Reconstruction Techniques after Proctectomy: What's the Best?

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ABSTRACT

There are ~40,000 new rectal cancer cases diagnosed each year in the United States, representing the second most common gastrointestinal malignancy (behind colon cancer). With the advent of sphincter preserving techniques, patients with mid and low colorectal cancers enjoy the benefits of better postoperative functional outcomes and quality of life; however, controversy exists over which reconstructive technique is superior in restoring bowel continuity. Construction of a straight coloanal anastomosis is technically simpler, but functional outcomes are inferior compared with colonic reservoirs. The purpose of this review is to summarize the current data regarding reconstructive techniques following proctectomy.

KEYWORDS: Rectal neoplasms, colonic pouches, proctocolectomy, restorative, anastomosis, surgical

Objectives: On completion of this article, the reader should be able to summarize the reconstructive techniques following proctectomy, including postoperative complications and functional outcomes.

Despite recent advances in diagnostic and therapeutic interventions, colorectal cancer remains a significant clinical and surgical challenge. Colorectal cancer is the most common gastrointestinal malignancy in the United States. In 2006, an estimated 148,610 new cases of colorectal cancer were diagnosed, and 55,170 deaths occurred.¹ Thirty percent of these cancers are located in the rectal area. Even though neo-adjuvant therapy is the standard of care for more advanced rectal cancers,^{2,3} surgery continues to be the mainstay in the management of these tumors.⁴ For patients with mid and low rectal tumors, sphincter-preserving techniques have become increasingly com-

mon due to the advent of new devices, which permit low anastomoses with acceptable oncologic results and preserved sphincteric function.⁵

The question as to which reconstructive technique following low anterior resection is superior in terms of functionality, low postoperative morbidity, and quality of life generates some debate. Straight coloanal anastomosis (SCAA) has been historically associated with relatively poor postoperative bowel function because of loss of the rectal reservoir.⁶ To overcome this, a neoreservoir using a colonic J-pouch (CJP) has been advocated for low colorectal and coloanal anastomoses.⁷ However, difficulties in reach,

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inability to contour the pouch into a deep male pelvis, and postoperative evacuation problems can make the CJP problematic.⁸ The development of a transverse colectomy (TC) has allowed us to overcome the poor bowel function seen with straight anastomoses and the technical challenges of the CJP.⁹ Randomized studies have demonstrated that CJP leads to better early functional results compared with the SCAA;¹⁰ however, ~10 to 30% of the patients with colonic J-pouches face late evacuation problems requiring the use of enemas or laxatives.¹¹ Studies have also shown that the TC pouch provides early functional results comparable to CJP, while avoiding these late evacuation problems.¹²

A significant number of prospective well-designed studies exist comparing these reconstructive techniques. In this article, we review the current literature regarding these techniques focusing on postoperative complications, bowel function, and quality of life after the operation.

STRAIGHT COLOANAL ANASTOMOSIS

Straight coloanal anastomosis has been the traditional choice for restoring bowel continuity after proctectomy. The anastomosis can be hand-sewn or stapled with a circular stapler that allows creation of the anastomosis for very distal rectal tumors. Hand-sewn colorectal anastomoses can be done in one or two layers and are typically performed transanally or transabdominally if the distal end can be adequately visualized. Early randomized studies comparing hand-sewn to stapled anastomoses raised questions regarding the safety of stapler devices;¹³ however, later trials demonstrated equivalent rates in postoperative leaks with either technique.^{14,15} In a multicenter randomized prospective study done over a decade ago, Docherty et al¹⁶ demonstrated a significant higher incidence of radiologic leak in patients undergoing sutured anastomoses for colorectal cancer. This finding, however, did not translate into higher clinical leak rates, morbidity, or mortality. A more recent meta-analysis done by MacRae and McLeod assessed all randomized controlled studies comparing hand-sewn to stapled anastomoses for colorectal cancer. The study included 13 trials that met inclusion criteria.¹⁷ The two findings that were noted to be significant between groups were intraoperative difficulties and postoperative strictures in the stapled group. No differences were observed in clinical or radiologic leak rates, local cancer recurrence, or mortality.¹⁷ In a recent systemic review by Lustosa et al,¹⁸ the overall anastomotic leak for stapled anastomoses was 13.0% compared with 13.4% for the hand-sewn patients. Postoperative stricture, wound infection, and specific mortality were also undistinguishable between stapled and hand-sewn

anastomoses. Currently, stapled anastomoses provide excellent results with relative low risk of postoperative complications.

Technically, stapled anastomoses offer less tissue manipulation, uniformity of staples in the anastomotic line and rapidity to the procedure. In a series of 103 consecutive patients undergoing surgery for adenocarcinoma of the rectum, Miller et al¹⁹ randomized patients to a single or a double stapling technique. A statistical difference was noted in the distal margin as well as bacterial contamination in favor of the double technique. Clinical leaks were noted in 9.5% of the single stapled patients compared with 2.4% of patients undergoing the double technique. No differences were documented in the rate of local recurrences or overall survival between groups. Multivariate analyses have shown that low anastomoses (<6 cm), preoperative radiation, steroids, diabetes mellitus, use of pelvic drainage, duration of surgery, presence of intraoperative adverse events, and male gender are independent risk factors for anastomotic leakage.^{20–22} Following completion, the integrity of the anastomosis should be tested intraoperatively by insufflating air into the rectum while keeping the anastomosis submerged because the presence of air leaks has been correlated with postoperative complications.^{23,24}

A controversial aspect in reconstructive techniques is the role of temporary stoma construction for patients undergoing anastomosis for rectal cancer. Proponents of temporary stomas agree that postoperative leakage rates are lower in those diverted;^{25–27} however, others have shown that leakage rates remain the same despite prophylactic diversion.^{28,29} Small randomized trials have failed to settle this debate.^{30,31} A recent prospective study of 1078 patients by Wong and Eu³² showed no differences in the anastomotic leak rate between diverted and nondiverted patients. The authors concluded that even though a diverting stoma does not reduce postoperative anastomotic leak rate, it reduces the otherwise catastrophic effects of an anastomotic leak such as fecal peritonitis and septicemia. Some authors suggest that stoma construction should be advocated for patients who are deemed preoperatively high risk for anastomotic leak,³³ such as obese patients and for those in which the aforementioned risk factors have been identified.³⁴ This more selective approach will likely result in lower overall costs associated with diverting patients;³⁵ however, it is prudent to construct a temporary defunctioning stoma at the time of surgery to prevent subsequent catastrophes. Our practice is to perform diversion for all patients with a colorectal or coloanal anastomosis within 6 cm of the anus, especially if they have undergone preoperative radiation therapy or have other risk factors for postoperative complications.

Postoperative Results of Straight Coloanal Anastomosis

In general, the most limiting factor that influences postoperative outcomes in patients undergoing SCAA is what has been termed *anterior resection syndrome*. Patients with anterior resection syndrome experience increased rates of stool frequency, urgency, and incontinence due to the loss of the rectal reservoir. Overall, up to 50% of patients will experience some degree of anterior resection syndrome in the first 6 months after surgery, but this rate decreases with time. Studies have shown that functionality of the SCAA is severely affected by postoperative radiation.³⁶ To avoid these functionality problems, a variety of colonic reservoir techniques have been developed. These include the CJP and more recently, the TC technique.

In summary, straight coloanal anastomoses are relatively easy to construct, and although anastomoses can be hand-sewn, most surgeons prefer the stapled technique. Both techniques have similar postoperative results. The overall postoperative leak rate for straight coloanal anastomoses is ~13%, postoperative strictures 7%, wound infections 7%, and rectovaginal fistulas 2%; mortality rate is 1 to 2%. More than 50% of patients will develop functionality problems, but this rate will eventually decrease with time. Even though no randomized trial has found prophylactic stomas to prevent anastomotic leak, stoma construction at the time of surgery is recommended by most experts to avoid intraabdominal catastrophes such as peritonitis or sepsis.

COLONIC J-POUCH

Colonic reservoirs following proctectomy have been developed to overcome the functional limitations of straight coloanal anastomoses. Research has shown that creation of a colonic reservoir improves postoperative function by increasing the volume capacity of the neorectum (Fig. 1).^{10,26,37} The CJP was first introduced 20 years ago by Lazorthes et al³⁸ and Parc et al³⁹ and has become a valid alternative for patients requiring low anastomoses.⁴⁰ Over the last several years, numerous well-designed randomized studies have validated the functional benefits of the CJP over the SCAA after low anterior resection.^{41,42}

The functional benefits of a CJP are directly related to the construction of the pouch. The pouch has to be neither too small to prevent urgency nor too large, which would result in too difficult evacuation. A mathematical model developed by Banerjee and Parc estimated that a pouch with limb lengths of 8 to 10 cm provides an undistended volume capacity between 60 to 105 mL.⁴³ However, larger sizes are generally associated with evacuatory problems.

Figure 1 Colonic J-pouch.

Lazorthes et al prospectively randomized 59 consecutive patients to undergo either a small (6 cm) or large (10 cm) colonic J-pouch for reconstruction following proctectomy for rectal cancer.⁴⁴ Patients were evaluated for frequency, urgency, continence, and laxative and enema use at 3, 6, 12, and 24 months after the operation. No differences were noted between groups in the rate of defecation frequency, urgency, or fecal continence at 3, 6, 12, and 24 months; however, the requirement for laxatives and enemas was higher in patients randomized to the larger size pouch 2 years after the operation. This was subsequently confirmed by other investigators in prospective trials.^{45,46} Currently, most experts recommend the creation of a pouch of ~6 to 7 cm. Our practice is to construct a 6 to 7 cm CJP that prevents urgency and allows an easy evacuation. Another technical aspect that influences the postoperative functionality of the pouch is the height of the J-pouch coloanal reconstruction. Hida and colleagues⁴⁰ determined in a comparative study of

48 patients that the functional outcome in those undergoing J-pouch reconstructions is significantly better when the distance of the anastomosis from the anal verge is between 4 to 8 cm. Moreover, the authors noted that anastomoses located 9 to 12 cm from the anal verge are associated with postoperative outcomes similar to those obtained with straight coloanal anastomoses, whereas anastomoses <3 cm from the anal verge have been associated with higher postoperative incontinence scores.⁴⁷

With the increasing popularity of minimally invasive approaches, laparoscopic techniques are being applied commonly to complex colorectal procedures. Laparoscopic resection of rectal cancer is associated with faster recovery, early return to normal diet, and lower morbidity.^{48,49} Retrospective analyses have shown no significant differences in terms of disease-free survival rate, local recurrence rate, mortality, morbidity, or postoperative anastomotic leakage in patients undergoing laparoscopic or open total mesorectal excision.⁵⁰ Laparoscopic techniques are also being applied to reinstitute bowel continuity with colonic reservoirs. In 2001, Chung and colleagues reported 5 patients undergoing total mesorectal excision with CJP reconstruction for low rectal cancers.⁵¹ In this series, the 5-cm CJP was performed extracorporeally with a 60-mm linear cutter using either the descending or the proximal sigmoid colon. Recently, a prospective trial of patients undergoing laparoscopic mesorectal excision with CJP reconstruction showed adequate oncologic and postoperative outcomes.⁵² In this series of 105 patients who were followed-up for a mean of 26 months, only 2 conversions were reported with 6 patients requiring reoperations for major complications. No 30-day mortality was reported and the 5-year cancer-specific survival and local recurrence rates were 81.3% and 8.9%, respectively.

Postoperative Outcomes of Colonic J-Pouch

Overall, postoperative complications, length of stay, and perioperative mortality of colonic J-pouches is similar to those of straight coloanal anastomoses. The incidence of anastomotic leak following colonic Jpouch construction is ~9%, J-pouch coloanal anastomosis stricture 7%, wound infections 7%, and rectovaginal fistula 2%.⁵³ The principal difference between both techniques; however, resides in the early postoperative function results. Patients with colonic J-pouches tend to experience less frequency, urgency, and evacuation difficulties immediately after surgery and up to a year postoperatively,⁵⁴ this translates into better quality of life.⁵⁵ This short-term functional benefit levels with time;^{37,56} the difference in stool frequency and urgency is similar between SCAA and CJP 2 years or beyond the procedure. After 2 years, patients that underwent a

large CJP require more laxative and enemas to evacuate their reservoir.¹⁰

Colonic J-pouches are an excellent alternative for patients following total mesorectal excision requiring reconstruction. Pouches that are ~6 to ~7 cm offer better functional outcomes than larger reservoirs. Laparoscopic techniques are associated with faster recovery with similar postoperative complications to that of open approaches. Recent data suggest that the laparoscopic technique provides adequate oncologic results; however, long-term prospective randomized trials are needed to confirm these findings. Colonic J-pouches are associated with early better functional outcomes compared with SCAA, but this difference tends to vanish 2 years out of the procedure.

TRANSVERSE COLOPLASTY

Between 5 to 25% of patients undergoing proctectomy are not suitable for J-pouch construction.^{8,42,57,58,60,61} The reasons why such patients are not suitable for a CJP creation are technical, such as narrow pelvis, bulky anal sphincters, the need for mucosectomy, diverticulosis, insufficient colon length, or pregnancy. The nontechnical reasons are complex surgery or distant metastases are present.⁸ In these circumstances, a TC has been proposed. The technique was first described in a pig model⁶² and subsequently adopted in humans.⁶³ It offers excellent functional results with acceptable postoperative complications.⁶⁴ Randomized trials have validated this

Figure 2 Transverse coloplasty.

approach for patients requiring reconstruction of bowel continuity.⁶⁵

Technically, a TC is fashioned by creating an 8- to 10-cm longitudinal colotomy between the tenia (Fig. 2). The colotomy should begin 4 to 6 cm from the cut end of the mobilized colon. Once created, the colotomy is closed transversally with a single layer of 3–0 interrupted stitches. After confirming integrity by insufflating the newly constructed pouch with air, the anastomosis can be hand-sewn or stapled. The surgery is then completed with a diverting ostomy.

A prospective randomized trial from Singapore found higher rates of postoperative leak in patients undergoing TC compared with CJP.⁵⁷ In this trial, 88 patients were assigned to a CJP or TC. Both groups were well-matched for age, gender, staging, adjuvant therapy, and mean follow-up. Patients subjected to the TC had a leak rate of 16% compared with none in the CJP group. In this study, all leaks were anterior to the coloanal anastomosis, below the site of the coloplasty. However, this postoperative leak rate with TC has not been corroborated by others. In a prospective phase I/II trial published by Z'graggen et al⁹ in 2001, the anastomotic leak was 7% in those undergoing TC; this was later confirmed by another prospective trial.⁶⁵ In a retrospective review by the senior author of this article, of 20 patients undergoing TC, only 1 postoperative anastomotic leak was identified in a patient with no defunctioned stoma.⁶⁴

Functional Outcomes of Transverse Coloplasties

The majority of studies published to date in the surgical literature found similar early postoperative functional results between a TC and a CJP. Proponents of the coloplasty agree that it is a relatively simpler operation that avoids the late CJP evacuation problems.⁶⁵ The frequency of bowel movements as well as urgency, fragmentation of stools, and incontinence tend to decrease over time. This is likely the

consequence of an increment in the volume capacity of the TC.⁶⁶ Some retrospective studies have demonstrated that quality of life is similar or even better in those receiving a TC compared with other reconstructive techniques.⁶⁷

The first study that clinically evaluated TC and compared the technique to SCAA or colonic J-pouches was published back in 2001 and included all consecutive patients operated on at the Cleveland Clinic Foundation by a senior colorectal surgeon.⁶⁴ Patients were well-matched for age, gender, and comorbidities. Twenty of the patients underwent a TC with the colorectal anastomosis within 3 cm of the dentate line, 16 others had a CJP, and a remaining 17 patients underwent a SCAA. In this series, major complications in the TC group occurred in five cases, including two small-bowel obstructions, one anal stricture requiring dilation, one bladder dysfunction requiring self-catheterization, and one anastomotic leak. Functional comparisons demonstrated that resting and squeeze pressures were not significantly different among the three groups. Statistically significant elevated maximum tolerated volume and compliance were found in the TC and CJP group compared with the SCAA patients (Table 1). Clinically, patients subjected to a TC or CJP had fewer bowel movements per day than the SCAA group (Table 2). Furthermore, the percentage of patients requiring medications to slow down their bowels, their continence scores, and the percentage of patients having a major complication were statistically similar among the groups. These findings were later confirmed in a prospective trial where patients were randomized to a TC or a CJP.⁶⁰ The investigators found no significant differences between groups regarding bowel function. The postoperative frequency of daily bowel movements, stool fragmentation, and urgency within the first 6 months of surgery were lower in the coloplasty group. In this study, no differences were found in the incidence of incontinence or manometric data between groups. The patients in the TC group did have more postoperative anastomotic leak rates, but this was not statistically significant.

Table 1 Average Postoperative Manometric Values in Patients with Coloplasty, Colonic J-Pouch or Straight Coloanal Anastomosis

	Coloplasty	Colonic J-Pouch	Straight Coloanal	P Value*
Rest pressure in mmHg	39.2 (11.6)	37.2 (24.5)	36.4 (13.8)	NS
Squeeze pressure in mmHg	136.2 (65.2)	128.4 (80.3)	143.2 (54)	NS
Max tolerated volume in ml	116.9 (43.8)	150 (56.4)	83.3 [†] (34.4)	< 0.05
Compliance in ml/mmHg	4.9 (2.9)	5.2 (3.1)	3.2 [†] (2.1)	< 0.05

*Chi-square.

[†]Significant comparing coloplasty and colonic J-pouch versus straight anastomosis.

Figures in parentheses are standard deviations.

NS, not significant.

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Table 2 Postoperative Functional Results

	Coloplasty-Pouch	Colonic J-Pouch	Straight Coloanal	P Value*
No. bowel movements/day (range)	2.6 (1–5)	3.1 (2–6)	4.5 [†] (1–8)	< 0.05
Antidiarrheal medication requirement (%)	20	35	20	NS
Continence (0–3)	2.5	2.2	2.7	NS

*Z-test.

[†]Significant comparing coloplasty and colonic J-pouch versus straight anastomosis.

NS, not significant.

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To conclude, the evacuatory problems experienced with colonic J-pouches are typically not seen with coloplasties. Although a prospective trial has raised the question of higher leak rates following TC, this has not been confirmed by others. Construction of a TC is simpler than a CJP and is associated with a decrease in operating time.⁵⁷

RECONSTRUCTION FOLLOWING PROCTECTOMY: WHAT'S THE BEST TECHNIQUE?

More than 50 prospective studies have been conducted in the last two decades comparing reconstructive techniques following proctectomy. Recently, Heriot and colleagues published an excellent meta-analysis

of all randomized and non-randomized trials comparing colonic reservoirs to straight coloanal anastomoses.⁵³ Most of the randomized prospective studies included in this meta-analysis compared straight coloanal anastomoses to colonic J-pouches and only five trials compared CJP to TC. No prospective study has been published to date comparing TC to SCAA. The analysis by Heriot and colleagues included a total of 2240 patients.

Straight Coloanal Anastomosis versus Colonic J-Pouch

Comparison of trials evaluating straight coloanal anastomoses to colonic J-pouches showed an anastomotic leak rate of 9% for the CJP and 13% for the

Table 3 Forrest Plot of Anastomotic Leak Rates in Studies of J-Pouch versus Straight Coloanal Anastomosis (CAA) Random-effect model. Odds ratios are shown with 95% confidence intervals. Test for heterogeneity: $2 = 7.69$, $Z = 1.79$, $p = 0.069$.From Heriot et al.⁵³ Copyright British Journal of Surgery Society Ltd. Reprinted with permission of John Wiley & Sons Ltd. on behalf of the BJSS Ltd.

SCAA group; however, this failed to reach statistical significance (Table 3).⁵³ Postoperative leakage rate was defined in Heriot's meta-analysis as contrast or fecal matter at the level of the anastomosis during postoperative radiologic assessment or at reoperation. Other postoperative events similar between groups included anastomotic stricture (7% for CJP versus 6% for SCAA), rectovaginal fistula (2% for CJP versus 2% for SCAA), wound infection (7% for CJP versus 5% for SCAA), respiratory tract infection (4% for CJP versus 4% for SCAA), and perianal excoriation (20% for CJP versus 22% for SCAA). In the studies included in the meta-analysis by Heriot et al,⁵³ no differences between these two groups were noted in the operating time, length of hospital stay, and anal manometric resting or squeeze pressures. Thirty-day postoperative mortality was ~2% for CJP and 3% for SCAA.

Detailed examination of functional outcomes between groups shows that patients with CJP have a reduction in the frequency of bowel movements within the first 6 months of the operation. This difference tends to equilibrate at 1 year or more. The incidence of fecal urgency within the first 6 months of a SCAA is ~51% compared with 21% of the CJP patients and this tendency continues during the first postoperative year; however, the difference disappears at 2 years. In addition, significant differences between the two groups were noted at 1 or more years for neorectal threshold and maximum neorectal volume in favor of the J-pouch group.

Comparison of Colonic J-Pouch with Transverse Coloplasty

Postoperative complications following CJP or TC are similar. Ho and colleagues reported a decreased operative time with TC, but CJP was associated with an overall shorter hospital stay.⁵⁷ Postoperative resting pressures are higher in patients with CJP^{57,58,60,64} than TC, although this has proven to be of no clinical relevance. Patients with CJP also have an increase neorectal threshold volume.⁵⁹

Comparison of All Three Techniques

Available outcomes comparing all three reconstructive techniques are extrapolated only from nonrandomized data.⁶⁴ In this study, an increased tolerated volume and compliance was found in the TC and CJP patients when compared with the straight group (Table 1). All groups had similar resting and squeeze pressures after surgery. From the functional standpoint, the TC and the CJP groups had significantly fewer bowel movements per day than SCAA patients (Table 2). Even though the continence values were

similar between groups, CJP patients used more antidiarrheals compared with the other two groups; however, this was not significant. Although the purpose of this study was to evaluate manometric and functional outcomes following all three reconstructive techniques, postoperative complications were also reported, but they were excluded from the statistical analysis. Major complications in the TC group occurred in five cases including two small-bowel obstructions requiring lysis of adhesion, one anal stricture requiring dilation, one bladder dysfunction requiring self-catheterization, and one leak from a colorectal anastomosis in a patient not having a covering loop ileostomy. In contrast, four complications were documented in the CJP including an ischiorectal abscess, a pouch prolapse, a pelvic abscess, and a minor leak. Three patients out of 17 had a complication in the SCAA group (e.g., anal stricture, ureteric injury, and a minor leak). A systemic review of all three reconstructive techniques has been conducted by Brown et al;⁶⁸ the results from this revision have just been published.

CONCLUSIONS

Sphincter-preserving procedures have become increasingly common for the treatment of mid and low rectal malignancies. Several reconstructive options are available for restoring bowel continuity after these procedures. Straight coloanal anastomosis has been the traditional approach; however, due to postoperative symptoms of defunctionality, other alternatives such as CJP or TC have been developed. Immediate postoperative complications are relatively similar between groups; however, colonic reservoirs are superior in terms of functionality compared with SCAA at least within the first 2 years postoperatively. Even though level 1 data are not available to support the routine use of temporary diversion, most experts agree that a stoma is indicated in high-risk patients to prevent abdominal catastrophes. Until prospective randomized data becomes available comparing all three reconstructive techniques, the chosen technique should be tailored to each patient individually.

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