

# Experience with the Use of the Circular Stapler in Rectal Surgery

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This report provides our personal experience along with a general overview of the use of the circular stapler in rectal surgery. To determine the results of our experience with the use of the circular stapler for construction of anastomoses following resection, a series of 215 anastomoses performed in 214 patients was reviewed. The patients ranged in age from 33 to 88 years. There were 116 men and 98 women. Indications for operation included malignancy, diverticular disease, villous adenoma, Crohn's disease, and rectal procidentia. The types of operation performed included removal of varying portions of the large bowel. The anastomosis was performed in a uniform manner with the EEA<sup>®</sup> (United States Surgical Corp., Norwalk, CT) and more recently the CEEA<sup>™</sup> (United States Surgical Corp., Norwalk, CT). The operative mortality was 0.47 percent, with the death being unrelated to the anastomosis. Intraoperative complications encountered included bleeding, difficult extraction, instrument failure, incomplete doughnuts, deficient anastomoses, and miscellaneous problems. Early postoperative complications included one leak and a number of complications unrelated to the anastomoses. Anastomotic stenosis developed in 27 patients, but only 8 were permanent and only 3 of these were symptomatic. Two of these patients were treated with balloon dilatation. Anastomotic recurrences developed in 13.1 percent of patients. Our experience gained with the circular stapling device and that reported in the literature have shown it to be a reliable method of performing anastomoses to the rectum in a safe and expeditious manner. [Key words: Circular stapler; Anastomosis; Rectal surgery]

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The introduction of staplers into North America by Steichen and Ravitch<sup>1</sup> has markedly facilitated intestinal anastomoses. What was initially considered to be nothing more than gimmickry has evolved to become standard instrumentation for many surgeons. Technology has expanded to provide tools never imagined possible. A classic ex-

ample is the advent of the circular stapler, which has extended the limits of low anterior resection by enabling surgeons to perform highly reliable anastomoses at a lower level than was technically possible with a traditional hand-sewn anastomosis, thus sparing a considerable number of patients from abdominoperineal resection and permanent colostomy. In his book *Second Thoughts of a Surgical Curmudgeon*, Ravitch wrote "While instruments may be mechanized, the surgeon is in no danger of becoming a mechanic, nor will more or less automatic instruments make a safe craftsman of the tyro."<sup>2</sup> This caveat underscores the fact that the general principles of anastomoses must be maintained, *i.e.*, tissues not fit to sew should not be stapled. Unfavorable conditions in which a surgeon would be reluctant to do a hand-sewn anastomosis are not situations to use staples. Staples are only one method, albeit a convenient one, to establish intestinal continuity. Considerations of adequate blood supply, absence of tension, accurate apposition of tissue, absence of sepsis, and gentle handling of tissue apply equally to both stapled and hand-sutured anastomoses. This report summarizes our experience and reviews the literature with the use of the circular stapler to re-establish intestinal continuity to the rectum following resection of varying amounts of the colon and rectum. The scope of the review has been restricted to the use of the circular stapler to perform end-to-end anastomoses to the rectum. To begin, our personal experience will be reviewed.

## PERSONAL EXPERIENCE

### Methods

The medical records of patients who had undergone stapled end-to-end anastomoses by one of

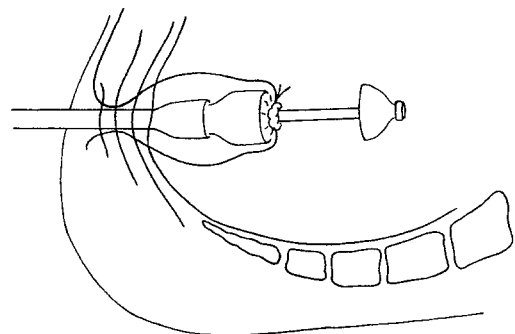
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the authors between 1982 and 1989 were reviewed. Information sought included the patient's age and sex, indications for operation, type of procedure performed, intraoperative difficulties encountered, early and late postoperative complications with special attention to anastomotic stenoses, and the ultimate development of recurrences in those patients undergoing resection for malignant disease. The series consisted of 214 consecutive patients who underwent 215 operations. Some of these cases were part of a previous report.<sup>3</sup> The circular stapler used was the EEA<sup>®</sup>, and more recently the CEEA<sup>™</sup>.

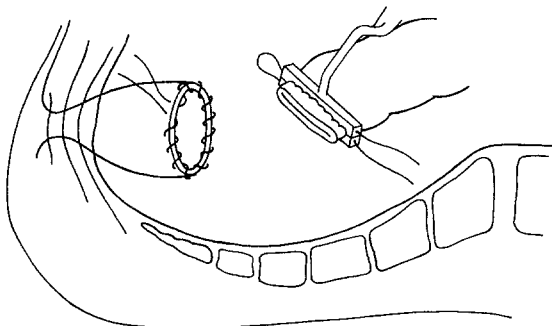
Details of the technique utilized were described previously.<sup>3,4</sup> The initial steps of the operative procedure are identical to those used to perform a low anterior resection.<sup>5</sup> The patient is placed in a modified lithotomy position to allow access to both the abdomen and perineum. Having determined that a low anterior resection with an EEA<sup>®</sup> anastomosis is feasible, the surgeon prepares the proximal bowel by clearing 1.0 to 1.5 cm from the proposed proximal resection margin. A pursestring suture may conveniently be applied using the specially designed fenestrated clamp (Fig. 1). The rectum is prepared in a similar manner, except that, for low anastomoses, the width of the pelvis is not adequate to permit application of the instrument and a Keith<sup>®</sup> needle (Richard-Allan, Medical Industries), so a whip stitch of 2-0 Prolene<sup>®</sup> (Ethicon, Somerville, NJ) is placed, taking evenly spaced bites 4 to 5 mm from the cut edge (Fig. 1). Sizers are used to determine the appropriate diameter of the stapler cartridge.

Before insertion of the EEA<sup>®</sup> stapler, the operator must confirm that the instrument has been properly assembled, taking special care to ensure the presence of the staples, circular knife, and Teflon<sup>®</sup> ring.

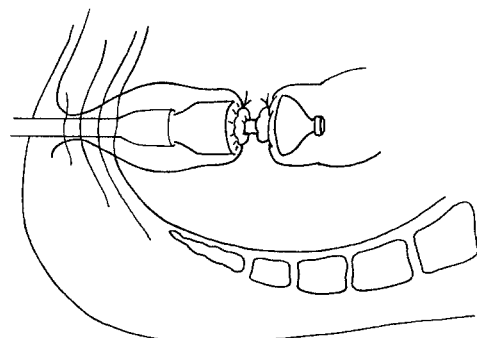
For the totally disposable stapler, only the cartridge and the head need be checked. The appropriately-sized cartridge is selected, lubricated, and inserted in the closed position with the handle up. The instrument is advanced until the tip of the anvil protrudes through the rectal lumen, and the stapler is opened fully by turning the wing nut counterclockwise. The distal pursestring is secured around the central shaft (Fig. 2). The proximal bowel is advanced over the anvil, and the proximal pursestring is secured around the central rod (Fig. 3). The stapler is closed by turning the wing nut clockwise, while the abdominal operator ensures that the gap is free of mesentery, bladder, other tissues, and sponges (Fig. 4). When the stapler is fully closed, the safety is released and the stapler is fired by squeezing the handle firmly. This action places a double, staggered, circular row of stainless steel staples that join the two ends of the bowel, while a circular knife simultaneously cuts two rings of tissue inside the staple line, thus creating an inverted end-to-end anastomosis (Fig. 5). Introduction of the CEEA<sup>™</sup> has dramatically facilitated the operation. When the CEEA<sup>™</sup> is used, the anvil is detached from the instrument and inserted into the proximal bowel after its transection. The proximal



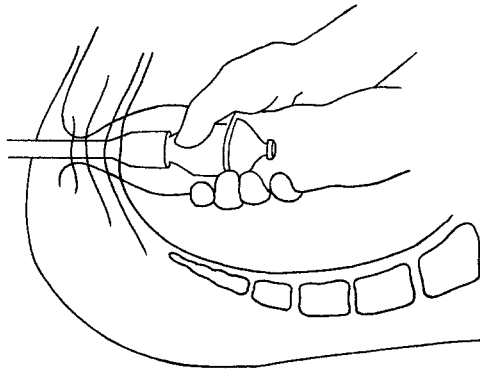
**Figure 2.** The distal pursestring suture is secured around the central shaft.



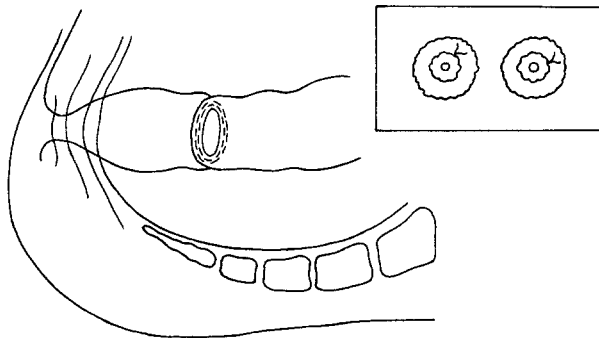
**Figure 1.** Application of proximal pursestring suture using a specially designed fenestrated clamp and of distal pursestring suture with a whip suture of 2-0 Prolene<sup>®</sup>.



**Figure 3.** The proximal pursestring suture is secured around the central shaft.



**Figure 4.** Manual exclusion of extraneous tissue during approximation of the bowel ends.



**Figure 5.** A completed anastomosis with "rings of confidence."

pursestring is tied and this avoids any contamination from the proximal bowel. Attention is then directed to the distal stump. The CEEA™ is inserted through the anus, the central shaft is extruded, and the distal pursestring is tied. In this manner, both the proximal and distal pursestrings can be secured under direct vision, the proximal one with great ease in the upper abdomen. The anvil is then engaged into the central shaft and the anastomosis is created with the same precautions. This device has become the instrument of choice for low anterior resections of the rectum.

To remove the instrument, the stapler is opened by turning the wing nut counterclockwise three complete turns. The stapler is rotated; it should move independently of the bowel. The instrument is then removed by a simple, gentle, simultaneous withdrawing and back-and-forth rotational motion. A check is made to ensure that the rings of tissue excised are intact. Anastomoses may be inspected for bleeding or obvious disruption directly with a sigmoidoscope. The integrity of the anastomosis is further tested by insufflating air into the bowel via the sigmoidoscopy with saline in the pelvis. The abdominal operator checks for bubbles arising

from the anastomosis. If an air leak is present, sutures can be placed to correct the defect.

## Results

The patients ranged in age from 33 to 88 years, with a mean age of 64.7 years. There were 116 men and 98 women. The indications for operation are listed in Table 1. Resections were performed for carcinomas that ranged in level from 6 cm from the anal verge to the midsigmoid colon. The level of anastomoses ranged from the proximal anal canal to 18 cm from the anal verge.

A 31-mm cartridge was used in 207 cases, a 28-mm cartridge in 6 cases, and a 25-mm cartridge in 2 cases. The proximal pursestring suture was placed with a fenestrated clamp in 197 cases: 18 of these cases had to be replaced with a hand-sewn whipstitch because of incomplete inclusion of the total circumference of the bowel. A whipstitch was used as the initial proximal pursestring in 18 cases. Two of the 215 cases required enlargement of the diameter of the proximal bowel to accommodate a 31-mm cartridge, a technique described previously.<sup>6</sup> In 86 cases, the distal pursestring was applied with the clamp; six needed replacement with a whipstitch. A primary whipstitch was applied for the distal pursestring in 129 patients. In two of these cases, the whipstitch was placed *per anum*.

In the immediate postoperative period, there was one death in this series, *i.e.*, a man who died of a myocardial infarction on the second postoperative day. A complementary colostomy in this series was performed in five patients. Previous radiotherapy to the pelvis was the indication in four patients; the other patient was being operated upon for Crohn's disease, and after an extremely difficult pelvic dissection, the anastomotic ring was noted to be deficient.

**Intraoperative Difficulties.** Intraoperative problems encountered are listed in Table 2. When difficulty was encountered in extraction of the instrument, guide sutures were placed through the anastomosis to help lift the anastomosis over the anvil (Fig. 6). The cases in which the bowel was torn while being drawn over the anvil before the anastomosis was made were managed simply by clearing another portion of the bowel and placing the pursestring suture a few centimeters proximal to the original placement. When the bowel was torn during sizer introduction, the problem was handled in a similar manner.

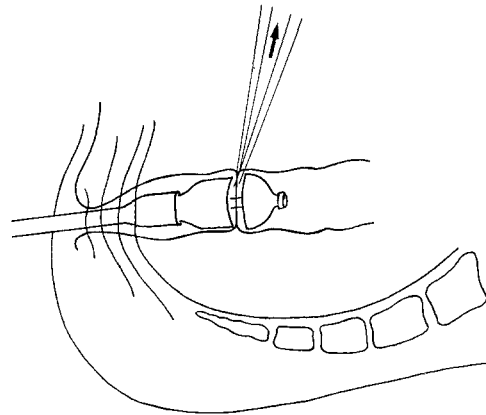
**Table 1.**  
Operative Indications

Indications	No. of Anastomoses
Malignant disease	176
Colorectal carcinoma	174
Dukes A	31
Dukes B	64
Dukes C	57
Metastatic	18
Recurrent	4
Ovarian carcinoma	2
Diverticular disease	26
Villous adenoma	8
Crohn's disease	3
Recurrent rectal procidentia	2
Total	215

**Table 2.**  
Intraoperative Difficulties

Complication	No. of Cases
Difficult extraction	3
Anvil not extractable	1
Tear while drawing over anvil	5
Tear during sizer introduction	3
Bleeding	9
Instrument failure	
Incomplete cutting	4
Misfiring of staples	1
Incomplete doughnut	
Distal	4
Proximal	2
Both	1
Doughnut excess mucosa	2
Deficient anastomosis	5
Pursestring	
Failure of pursestring clamp	5
Inadequately tied	1
Torn bowel edge	2
Tear of rectal wall during introduction	1
Narrowed proximal rectum	1
Excessively thin wall adjacent to anastomosis	1

Instrument failure was not frequent, but did occur. Cutting of the doughnuts was incomplete in four cases. In three cases, the anastomoses were very low, and after separating the anvil and cartridge, the remaining tissue was simply transected circumferentially with a scalpel. In the other case, the instrument was not extractable. A proximal colotomy was performed and the anvil removed, but, because of a totally unsatisfactory anastomosis, the short segment of bowel with the anastomosis



**Figure 6.** Suture placement through the anastomosis to help lift the anastomosis over the anvil.

was excised and a new anastomosis was fashioned with the EEA® circular stapler.

In seven cases, doughnuts were noted to be incomplete. Sigmoidoscopic evaluation of five of these revealed an air-tight, intact ring. Reinforcing sutures were placed from above in one instance. In one case, a suture was placed *per anum*. In the other five, no further treatment was instituted. The seventh patient had a deficient anastomosis along with incomplete proximal and distal rings. He was operated on for Crohn's disease and had a proximal transverse colostomy. Four other patients had a deficient anastomosis. Two patients had the defect sutured *via* the abdominal route and another patient had the defect repaired *per anum*. In the last patient, reanastomosis was needed. None of these patients had a colostomy.

On sigmoidoscopic examination, bleeding was noted from the anastomosis in nine patients. In six cases, bleeding was controlled by brief tamponade through the sigmoidoscope. In two patients, bleeding from a high anastomosis was controlled by sutures placed *via* the abdominal route, and in the other case, in which the anastomosis was very low, hemostasis was obtained by placement of a suture from below.

When use of the pursestring clamp failed to result in adequate placement of the pursestring suture, the suture was simply replaced by a whip-stitch. In one patient, the pursestring suture was not adequately tied, and it was managed by snugging the edge of the bowel to the central shaft with a tightening suture. In two cases, the edge of the bowel in one portion of the circumference was torn, and it was drawn toward the central shaft with an interrupted suture.

In two cases, excess mucosa was noted on the excised doughnut, a problem believed to arise because the shoulders of the cartridge were not against the distal rectum, thus allowing incorporation of extra tissue in the ring.

*Early Postoperative Complications.* A single clinically evident leak occurred in this series. The patient was managed with an emergency transverse colostomy on the tenth postoperative day. Intensive studies, such as early postoperative meglucamine diatrizoate (Gastrografin®, E.R. Squibb & Sons, Inc., Princeton, NJ) enemas, were not employed to seek out subclinical leaks. There were two wound infections, but no pelvic abscesses were encountered. Miscellaneous complications unrelated to the use of staples included three renal failures (one due to ureteral catheter insertion), two deep venous thromboses, one postoperative fever of undetermined origin, two respiratory distress cases of undetermined origin, one sciatic nerve palsy, one atrial fibrillation, one gouty arthritis of the hand, one urinary retention requiring a transurethral resection of the prostate, one profound anemia without evidence of bleeding, and one small bowel obstruction requiring laparotomy.

*Late Postoperative Complications.* In a previous report, we found a 20 percent incidence of stenosis. Stenosis was defined as failure of the 19-mm sigmoidoscope to pass freely through the anastomosis. We postulated that the narrowing was based on ischemia due to excessive cleaning of the mesentery adjacent to the anastomosis. By preparing a shorter length of bowel, we reduced the incidence of narrowing to 12.5 percent. In the last 72 cases, only three stenoses were noted for an incidence of 4.2 percent. In all, 27 patients were found to have a stenosis, but only eight of these were permanent. Of these eight, five were totally asymptomatic and the other three were treated with balloon dilations. Of the three patients requiring balloon dilatation, one anastomosis was constructed with a 25-mm cartridge and the other two were constructed with a 31-mm cartridge.

Temporary incontinence developed in the immediate postoperative period in one patient who had had an anastomosis performed 7 cm from the anal verge. It resolved spontaneously within one month. In the follow-up, three patients developed small bowel obstruction, one of whom required a laparotomy.

*Recurrences.* Of the 152 patients who were operated upon for cure of their carcinoma, 20 devel-

oped recurrences for a recurrence rate of 13.1 percent. The time to recurrence ranged from 5 months to 39 months. The overall length of follow-up ranged from 4 months to 124 months.

## DISCUSSION

Of all the stapling instruments, the circular stapler was the most readily accepted because it produced an inverted anastomosis. In contrast, the linear stapler produced a mucosa-to-mucosa closure and this was not in keeping with the generally accepted principles of intestinal anastomoses, which dictated an inverted technique. However, clinical experience has proven this anastomosis to function well and it has become well accepted.

The superiority of stapling techniques has been difficult to assess objectively. The problem, of course, has been that surgeons with the most stapling experience are so convinced of the superiority of stapling that they are unwilling to mount an elaborate prospective clinical trial of colonic or rectal anastomoses. Nevertheless, the reality that staples have assumed a growing acceptance among surgeons serves as testimony for the utility of their use. For the most part, complications are not numerous, and as surgeons develop proficiency in their use, advantages of time saving and decreased contamination may accrue.

As with any new technologic advance, growing pains can be expected. This proved true after the introduction of the circular stapler. To evaluate experiences with the then new stapler, a survey of the members of The American Society of Colon and Rectal Surgeons was conducted.<sup>7</sup> From that poll, Smith<sup>7</sup> reported an intraoperative complication rate of 15.1 percent, early postoperative complications in 3.7 percent, death in 0.5 percent, and late complications in 13.8 percent. The majority of late complications were subclinical or transient in most patients. Data from that study provided invaluable information for surgeons and offered solutions to recognizing problems and tips and precautions to prevent other problems. These have been incorporated into the sections of Methods and Results.

With our initial publication, we were concerned with the high incidence of narrowing of the anastomoses. Others who have recorded complications following the use of the EEA® in rectal anastomoses have reported narrowings ranging from 0 to 30 percent (Table 3). Few authors have given their

**Table 3.**  
Complications with the Circular Stapler\*

Author	No. of Cases	Leaks (%)		Stenosis (%)
		Clinical	Radiologic	
Kirkegaard <i>et al.</i> <sup>8</sup> 1980	30	7	17	13
Laitinen <i>et al.</i> <sup>9</sup> 1980	39	5	NA	5
Brown <i>et al.</i> <sup>10</sup> 1981	37	0	3	5
Cade <i>et al.</i> <sup>11</sup> 1981	50	6	NA	4
Cutait <i>et al.</i> <sup>12</sup> 1981	49	12	NA	6
Heald and Leicester <sup>13</sup> 1981	100	13	17	1
Killingback <sup>14</sup> 1981	64	9	NA	14
Dorricott <i>et al.</i> <sup>15</sup> 1982	50	6	20	NA
Friis <i>et al.</i> <sup>16</sup> 1982	38	11	NA	NA
Goligher <sup>17</sup> 1982	101	3	9	5
Hamelmann <i>et al.</i> <sup>18</sup> 1982	54	11	28	17
Helm and Rowe <sup>19</sup> 1982	78	9	NA	5
Leff <i>et al.</i> <sup>20</sup> 1982	106	8	NA	11
Polglase <i>et al.</i> <sup>21</sup> 1982	19	16	36	30
Vezeridis <i>et al.</i> <sup>22</sup> 1982	58	0	NA	3
Anderberg <i>et al.</i> <sup>23</sup> 1983	34	12	NA	NA
Fegiz <i>et al.</i> <sup>24</sup> 1983	134	16	30	NA
Isbister <i>et al.</i> <sup>25</sup> 1983	88	15	NA	1
Kennedy <i>et al.</i> <sup>26</sup> 1983	236	3	NA	NA
Resnick <i>et al.</i> <sup>27</sup> 1983	61	3	NA	NA
Fazio <sup>28</sup> 1984	183	3	6	1
Hedberg and Helmy <sup>29</sup> 1984	63	3	NA	10
Steichen and Ravitch <sup>1</sup> 1984	33	6	NA	NA
Fazio <i>et al.</i> <sup>30</sup> 1985	85	1	4	NA
McGinn <i>et al.</i> <sup>31</sup> 1985	58	12	24	NA
Gillen and Peel <sup>32</sup> 1986	55	6	24	NA
Antonsen and Kronborg <sup>33</sup> 1987	178	15	NA	8
Kantarzis <i>et al.</i> <sup>34</sup> 1987	87	18	NA	NA
Zannini <i>et al.</i> <sup>35</sup> 1987	209	9	NA	9
Belli <i>et al.</i> <sup>36</sup> 1988	74	4	NA	3
Malmberg <i>et al.</i> <sup>37</sup> 1988	96	14	NA	NA
Dehong <i>et al.</i> <sup>38</sup> 1991	84	5	NA	NA
Stegmuller and Brown <sup>39</sup> 1991	133	3	NA	NA
Present series	215	0.4	NA	13

\* Percentages rounded to closest whole number.  
NA = not addressed.

definition of stenosis. Leff *et al.*<sup>20</sup> and Fazio<sup>28</sup> have defined a stricture as narrowing that does not allow passage of a 15-mm sigmoidoscope. For purposes of this article, we considered as stenotic any anastomosis that did not accept the 19-mm sigmoidoscope. We believe the problem of stenosis is probably an ischemic one, and in the enthusiasm to clear the bowel for application of the pursestring instrument, excess blood supply is stripped from the edge. By decreasing the amount of bowel prepared for the anastomosis, we noted a decrease in the incidence of stenoses from 20 percent in our early experience to 13 percent in subsequent patients. In the last 72 cases, the incidence of stenosis was further reduced to 4.2 percent. Use of the

largest caliber instrument that the bowel will accommodate should decrease the incidence of stenosis.

From the point of view of anastomotic security, reported clinical rates of leakage have ranged from 0 to 16 percent (Table 3). We were fortunate in that only one patient developed a clinical leak (0.4 percent). Those who have studied patients with Gastrografin® enemas have found radiologic leakage rates ranging from 3 percent to 36 percent and even higher if only very low anterior resections were considered.<sup>40</sup> Several authors have compared staples with hand-sewn anastomoses.<sup>38, 40-43</sup> In three of these cited series, stapled anastomoses fared better than hand-sewn anastomoses. In the

report by Beart and Kelly,<sup>41</sup> the two techniques were equal, but it must be noted that in 12 percent of the patients in that series, the rectum was preserved as the result of the stapling procedure. Other authors have reported that the use of a circular stapling device has diminished the need for abdominoperineal resection<sup>10, 16, 20, 44-47</sup> and we certainly support this view. In the report by McGinn *et al.*,<sup>31</sup> stapled anastomoses suffered a 12 percent clinical leak, whereas hand-sutured anastomoses experienced only a 3 percent clinical leak. These results are clearly at variance with other reports. In the study by Dehong *et al.*,<sup>38</sup> there was a slightly higher leak rate when manual sutures were used (5 percent *vs.* 2 percent). The authors state that the reason for the higher leak rate in the stapled anastomoses was because of the lower anastomoses performed in the early part of their learning curve and preoperative radiotherapy given in one patient.

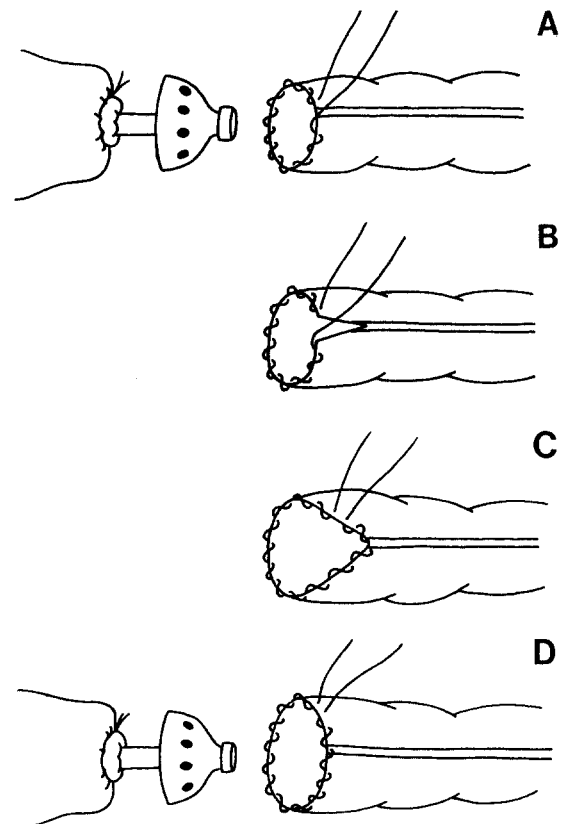
Suggestions to diminish the incidence of both intraoperative and postoperative complications have been enunciated previously.<sup>3-5</sup> What cannot be overemphasized is the importance of accurate placement of the pursestring suture, because this part of the operation is pivotal to the success of the anastomosis. A monofilament suture that easily glides through the tissue should be used. Equidistant, full-thickness bites that provide for inclusion of the entire circumference should be placed and the pursestring should be secured around the central shaft.

Griffin *et al.*<sup>48</sup> described the double-staple technique to eliminate the need for a distal pursestring suture. A ROTICULATOR<sup>®</sup> 55 (United States Surgical Corp., Norwalk, CT) is placed on the rectal stump. With this technique, the PREMIUM CEEA<sup>™</sup> (United States Surgical Corp.) is ideally suited to reconstruct the anastomosis. In a review of 75 patients, they found an anastomotic leak rate of 2.7 percent and a 2.7 percent incidence of stenosis that required treatment. Other surgeons have successfully employed this technique.<sup>49-51</sup>

A technical problem that is not infrequently encountered is the discrepancy in the diameter of the bowel ends to be anastomosed. Probably the simplest way to enlarge the bowel lumen is by insertion of progressively larger sizers manufactured by United States Surgical Corp. A second option is the use of sponge forceps to stretch the bowel. Another technique is the very slow expansion of a 30-cc Foley catheter balloon (Bard-Urological Division)

with saline after it is positioned in the bowel lumen.<sup>52</sup> All these methods of dilatation may result in tearing of the bowel wall. Simple techniques of enlarging the diameter of the bowel lumen for performance of end-to-end anastomoses using the EEA<sup>®</sup> stapler were described by Tchervenkov *et al.*<sup>6</sup> If the transected bowel end cannot be dilated to accept a staple cartridge of appropriate size and the pursestring suture has already been applied, an incision can be made along the antimesenteric border of the colon. Ideally, the pursestring suture will have been placed so that the free ends are at the antimesenteric position of the circumference of the bowel (Fig. 7A). It is a simple matter to incise the bowel between the two ends of the suture (Fig. 7B) and then continue the suture along the newly created border past the apex of the incision to meet the other end of the suture (Fig. 7C). The new configuration of the circumference will be egg shaped (Fig. 7D).

If it is apparent from the outset that the bowel caliber is definitely too small and will not be successfully dilated by the previously described meth-



**Figure 7.** A. Application of pursestring clamp such that one end is on the antimesenteric border. B. Incision of bowel along tenia between sutures. C. Continuation of suture along newly created border. D. Completed application of pursestring suture.

ods, the oblique application of the pursestring clamp will result in a larger diameter of the bowel end (Fig. 8).

Concern has been expressed that the introduction of the circular stapling devices might result in a higher incidence of anastomotic or local recurrence<sup>23, 53-55</sup> (Table 4). The concern is that surgeons might compromise on the distal margin of resection. Yet it might also be argued that since a lower anastomosis can be created with a circular stapling device, a greater distal margin might be achieved in a given case while still preserving the anal sphincter.

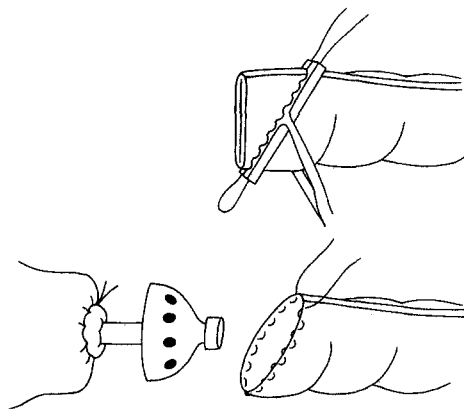


Figure 8. Oblique application of pursestring clamp.

Table 4.  
Local Recurrence with Circular Staplers

Author	No. of Cases	Follow-up (mo) Mean or Range	%
Heald and Leicester <sup>13</sup> 1981	40	16	3
Hurst <i>et al.</i> <sup>53</sup> 1982	32	7-25	32
Anderberg <i>et al.</i> <sup>23</sup> 1983	34	5	21
Fegiz <i>et al.</i> <sup>24</sup> 1983	102	9-38	9
Isbister <i>et al.</i> <sup>25</sup> 1983	63	?	14
Luke <i>et al.</i> <sup>56</sup> 1983	79	24	22
Kennedy <i>et al.</i> <sup>57</sup> 1985	63	44	36
Leff <i>et al.</i> <sup>58</sup> 1985	70	36	11
Rosen <i>et al.</i> <sup>55</sup> 1985	76	24	21
Gillen and Peel <sup>32</sup> 1986	55	>24	15
Malmberg <i>et al.</i> <sup>37</sup> 1986	96	65	18
Wolmark <i>et al.</i> <sup>59</sup> 1986	82	41	12
Carlsson <i>et al.</i> <sup>60</sup> 1987	40	78	35
Colombo <i>et al.</i> <sup>61</sup> 1987	61	6-52	10
Neville <i>et al.</i> <sup>62</sup> 1987	76	43	24
Zannini <i>et al.</i> <sup>35</sup> 1987	108	>24	18
Belli <i>et al.</i> <sup>36</sup> 1988	74	37	4
Dehong <i>et al.</i> <sup>38</sup> 1991	84	?	4
Current series	215	4-124	13

Several reports in the past decade have shown that five-year survival rates for patients with carcinoma of the middle third of the rectum are at least as good or better with the use of a low anterior resection than with abdominoperineal resection.<sup>46, 63-68</sup> It also has been reported that local recurrences are higher after abdominoperineal resections than after low anterior resections.<sup>60, 66, 69</sup> Since anastomoses are being created at a lower level than previously possible before the introduction of the stapler, should the incidence of local recurrence after the use of the EEA<sup>®</sup> stapler be shown to be higher than with the conventional hand sutured anastomoses, it might be appropriate to compare at least some of these recurrences to recurrences in patients who have had abdominoperineal resection. In an effort to shed light on this controversy, Wolmark *et al.*<sup>59</sup> compared the incidence of local recurrence in patients undergoing stapled or hand-sewn anastomoses following curative resection of Dukes B and C colorectal carcinoma. There were 99 patients in the sutured group and 82 in the stapled group. The average time on study was 41 months. Analyses of the distal resection margins were made in the two groups. For anterior resections, the length of the distal margin was  $2.7 \pm 0.2$  cm for hand-sewn anastomoses and  $2.8 \pm 0.2$  cm for those effected by the EEA<sup>®</sup> instruments. There was no significant difference in the development of local recurrences as a first site of treatment failure when hand-sewn and stapled anastomoses were contrasted. If any trend was in evidence, it was in favor of the patient cohort with stapled anastomoses, where the proportion of patients with local recurrence was 12 percent compared with 19 percent for the hand-sewn group. It was concluded that the use of stapled anastomoses did not compromise the patient.

## CONCLUSION

Experience gained with the circular stapling device has shown it to be a reliable method of performing anastomoses to the rectum in a safe and expeditious manner. An understanding of the instruments and stapling techniques, along with the limitations, the pitfalls, and the solutions to overcome intraoperative technical problems, will contribute to a successful outcome in most cases. Careful technique will minimize most intraoperative problems and should these arise, most can be remedied. Thus, a one-stage resection with a low



incidence of postoperative complications and avoidance of a defunctioning colostomy can generally be accomplished safely.

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