the pouch fistula. A third patient with ulcerative colitis, but which was not steroid dependent, manifested a pelvic abscess 3 weeks after the stapled ileoanal procedure. At the time of re-exploration, methylene blue was inserted per anus into the ileoanal pouch and no leak could be detected. The abscess was drained and subsequently the patient has had no further complications in the 1.5 years since surgery.

One of the patients in the stapled J pouch group initially had excessive stool frequency, problems with leakage, and the need to wear a perineal pad. This patient had the lowest anastomosis in the entire stapled group, constructed at the dentate line. Anal manometry revealed a very low resting pressure but a good 'squeeze' pressure. During the course of 1 year, the patient gradually developed better stool control; however he still has frequent accidents and is the only patient who needs to wear a perineal pad at night.

Complications: Nonstapled Group

In the nonstapled J pouch group, two patients required removal of the ileoanal pouch because of excessive stool frequency and inadequate control (Table 1). The pouch was removed in two other patients as a result of complications early in the series: one from bleeding from pelvic veins and one from bleeding at the ileostomy anastomosis, which was treated at another hospital with radiographic bead embolization leading to subsequent necrosis of the ileoanal pouch. One patient developed a pelvic abscess that required drainage. Two patients required dilation of ileoanal anastomotic stenoses (Table 1). One patient in the standard J pouch group developed an enterocutaneous fistula after ileostomy closure (Table 2). There were three other enterocutaneous fistulas in the series after ileostomy closure: one with a reversed J pouch and two with an S

TABLE 2. *Ileostomy Complications*

Complication	Nonstapled J	Reversed J	S	Stapled J*
No. Patients	25	19	18	2
Enterocutaneous fistula	1	1	2	—
Ileostomy anastomosis bleed	1	—	—	—
Ileostomy anastomosis disruption	—	1	—	—
Ileostomy site hernia	—	1	1	—

* Nineteen patients underwent a stapled J pouch without ileostomy. Eight of sixty-five patients had ileostomy-associated complications.

pouch. Two patients developed ileostomy site hernias. Thus 8 of 65 patients (12%) who underwent ileostomy closure developed complications that required surgical intervention (Table 2). Three patients developed small bowel obstructions requiring laparotomy and adhesiolysis; two of these were in the standard J pouch group (Table 1).

Discussion

This study confirms the results of several British series¹⁰⁻¹³ that after a total abdominal colectomy, an ileal pouch-anal anastomosis stapled immediately above the *levator ani* muscles is a procedure that is technically much easier and provides significantly better stool control than an ileoanal anastomosis sutured at the dentate line after a mucosectomy. During development of the ileoanal procedure, it was initially thought that the entire rectal muscular cuff was required to preserve adequate sensation for control of defecation.⁴ However placing an ileal pouch within this long rectal cuff was associated with a high incidence of pelvic sepsis.⁴ Shorter and shorter amounts of rectal muscle were preserved and the technique of mucosal stripping was performed entirely from the perineal direction to just above the *levator ani* muscle. No deterioration in anal sphincter function was seen and a lower incidence of pelvic sepsis was achieved.⁵

Stool Control

Martin and Fischer⁸ were the first to note improved stool control after preservation of the columns of Morgagni above the dentate line, often called the anal transition zone. Significantly better anal sensation and discriminatory function also were noted by Holdsworth and Johnston¹⁷ after a sutured end-to-end ileoanal anastomosis with preservation of the anal transition zone than after mucosal proctectomy with endoanal anastomosis. A similar improvement in anal sensation after preservation of the anal transition zone, which was not clinically signif-

icant, also was noted in a small series of patients by Miller et al.¹⁸ On the other hand, Keighley et al.¹⁹ did not find any impairment in discrimination after excision of this zone; however only six patients were studied who had the anal transition zone preserved in contrast to 15 who had it excised. Lavery et al.²⁰ also noted a significantly greater resting anal sphincter tone with better stool control with the stapled ileoanal technique. This group also noted that 50% of their patients had preservation of the rectoanal inhibitory reflex. Even a straight ileoanal anastomosis without construction of a pouch was associated with perfect anal continence when a mucosal cuff was preserved, as contrasted to a 30% incidence of significant incontinence after mucosectomy.²¹ Our patients also had significantly better maximal resting anal sphincter pressures (Fig. 6) and stool control (Fig. 7), especially at night (Fig. 8), when the anastomosis was constructed at the *levator ani* muscles, thus preserving the anal transition zone, as compared to an endoanal mucosectomy with the anastomosis at the dentate line. In contrast to the study by Lavery et al.,²⁰ only one of our stapled ileoanal patients had evidence of receptive relaxation, or preservation of the rectoanal inhibitory reflex.

Risk of Persistent Disease Activity

The greatest concerns with procedures that preserve any tissue above the dentate line are the potential problems for continued disease activity and the possibility of malignant transformation. In the comments after a recent series reported using the stapling technique, it was stated that no residual diseased mucosa was left.²² This is the group, however, who noted receptive relaxation in 50% of their patients,²⁰ a finding we only found in one patient and he had the longest (3.5 cm) residual anal canal. In our series residual ulcerative colitis was noted microscopically at the anastomosis in all but one of our stapled patients. Three of the stapled patients had problems with rectal bleeding and burning, which were controlled with small amounts of either a steroid or Rowasa® enema. It is certainly possible that other patients in whom we have performed this procedure could develop disease reactivation in the future. Bloody diarrhea in these patients can be secondary to either pouchitis or inflammation of the residual anal canal. Pouchitis has been thought to be secondary to overgrowth of anaerobic bacteria within the ileal pouch and usually responds to antibiotic therapy with either metronidazole or Bactrim-DS®.²³ Four of our stapled ileoanal patients developed symptoms of pouchitis that have responded to antibiotic therapy, an incidence that is not different from the nonstapled patients.

In a recent report from the Mayo Clinic, Lohmuller et al.²⁴ noted that extraintestinal manifestations of inflammatory bowel disease were frequent after the ileoanal pro-

cedure. This incidence was even greater in the patients who developed pouchitis. It is possible that leaving behind a small amount of diseased tissue might further increase the risk of extraintestinal complications, such as pyoderma gangrenosum, erythema nodosum, arthritis, uveitis, and so on. None of the stapled ileoanal patients in our series developed extraintestinal manifestations of inflammatory bowel disease to date.

Risk of Carcinoma

The greatest reservation for using the stapled procedure is the potential for malignant transformation of residual diseased anal mucosa. In one study an unsuspected adenocarcinoma of the anal canal, extending to the level of the dentate line, was found in a patient who was undergoing an ileoanal procedure for moderate dysplasia.²⁵ These authors believe that 'the anal mucosa should always be removed down to the level of the dentate line in restorative operations for ulcerative colitis.'²⁵ Stern et al.²⁶ recently reported a patient who developed an adenocarcinoma in the rectal cuff 4 years after a mucosal proctectomy and ileoanal J pouch for severe dysplasia; this patient had undergone a subtotal colectomy, ileorectal anastomosis 7 years previously at which time an occult, Duke's C adenocarcinoma was found in the ascending colon. These authors also believe that a radical total mucosectomy is mandatory in patients with ulcerative colitis. In one of our three patients who underwent the procedure for severe dysplasia, mild dysplasia was noted at the anastomosis. This patient had only 3 mm of residual diseased mucosa left below the anastomosis. In a study by Emblem et al.,²⁷ it was noted that 10 of 13 patients with familial polyposis with preservation of the anal transition zone developed further polyposis in this area.

Until recently ileorectal anastomosis often was used by colorectal surgeons for ulcerative colitis as an alternative to total colectomy, proctectomy, and permanent ileostomy. In one recent report of 51 patients with this procedure performed between 1955 and 1984, no patient developed a rectal carcinoma.²⁸ Khubchandani et al.²⁹ noted three adenocarcinomas (one *in situ*) in 51 patients for a 5.6% incidence. This is similar to the incidence noted in several published series, although the cumulative risk may be as high as 15% during a period of 30 years.³⁰⁻³³ The risk of developing a carcinoma when leaving 1 to 2 cm of disease must surely be a fraction of the ileorectal experience, in which approximately 15 cm of diseased rectum was usually left behind.

It will, therefore, be incumbent on surgeons who leave the anal transition zone intact to inform their patients of the necessity for follow-up examinations of the anal canal. The frequency of these examinations is difficult to determine, but should probably be annually at first until the

safety of the procedure can be established. The procedure will only require anoscopy, which would be far less costly, unpleasant, and time-consuming than a complete colonoscopy, to which these patients were previously subjected. A small commercial enema would be the only preparation required. Malignant transformation probably would necessitate an abdominal-perineal resection. This should be an integral component to preoperative informed consent.

Safety of the Stapled Ileoanal Procedure

The development of the Premium CEEA® and Roticulator® surgical intestinal staplers greatly simplified the operation and probably improved its safety.¹⁰⁻¹³ Total operative time is about 4 hours. However sometimes it may not be possible, or appropriate, to perform the stapled ileoanal procedure. This occurred in four of our patients, two for medical and two for technical reasons at the time of the attempted stapled operation. Therefore surgeons must be adept at both techniques, including the ability to construct either a J or S pouch.

Although there is a concern that the circular EEA stapler crosses four staple lines, this has rarely been associated with an anastomotic leak. Only 1 of our 21 patients who underwent the procedure developed a leak at this anastomosis and this patient was quite ill and malnourished before his operation. There was one other leak higher in the stapled J pouch that seemed to be temporally related to the inadvertent removal of a suction Jackson-Pratt® drain without opening it to atmospheric pressure.

Avoiding a Diverting Ileostomy

The ease and safety of the procedure led us to perform it without a diverting ileostomy when the operation appeared to proceed without difficulty. This obviates the need for a second operation and its morbidity. Ileostomy following the ileoanal procedure can be technically difficult because the ileum is tethered low in the pelvis. This is a problem particularly in obese patients. Furthermore takedown of the ileostomy also may be quite challenging because the distal nonfunctional ileal lumen may be very small. Several of our patients developed complications after ileostomy closure (Table 2). Complications are noted in several other reports,^{14,34-38} following ileostomy closure, with about a 10% rate of ileostomy anastomotic leakage (Table 3). Peritonitis developed in 6.4% of patients from the Mayo Clinic after ileostomy closure, which required re-exploration in all patients and re-establishment of the ileostomy in some.³⁴ The Lahey Clinic had a 37% rate of ileostomy complications, with 22% requiring surgical correction.¹⁴ We managed our four ileostomy leaks with percutaneous drainage and parenteral nutrition.

It is possible that ileostomy construction and its sub-

TABLE 3. *Ileostomy Complications Collected Series*

Series	No. (%)	Complication
Mayo Clinic ³⁴	6	Ileostomy leak
Lahey Clinic ¹⁴	37	Complications
	22	Operative correction
Vancouver ³⁶	27	Complications
	10	Ileostomy leak (1 death)
Finland ³⁸	52	Complications
	10	Ileostomy leak
Richmond	12	Operative correction
	8	Ileostomy leak

sequent closure may be related in part to the high incidence of small bowel obstruction noted following the ileoanal pouch procedure. Seventeen per cent of ileoanal patients from the Mayo Clinic developed a small bowel obstruction, of whom 7.5% required surgical intervention.³⁹ We also had several patients with small bowel obstruction in our previous series of patients, although none of the current stapled group have developed this complication to date. While the follow-up is perhaps too short, several patients who had undergone a temporary diverting ileostomy had already experienced episodes of small bowel obstruction during a similar time period.

Several studies evaluated performing the ileoanal operation without an ileostomy. Thow⁴⁰ was one of the first to do this. In 1986 a report from the Mayo Clinic described nine patients of 200 who underwent the procedure without an ileostomy, of whom eight had good results.⁴¹ One patient developed jejunal volvulus and perforation after discharge and required pouch excision. They recommended that the operation could be performed in carefully selected patients. Others have had catastrophic results when an ileostomy was avoided.³⁵ In a study by Everett and Pollard,³⁷ 29 of 64 patients had a hand-sewn W reservoir ileoanal anastomosis without a diverting ileostomy and had a lower incidence of complications and total hospital stay than did those with a stoma. Five of the 35 patients who had an ileostomy developed complications directly attributable to the stoma. They concluded that, in experienced hands, there can be a considerable benefit in reduction of operative procedures and hospital stay when the ileostomy is avoided. A recent series from Finland, using a stapled J pouch but hand-sewn ileoanal anastomosis without a protective ileostomy, had one patient of 25 who developed an anastomotic leak requiring subsequent construction of a diverting ileostomy.³⁸ They had also previously noted a high incidence of complications directly related to the ileostomy closure. In one series with a hand-sewn anastomosis without a pouch or ileostomy constructed at the *levator ani* muscle, 4 of 32 patients developed an anastomotic leak.²⁷

The only series of stapled ileoanal procedures published to date without a covering ileostomy was that of Kmiot

and Keighley.¹² Of 16 patients so treated, three patients receiving steroids had serious postoperative morbidity: one patient developed peritonitis and gram-negative bacteremic shock but no leakage was found at the time of laparotomy 7 days after the ileoanal procedure. A second patient developed a leak at the transected ileum but not at the ileoanal anastomosis. The third patient developed an intussusception of the afferent limb resulting in infarction of the pouch necessitating excision 5 days after the original operation. The authors recommended performing the stapled ileoanal operation without a covering ileostomy only in patients who are not receiving steroids.

Of our 19 patients who underwent the stapled ileoanal operation without a diverting ileostomy, 13 were taking prednisone, 8 underwent the procedure semi-urgently for uncontrollable bleeding, and 3 had significant hypoalbuminemia. Three of these 19 patients developed complications, of whom only one had been taking steroids. This patient also had uncontrollable bleeding and was hypoalbuminemic before the ileoanal procedure; he developed the only leak at the ileoanal anastomosis. In a recent report, subtotal colectomy with an ileostomy and preservation of the rectum as a Hartmann procedure was recommended for the emergent management of severe colonic bleeding in ulcerative colitis.⁴² Our data suggest that this degree of conservatism is unnecessary.

The risk:benefit ratio of performing the operation without a diverting ileostomy is yet to be determined. Avoidance of a second operation with its complications may not only significantly reduce hospital costs but also may permit earlier return of the patient to a functional role in society. On the other hand, major morbidity from an undiverted anastomotic leak is a cause for genuine concern and may require three or more operations to control the septic process and restore function. Diversion probably should still be considered for a severely malnourished patient taking high-dose steroids, although a diverting ileostomy was successfully omitted in two such patients in our series. One other disadvantage from avoidance of the ileostomy is that these patients will not experience its inconvenience and thus will be unable to compare it to having frequent stools with the ileoanal procedure.

Stool Frequency

Stool frequency in the stapled J pouch ileoanal patients was similar to our patients who underwent a sutured J pouch ileoanal anastomosis at the dentate line. Excessive stool frequency persists as one of the major problems of the ileoanal procedure. Although some of our patients only have three stools in a 24-hour period with none during the night, some have as many as 15 stools per 24 hours with several during the night, interfering with their

sleep. Two patients in the hand-sewn group insisted that their pouch be removed with construction of a permanent ileostomy. In two series, the triplicated S pouch was noted to have a lower stool frequency than a J pouch.^{43,44} However this has not been seen in our experience or by other investigators.⁴⁵ Harms et al.⁴⁶ suggested that a W pouch would have an even greater compliance and lower stool frequency than the S pouch. However in a recent study they did not note any significant differences from an S pouch.⁴⁷ Although Harms et al.⁴⁷ did not compare the W pouch to a J pouch, no difference in stool frequency or continence were noted by Kmiot et al.⁴⁸ between these pouches. Neither the S nor W pouches can be constructed with a surgical stapler and they may also be difficult to anastomose to the anus with the Premium CEEA® stapler.

Thow⁴⁰ proposed an antiperistaltic J pouch to decrease stool frequency. We used a similar pouch in 19 patients and found that it significantly reduced stool frequency when compared to a standard J pouch. However several of these patients required insertion of a silastic catheter to evacuate and two patients developed life-threatening complications as a result of their functional obstruction. This led us to abandon the reversed J pouch procedure.

Conclusions

This study supports a stapled, supralelevator ileoanal J pouch anastomosis for ulcerative colitis and, possibly, familial polyposis. The operation is easier and appears to be safer to perform than the standard handsewn ileoanal anastomosis. In most circumstances it may be performed without a diverting ileostomy. These patients have significantly better continence, especially at night, than those who have had a mucosal proctectomy and anastomosis to the dentate line. However surgeons who perform this procedure must still be adept at the standard mucosectomy and ileoanal anastomosis technique because sometimes this may be required. Follow-up anoscopic evaluation of the residual anal mucosa will be important but may be difficult to achieve in asymptomatic patients. A randomized, prospective trial will be required before the benefit regarding stool control and overall reduction in complications, duration of hospitalization, and costs strongly suggested by this study and others can be proved. A much longer time will be required before we can be certain that the procedure will not be associated with an unacceptable incidence of subsequent adenocarcinomas.

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DISCUSSIONS

DR. JOSEF FISCHER (Cincinnati, Ohio): I do not know of any other group that has experience with the various types of pouches and has analyzed them as carefully as this manuscript.

I would like to make several comments about three different areas that Dr. Sugerman has detailed and then to ask a question.

We emphatically support the retention of the transitional zone. And we continue to believe, and it appears that the data are gradually being accepted, that this is directly related to the preservation of nighttime continence.

It is interesting that the only patient in Dr. Sugerman's more recent series who must wear a pad is the patient in whom the dissection is down to the dentate line. In our early experience with Dr. Lester Martin, when we intentionally dissected down to the dentate line, we had a great deal more difficulty with continence than we do now.

If you look at the incidence of wearing a pad, I am not sure it is all related to the transitional zone. Our incidence of wearing a pad in a group of patients, which now numbers about 200, and we are part of the way through reviewing them with questionnaires and interviews and things like that, is about 7% in those patients without pouchitis.

We have a 6% incidence of pouchitis and we have a 7% incidence of patients without pouchitis who wear a pad, which is about the same as in this study.

Does the concern about leaving the transitional zone involve the kind of epithelium? Is it rectal epithelium or is it a different kind of epithelium? Our experience with many polyposis patients is not to have the regrowth of polyps, and I would wonder whether those patients are really transitioning into Gardner's syndrome, of whom we have seen a fair number with small bowel polyps and also gastric polyps.

I suspect that the length of rectal mucosa that we leave is about the same as Dr. Sugerman. We do not measure, but the distance between

the dentate line and the top of the columns, as we estimate it, is about 1.5 cm.

In the early part of the series, when we intentionally left 1 cm additional above where we thought the transitional zone ended, as does Dr. Sugerman, we had trouble with recurrent rectal disease. And 6 of the 12 patients in whom we intentionally left a good length of rectal mucosa have had difficulty, requiring continuous steroids, suppositories, and systemic steroids (one patient), so I do not think that is a very good idea.

The type of pouch is perhaps less important than the length of the sleeve of the exit, which, of course, is not an issue with the J-pouch because you anastomose the J pouch directly to the anus. We continue, because Cincinnati is a very traditional city, to use one form of operation, which is the S pouch. But the one thing we have done is that we have consistently shortened the length of the exit spout to about 5 mm and to make the pouch smaller. And the pouch is now about 10 cm on a side in the stretched state, the S pouch, which we believe contributes to a lower incidence of pouchitis, because the pouch empties completely.

The third question is that of diversion. If, in fact, it works out that the incidence of complications in the patients who are not diverted is lower than the patients who are diverted, then that would be a useful argument for doing some type of anastomosis and not protecting it.

Surgeons have very selective memories. As I was talking to Dr. Sugerman earlier, I said that I did not recall a patient with a leak following an ileostomy closure, but I probably would have repressed it anyway if I had. But we have had a certain number of complications from the ileostomy itself, including stenosis, a number of patients in whom we have had intestinal obstruction. And I had an occasion to revise an ileostomy at the peritoneal reflection last week in a patient 4 weeks after a diverting ileostomy.

The jury is still out on this. But if, in fact, the protective effect of the ileostomy and the leaks and the abscesses is less than that of the complications from the ileostomy or its closure, this is a very significant contribution.