

# Long-Term Functional and Quality of Life Outcomes After Coloanal Anastomosis for Distal Rectal Cancer

Imran Hassan, M.D.,<sup>1</sup> David W. Larson, M.D.,<sup>1</sup> Robert R. Cima, M.D.,<sup>1</sup>  
Janette U. Gaw, M.D.,<sup>1</sup> Heidi K. Chua, M.D.,<sup>2</sup> Dieter Hahnloser, M.D.,<sup>1</sup>  
John M. Stulak, M.D.,<sup>1</sup> Megan M. O'Byrne, M.A.,<sup>3</sup> Dirk R. Larson, M.S.,<sup>3</sup>  
Bruce G. Wolff, M.D.,<sup>1</sup> John H. Pemberton, M.D.<sup>1</sup>

<sup>1</sup>*Division of Colon and Rectal Surgery, Mayo Clinic, Rochester, Minnesota*

<sup>2</sup>*Division of Colon and Rectal Surgery, Mayo Clinic, Jacksonville, Florida*

<sup>3</sup>*Division of Biostatistics, Mayo Clinic, Rochester, Minnesota*

**PURPOSE:** This study was designed to evaluate the long-term functional and quality-of-life outcomes of patients after coloanal anastomosis for distal rectal cancer. **METHODS:** A total of 192 patients underwent coloanal anastomosis between 1982 and 2001 at two tertiary referral institutions. Standardized and validated questionnaires to assess functional and quality-of-life outcomes were mailed to 151 patients, of which 121 patients responded (median follow-up, 65 months). **RESULTS:** Patients receiving pelvic radiotherapy had more bowel function problems than patients who did not receive pelvic radiotherapy. No significant differences in relevant functional and quality-of-life outcomes were seen among patients who received preoperative or postoperative pelvic radiotherapy. Patients requiring permanent diversion as a result of complications of the surgery had decreased quality of life. **CONCLUSIONS:** Coloanal anastomosis for distal rectal cancer has favorable long-term outcomes. Pelvic radiotherapy has an adverse effect on subsequent bowel function (whether given preoperatively or postoperatively) in patients who maintain intestinal continuity. Loss of intestinal continuity after a coloanal anastomosis is associated with diminished quality

of life. [Key words: Distal rectal cancer; Coloanal anastomosis; Pelvic radiotherapy; Functional outcomes; Complications; Quality of life]

Advances in surgical technique and adjuvant therapies have improved the oncologic and functional results for patients with rectal cancer. Sphincter preservation with a coloanal anastomosis is the current standard surgical treatment for distal rectal cancers.<sup>1-3</sup> In this context, the rationale and benefit of pelvic radiotherapy also have been demonstrated.<sup>4-7</sup> Conventional outcomes, such as oncologic and short-term functional results after a coloanal anastomosis for distal rectal cancer, have been rigorously assessed. However, patient-oriented outcomes, such as quality of life (QOL) have received much less attention.<sup>8,9</sup> Although the actual definition of QOL is open to debate, in terms of evaluating a surgical procedure, QOL can be regarded as an individual's ability to perform daily activities, as well as satisfaction with personal performance and with the balance between disease control and adverse effects of treatment.<sup>10</sup> Therefore, our goal was to evaluate the long-term functional and QOL outcomes of patients after a coloanal anastomosis and assess the impact of pelvic radiotherapy and its timing on these outcome measures.

Read in part at the meeting of The American Society of Colon and Rectal Surgeons, Philadelphia, Pennsylvania, April 30 to May 5, 2005.

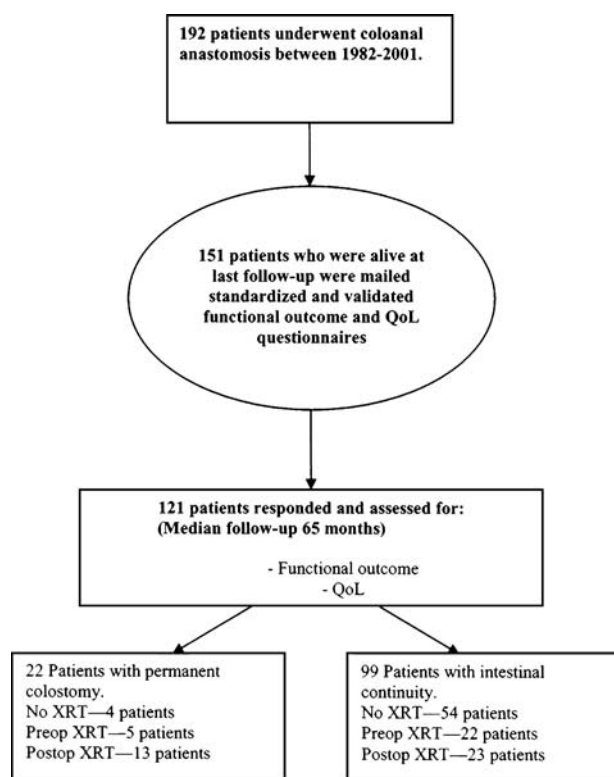
Correspondence to: David W. Larson, M.D., Division of Colon and Rectal Surgery, Mayo Clinic, 200 First Street SW, Rochester, Minnesota 55905, e-mail: larson.david2@mayo.edu

Dis Colon Rectum 2006; 49: 1266-1274

DOI: 10.1007/s10350-006-0640-0

© The American Society of Colon and Rectal Surgeons

Published online: 18 August 2006



**Figure 1.** Flow chart of patients undergoing a coloanal anastomosis and assessed for functional and quality of life (QOL) outcomes.

## PATIENTS AND METHODS

A total of 192 patients were identified using the institutional surgical index as having undergone a coloanal anastomosis for a histologically proven distal rectal adenocarcinoma between 1982 and 2001 at the Mayo Clinic in Rochester, Minnesota, or Jacksonville, Florida. One hundred fifty-one patients were alive when surveys were mailed to assess long-term functional and QOL outcomes. One hundred twenty-one patients responded (80 percent response rate). The median follow-up for the responders at the time of mailing was 65 months (Fig. 1). The functional and QOL outcomes of this patient cohort form the basis of our report. The study was approved by the institutional review board.

### Surgical Technique

The technique for surgical dissection and establishing intestinal continuity has been described in detail elsewhere.<sup>11</sup> The shape of the reservoir (colonic J-pouch *vs.* straight), type of anastomosis to the anal canal (stapled *vs.* handsewn), and the need for temporary fecal diversion were determined according to the surgeon's preference.

### Pelvic Radiotherapy

Pelvic radiotherapy, preoperative or postoperative, was delivered as a long-course regimen, which is external beam megavoltage radiation therapy (5,040 cGy) during five to six weeks in fractions of 1.8 to 2 cGy per fraction.

### Functional Outcome and Quality of Life Questionnaires

The bowel function questionnaire was modified from an institution-specific questionnaire described previously<sup>12</sup> to obtain long-term information about postoperative functional results, such as stool frequency, evacuation problems, and need for medication (bulking agents or antidiarrheals). Additional demographic and clinical data were obtained by a review of patient records and operative notes.

The QOL assessment was made using the European Organization for Treatment and Research of Cancer (EORTC) QLQ (QOL questionnaire), which is an integrated system for evaluating the QOL of cancer patients. It has a core questionnaire known as the EORTC QLQ-C30, which is a "generic" cancer QOL instrument, whereas the EORTC QLQ-CR38 is a supplemental "disease-specific" QOL instrument designed to evaluate QOL of patients with colorectal cancer. Both have been validated for QOL measurement in colorectal cancer patients.<sup>13,14</sup>

The EORTC QLQ-C30 comprises 30 questions and has both multi-item scales and single-item measures. It includes five functional scales (physical, emotional, cognitive, social, and role functioning), three symptom scales (fatigue, nausea and vomiting, and pain), a global QOL two-item measure, and six single-item measures (dyspnea, insomnia, anorexia, constipation, diarrhea, and financial difficulties). The EORTC QLQ-CR38 comprises 38 questions and has both multi-item scales and single-item measures. It includes two functional scales (body image and sexual function), seven symptom scales (micturition problems, gastrointestinal tract symptoms, chemotherapy side effects, defecation problems, stoma-related problems, and male and female sexual problems), and three single-item measures (sexual enjoyment, weight loss, and future perspective). Values in the functional scales and items range from 0 (worse outcome) to 100 (better outcome), whereas those in the symptom scales or items range from 0 (fewer symptoms) to 100 (more symptoms).

**Table 1.**

Demographic, Tumor, and Operative Characteristics of Patients Who Replied to Mailed Surveys (n = 121): Comparison of Patients Receiving no Pelvic Radiotherapy, Preoperative Pelvic Radiotherapy, and Postoperative Pelvic Radiotherapy

|                                         | No XRT<br>(n = 58) | Preoperative<br>XRT (n = 27) | Postoperative<br>XRT (n = 36) | P Value              |
|-----------------------------------------|--------------------|------------------------------|-------------------------------|----------------------|
| Age at initial surgery (yr)             | 58.5 (28–85)       | 58 (28–71)                   | 56.5 (22–77)                  | 0.2                  |
| Follow-up (mo)                          | 81 (16–236)        | 35 (8–82)                    | 74 (21–248)                   | <0.01 <sup>a,b</sup> |
| Male                                    | 36 (62.1)          | 19 (70.4)                    | 28 (77.8)                     | 0.27                 |
| Tumor distance from the anal verge (cm) | 5 (2–18)           | 6 (2–10)                     | 6.5 (3–10)                    | 0.04 <sup>c</sup>    |
| Stage                                   |                    |                              |                               |                      |
| I                                       | 46 (79.3)          | 0 (0)                        | 0 (0)                         | <0.01 <sup>a,c</sup> |
| II                                      | 7 (12.1)           | 6 (22.2)                     | 11 (30.6)                     |                      |
| III                                     | 4 (6.9)            | 21 (77.8)                    | 25 (69.4)                     |                      |
| IV                                      | 1 (1.7)            | 0 (0)                        | 0 (0)                         |                      |
| Shape of reservoir                      |                    |                              |                               | 0.44                 |
| Straight                                | 34 (58.6)          | 12 (44.4)                    | 18 (50)                       |                      |
| J-pouch                                 | 24 (41.4)          | 15 (55.6)                    | 18 (50)                       |                      |
| Mucosectomy                             | 35 (60.3)          | 10 (37)                      | 18 (50)                       | 0.13                 |
| Temporary diverting ileostomy           | 44 (75.9)          | 27 (100)                     | 29 (80.6)                     | 0.02 <sup>a,b</sup>  |

XRT = pelvic radiotherapy.

Data are medians with ranges in parentheses or numbers with percentages in parentheses unless otherwise indicated.

<sup>a</sup>Significant difference when comparing the “No XRT” group to the “Preoperative XRT” group.

<sup>b</sup>Significant difference when comparing the “Preoperative XRT” group to the “Postoperative XRT” group.

<sup>c</sup>Significant difference when comparing the “No XRT” group to the “Postoperative XRT” group.

### Statistical Analysis

To assess the functional outcome and QOL of the cohort, three main groups were compared: 1) patients not receiving pelvic radiotherapy, 2) patients receiving preoperative pelvic radiotherapy, and 3) patients

receiving postoperative pelvic radiotherapy. Additional analyses were performed comparing patients not receiving pelvic radiotherapy with patients receiving pelvic radiotherapy and comparing patients receiving preoperative pelvic radiotherapy with patients receiving postoperative pelvic radiotherapy. Groups were

**Table 2.**

Functional Results of Patients With Intestinal Continuity (n = 99): Comparison of Patients Receiving no Pelvic Radiotherapy, Preoperative Pelvic Radiotherapy, and Postoperative Pelvic Radiotherapy

|                                                                               | No XRT<br>(n = 54) | Preoperative<br>XRT (n = 22) | Postoperative<br>XRT (n = 23) | P Value             | Preoperative or<br>Postoperative<br>XRT (n = 45) | P Value <sup>a</sup> |
|-------------------------------------------------------------------------------|--------------------|------------------------------|-------------------------------|---------------------|--------------------------------------------------|----------------------|
| No. of stools during the day                                                  | 2.5 (0–12)         | 3 (0–5)                      | 4 (1–10)                      | 0.03 <sup>b,c</sup> | 3 (0–10)                                         | 0.14                 |
| No. of stools at night                                                        | 0 (0–12)           | 1 (0–4)                      | 1 (0–6)                       | 0.13                | 1 (0–6)                                          | 0.06                 |
| No. of stools weekly                                                          | 14 (3–100)         | 20 (2–60)                    | 28 (7–90)                     | 0.02 <sup>b,c</sup> | 21 (2–90)                                        | 0.07                 |
| Difficulties emptying bowels                                                  | 26 (49.1)          | 15 (68.2)                    | 13 (56.5)                     | 0.31                | 28 (62.2)                                        | 0.19                 |
| Frequently feel incomplete emptying of bowels                                 | 16 (30.2)          | 12 (54.5)                    | 8 (34.8)                      | 0.13                | 20 (44.4)                                        | 0.14                 |
| Use of medications                                                            | 26 (48.1)          | 12 (54.5)                    | 13 (56.5)                     | 0.76                | 25 (55.6)                                        | 0.46                 |
| Bowel function has interfered with general health quite a bit or extremely    | 5 (9.3)            | 8 (36.4)                     | 5 (21.7)                      | 0.02 <sup>d</sup>   | 13 (28.9)                                        | 0.01                 |
| Bowel function has interfered with social activities quite a bit or extremely | 14 (25.9)          | 11 (50)                      | 10 (43.5)                     | 0.09                | 21 (46.7)                                        | 0.03                 |

XRT = pelvic radiotherapy.

Data are medians with ranges in parentheses or numbers with percentages in parentheses unless otherwise indicated.

<sup>a</sup>Comparing the “No XRT” group to the combined (preoperative or postoperative) XRT group.

<sup>b</sup>Significant difference when comparing the “No XRT” group to the “Postoperative XRT” group.

<sup>c</sup>Significant difference when comparing the “Preoperative XRT” group to the “Postoperative XRT” group.

<sup>d</sup>Significant difference when comparing the “No XRT” group to the “Preoperative XRT” group.

compared on baseline demographics, functional outcomes, and QOL. Outcomes comprised of continuous variables were compared using Kruskal-Wallis tests.<sup>15</sup> Discrete nominal variables were analyzed using chi-squared or Fisher's exact tests, as appropriate,<sup>16</sup> whereas discrete ordinal variables were compared using Wilcoxon's rank-sum tests and Kruskal-Wallis tests.<sup>17–20</sup> Differences in functional and QOL outcomes of patients with J-pouch and straight reservoirs were assessed after adjustment for potentially important covariates with linear or logistic regression. All

statistical tests were two-sided, and *P* values < 0.05 were considered significant.

## RESULTS

To exclude the possibility of a systematic error because of a response bias, we compared the characteristics of the responders and nonresponders based on available data. There were no significant differences in the demographic, tumor, or operative characteristics of the patients who responded to the survey

**Table 3.**

Quality of Life of Patients With Intestinal Continuity (n = 99): Comparison of Patients Receiving no Pelvic Radiotherapy, Preoperative Pelvic Radiotherapy and Postoperative Pelvic Radiotherapy

|                           | No XRT<br>(n = 54) | Preoperative<br>XRT (n = 22) | Postoperative<br>XRT (n = 23) | <i>P</i> Value      | Preoperative or<br>Postoperative<br>XRT (n = 45) | <i>P</i> Value <sup>a</sup> |
|---------------------------|--------------------|------------------------------|-------------------------------|---------------------|--------------------------------------------------|-----------------------------|
| <b>A. EORTC QLQ-C30</b>   |                    |                              |                               |                     |                                                  |                             |
| Function scales           |                    |                              |                               |                     |                                                  |                             |
| Global Health Status/QOL  | 77.4 (17)          | 75 (20)                      | 81.2 (17)                     | 0.42                | 78.1 (18)                                        | 0.69                        |
| Physical functioning      | 94.6 (11)          | 89.4 (14)                    | 95.4 (7)                      | 0.21                | 92.4 (11)                                        | 0.26                        |
| Role functioning          | 90.9 (19)          | 84.8 (26)                    | 90.6 (16)                     | 0.61                | 87.8 (21)                                        | 0.4                         |
| Emotional functioning     | 88.4 (15)          | 83 (15)                      | 88.4 (11)                     | 0.27                | 85.7 (13)                                        | 0.18                        |
| Cognitive functioning     | 86.8 (15)          | 92.4 (14)                    | 92.8 (10)                     | 0.13                | 92.6 (12)                                        | 0.05                        |
| Social functioning        | 83.6 (19)          | 80.3 (26)                    | 84.1 (22)                     | 0.85                | 82.2 (24)                                        | 0.9                         |
| Symptom scales            |                    |                              |                               |                     |                                                  |                             |
| Fatigue                   | 14.9 (20)          | 15.2 (19)                    | 12.1 (13)                     | 0.99                | 13.6 (16)                                        | 0.94                        |
| Nausea and vomiting       | 2.8 (15)           | 5.3 (16)                     | 1.4 (7)                       | 0.41                | 3.3 (12)                                         | 0.55                        |
| Pain                      | 4.1 (11)           | 5.3 (9)                      | 5.1 (11)                      | 0.62                | 5.2 (10)                                         | 0.37                        |
| Dyspnea                   | 6.3 (15)           | 13.6 (24)                    | 2.9 (10)                      | 0.2                 | 8.1 (19)                                         | 0.84                        |
| Insomnia                  | 20.8 (29)          | 12.1 (22)                    | 13 (19)                       | 0.42                | 12.6 (20)                                        | 0.21                        |
| Appetite loss             | 3.8 (13)           | 6.1 (13)                     | 1.4 (7)                       | 0.31                | 3.7 (11)                                         | 0.82                        |
| Constipation              | 15.7 (21)          | 22.7 (30)                    | 10.1 (16)                     | 0.37                | 16.3 (24)                                        | 0.95                        |
| Diarrhea                  | 16.7 (21)          | 22.7 (26)                    | 17.4 (33)                     | 0.41                | 20 (30)                                          | 0.97                        |
| Financial difficulties    | 10.3 (19)          | 12.1 (19)                    | 17.4 (24)                     | 0.34                | 14.8 (22)                                        | 0.22                        |
| <b>B. EORTC QLQ-CR38</b>  |                    |                              |                               |                     |                                                  |                             |
| Function scales           |                    |                              |                               |                     |                                                  |                             |
| Body image                | 89.9 (16)          | 84.8 (20)                    | 85.5 (20)                     | 0.62                | 85.2 (20)                                        | 0.35                        |
| Sexual functioning        | 30 (25)            | 23.5 (20)                    | 33.3 (25)                     | 0.44                | 28.4 (23)                                        | 0.85                        |
| Sexual enjoyment          | 62.3 (29)          | 55.6 (22)                    | 51.1 (31)                     | 0.51                | 53.1 (27)                                        | 0.26                        |
| Future perspective        | 77.8 (24)          | 59.1 (29)                    | 78.3 (19)                     | 0.02 <sup>c,d</sup> | 68.9 (26)                                        | 0.07                        |
| Symptom scales            |                    |                              |                               |                     |                                                  |                             |
| Micturition problems      | 18.2 (13)          | 25 (13)                      | 14 (14)                       | 0.03 <sup>c,d</sup> | 19.4 (14)                                        | 0.64                        |
| Chemotherapy side-effects | 4.9 (8)            | 11.6 (13)                    | 8.7 (9)                       | 0.04 <sup>c</sup>   | 10.1 (11)                                        | 0.01                        |
| Symptoms in GI tract      | 15.6 (12)          | 17.3 (12)                    | 15.4 (10)                     | 0.83                | 16.3 (11)                                        | 0.66                        |
| Male sexual problems      | 45.4 (40)          | 65.7 (30)                    | 46.2 (43)                     | 0.25                | 57.2 (37)                                        | 0.32                        |
| Female sexual problems    | 23.8 (16)          | 16.7 <sup>b</sup>            | 21.4 (23)                     | 0.72                | 20.8 (21)                                        | 0.46                        |
| Defecation problems       | 19.5 (14)          | 26.8 (13)                    | 25.5 (15)                     | 0.09                | 26.2 (14)                                        | 0.03                        |
| Weight loss               | 6.8 (16)           | 1.5 (7)                      | 4.3 (11)                      | 0.36                | 3 (10)                                           | 0.24                        |

XRT = pelvic radiotherapy; EORTC QLQ = European Organization for Treatment and Research of Cancer quality of life (QOL) questionnaire; GI = gastrointestinal.

Data are means with standard deviations in parentheses. Values in the functional scales range from 0 (worse outcome) to 100 (better outcome); those in the symptom scales range from 0 (fewer symptoms) to 100 (more symptoms).

<sup>a</sup>Comparing the "No XRT" group to the combined (preoperative or postoperative) XRT group.

<sup>b</sup>Not applicable, score available for only one patient.

<sup>c</sup>Significant difference when comparing the "No XRT" group to the "Preoperative XRT" group.

<sup>d</sup>Significant difference when comparing the "Preoperative XRT" group to the "Postoperative XRT" group.

and the 30 patients who were nonresponders. Ninety percent of the responders answered 90 percent or more of the survey questions (data not shown).

### Demographic, Tumor, and Operative Characteristics

Of the 121 patients who underwent a coloanal anastomosis that replied to the survey, 58 patients did not receive pelvic radiotherapy, whereas 63 patients received pelvic radiotherapy (27 preoperative and 36 postoperative patients). No significant differences among the three groups were seen in terms of age at surgery ( $P = 0.2$ ) or gender ( $P = 0.27$ ). Patients who received pelvic radiotherapy (preoperative or postoperative) had a higher local tumor stage than patients who did not receive pelvic radiotherapy ( $P < 0.001$ ). Patients who received preoperative radiotherapy were more likely to undergo temporary diversion and had shorter follow-up duration compared with patients who did not receive pelvic radiotherapy or received postoperative pelvic radiotherapy ( $P = 0.02$  and  $P < 0.001$  respectively). Demographic, tumor, and operative characteristics of the 121 responding patients are shown in Table 1.

### Functional Results and Quality of Life of Patients With Intestinal Continuity

Comparisons of the three groups (patients not receiving pelvic radiotherapy or receiving preoperative or postoperative pelvic radiotherapy) showed that patients who received postoperative radiotherapy had more bowel movements during the day and during a one-week period than patients who received no radiotherapy or preoperative pelvic radiotherapy (Table 2). Patients who received preoperative pelvic radiotherapy had lower scores (indicating worse outcome) on future perspective and higher scores (indicating more symptoms) on micturition problems on the EORTC QLQ-CR38 compared with patients who did not receive radiotherapy or patients who received postoperative radiotherapy. Patients who received preoperative radiotherapy had higher scores (indicating more symptoms) on chemotherapy side-effects compared with the patients who did not receive radiotherapy. All other EORTC QLQ C-30 and CR-38 scales and items were similar among the three groups (Table 3A and B).

Patients who received pelvic radiotherapy (preoperative or postoperative) were combined and compared with patients who did not receive pelvic radiotherapy;

patients who did not receive pelvic radiotherapy tended to have fewer bowel movements during the day and during a one-week period compared with patients who received pelvic radiotherapy, although this did not achieve statistical significance. The proportion of patients who received pelvic radiotherapy and reported quite a bit or extreme interference of bowel function in their social activities and overall health was greater compared with the proportion of patients who did not receive pelvic radiotherapy (Table 2). Patients who received pelvic radiotherapy also had significantly higher scores (meaning more symptoms) on the defecation problems scale of the EORTC QLQ-CR38 compared with patients who did not receive pelvic radiotherapy (mean defecation problems score (standard deviation) 26.2 (14) *vs.* 19.5 (14);  $P = 0.03$ ). The scores on the remaining relevant EORTC QLQ-C30 and CR38 scales and items were similar between the two groups (Table 3A and B).

**Table 4.**

Demographic, Tumor, and Operative Characteristics of Patients Who Replied to Mailed Surveys ( $n = 121$ ): Comparison of Patients With a Colostomy and Patients With Intestinal Continuity

|                                         | Patients<br>With a<br>Colostomy<br>( $n = 22$ ) | Patients<br>With<br>Intestinal<br>Continuity<br>( $n = 99$ ) | <i>P</i><br>Value |
|-----------------------------------------|-------------------------------------------------|--------------------------------------------------------------|-------------------|
| Age at initial surgery (yr)             | 58 (28–78)                                      | 58 (22–85)                                                   | 0.36              |
| Follow-up (mo)                          | 80 (8–248)                                      | 63 (16–236)                                                  | 0.08              |
| Male                                    | 18 (81.8)                                       | 65 (65.7)                                                    | 0.14              |
| Tumor distance from the anal verge (cm) | 6 (2–18)                                        | 6 (2–10)                                                     | 0.88              |
| Stage                                   |                                                 |                                                              |                   |
| I                                       | 2 (9.1)                                         | 44 (44.4)                                                    | 0.02              |
| II                                      | 8 (36.4)                                        | 16 (16.2)                                                    |                   |
| III                                     | 12 (54.5)                                       | 38 (38.4)                                                    |                   |
| IV                                      | 0 (0)                                           | 1 (1)                                                        |                   |
| Shape of reservoir                      |                                                 |                                                              |                   |
| Straight                                | 12 (54.5)                                       | 52 (52.5)                                                    | 0.86              |
| J-pouch                                 | 10 (45.5)                                       | 47 (47.5)                                                    |                   |
| Mucosectomy                             | 15 (68.2)                                       | 48 (48.5)                                                    | 0.09              |
| Temporary diverting ileostomy           | 16 (72.7)                                       | 84 (84.8)                                                    | 0.21              |
| Treatment group                         |                                                 |                                                              |                   |
| Preoperative XRT                        | 5 (22.7)                                        | 22 (22.2)                                                    | <0.01             |
| Postoperative XRT                       | 13 (59.1)                                       | 23 (23.2)                                                    |                   |
| No XRT                                  | 4 (18.2)                                        | 54 (54.5)                                                    |                   |

XRT = pelvic radiotherapy.

Data are medians with ranges in parentheses or numbers with percentages in parentheses unless otherwise indicated.

After adjusting for the need and timing of pelvic radiotherapy, patients with a J-pouch reservoir had lower scores (meaning fewer symptoms) on the defecation problem scale of the EORTC QLQ-CR38 compared with patients with a straight reservoir (19 *vs.* 25;  $P = 0.03$ ). The scores on the other EORTC QLQ-C30 and CR-38 scales and items were similar between the two groups of patients. In the study-specific bowel function questionnaire, a greater proportion of patients with a straight reservoir reported bowel function to interfere with their social activities compared with patients with a J-pouch reservoir. However, there were no differences in the number of daily and weekly bowel movements and other measured functional outcomes between these two groups of patients.

### Comparison of QOL Between Patients With and Without Intestinal Continuity

Among the 121 patients who replied to the mailed surveys, 99 patients had intestinal continuity, 20 patients had a stoma because of postoperative complications, and 1 patient each had a stoma because of recurrent tumor and patient preference. Demographic, tumor, and operative characteristics of these two groups of patients are shown in Table 4.

A comparison of the QOL of patients who had intestinal continuity and those who did not have intestinal continuity is shown in Table 5A and B. Patients without intestinal continuity had significantly

**Table 5.**

QOL of Patients Who Replied to Mailed Surveys (n = 121): Comparison of Patients With a Colostomy and Patients With Intestinal Continuity

|                           | Patients With a<br>Colostomy (n = 22) | Patients With Intestinal<br>Continuity (n = 99) | P Value |
|---------------------------|---------------------------------------|-------------------------------------------------|---------|
| <b>A. EORTC QLQ-C30</b>   |                                       |                                                 |         |
| Functional Scales         |                                       |                                                 |         |
| Global Health Status/QOL  | 68.2 (25)                             | 77.7 (17)                                       | 0.11    |
| Physical functioning      | 85.4 (20)                             | 93.6 (11)                                       | 0.01    |
| Role functioning          | 84.9 (28)                             | 89.5 (20)                                       | 0.8     |
| Emotional functioning     | 80.6 (20)                             | 87.2 (14)                                       | 0.24    |
| Cognitive functioning     | 87.3 (14)                             | 89.5 (14)                                       | 0.37    |
| Social functioning        | 70.6 (26)                             | 83 (21)                                         | 0.03    |
| Symptom scales            |                                       |                                                 |         |
| Fatigue                   | 29.6 (26)                             | 14.3 (18)                                       | <0.01   |
| Nausea and vomiting       | 6.3 (11)                              | 3.1 (13)                                        | <0.01   |
| Pain                      | 15.1 (21)                             | 4.6 (10)                                        | 0.01    |
| Dyspnea                   | 14.3 (20)                             | 7.1 (17)                                        | 0.04    |
| Constipation              | NA                                    | 16 (23)                                         | NA      |
| Diarrhea                  | NA                                    | 18.2 (25)                                       | NA      |
| Financial difficulties    | 15.9 (27)                             | 12.4 (21)                                       | 0.74    |
| <b>B. EORTC QLQ-CR38</b>  |                                       |                                                 |         |
| Functional scales         |                                       |                                                 |         |
| Body image                | 66.9 (27.8)                           | 87.8 (18.06)                                    | <0.01   |
| Sexual functioning        | 22.2 (22.57)                          | 29.3 (23.78)                                    | 0.21    |
| Sexual enjoyment          | 51.9 (29.4)                           | 57.3 (27.8)                                     | 0.64    |
| Future perspective        | 65.1 (34.12)                          | 73.7 (25.32)                                    | 0.37    |
| Symptom scales            |                                       |                                                 |         |
| Micturition problems      | 25.9 (15.45)                          | 18.8 (13.81)                                    | 0.04    |
| Chemotherapy side-effects | 14.6 (14.54)                          | 7.3 (9.93)                                      | 0.02    |
| Symptoms in GI tract      | 13.8 (12.76)                          | 15.9 (11.51)                                    | 0.38    |
| Male sexual problems      | 71.9 (30.86)                          | 51.4 (38.69)                                    | 0.05    |
| Female sexual problems    | 66.7 <sup>a</sup>                     | 22.2 (18.54)                                    | 0.14    |
| Defecation problems       | NA                                    | 22.4 (14)                                       | NA      |
| Stoma-related problems    | 31.7 (24)                             | NA                                              | NA      |
| Weight loss               | 11.1 (19.25)                          | 5.1 (13.77)                                     | 0.08    |

EORTC QLQ = European Organization for Treatment and Research of Cancer quality of life (QOL) questionnaire; GI = gastrointestinal.

Data are means with standard deviations in parentheses unless otherwise indicated. Values in the functional scales range from 0 (worse outcome) to 100 (better outcome); those in the symptom scales range from 0 (fewer symptoms) to 100 (more symptoms).

lower scores (indicating worse outcome) for physical and social functioning on the EORTC QLQ-C30 and body image on the EORTC QLQ-CR38 and higher scores (indicating more symptoms) for fatigue, nausea and vomiting, pain, dyspnea on the EORTC QLQ-C30, and micturition problems and chemotherapy side-effects on the EORTC QLQ-CR38.

## DISCUSSION

The functional and QOL outcomes from our study firmly establish this approach to sphincter preservation as having favorable long-term results. In addition, we demonstrate the adverse impact of pelvic radiotherapy on functional results, regardless of its timing.

Patients who did not receive pelvic radiotherapy tended to have fewer bowel movements per day and per week and reported fewer problems with defecation on the EORTC QLQ-CR38 scale than patients who received pelvic radiotherapy. The remaining functional and symptoms scales on the EORTC QLQ-C30 and CR38 were similar between the two groups of patients, indicating that the altered bowel function did not necessarily negatively impact other aspects of their lives. These patients had similar demographic and clinical characteristics, other than the fact that patients receiving pelvic radiotherapy (preoperative or postoperative) were more likely to have had a higher local disease stage.

Several previous reports have demonstrated an adverse impact of postoperative radiotherapy on bowel function after rectal resection.<sup>21–23</sup> Other studies have suggested that preoperative pelvic radiotherapy may prevent the “short-term” detrimental effects of postoperative radiotherapy by avoiding radiation to the neorectum.<sup>6,24,25</sup> In our study, patients receiving preoperative radiotherapy had a median of one fewer bowel movement during the day compared with patients who received postoperative radiotherapy. However, we found no significant differences in relevant functional outcomes as measured by the EORTC QLQ-C30 and CR38 and the study-specific bowel function questionnaire between patients receiving preoperative or postoperative pelvic radiotherapy. This suggests that the reported functional benefit of preoperative radiotherapy may not be durable and that with long-term follow-up, pelvic radiotherapy (preoperative or postoperative), has an equally detrimental effect on functional results.

Studies that have serially measured functional outcomes after a coloanal anastomosis have shown that functional results stabilize after 12 months from establishment of intestinal continuity.<sup>26,27</sup> A longitudinal evaluation of QOL after surgery for rectal cancer using the EORTC QLQ-C30 and CR38 suggested that most relevant QOL scales and items tend to become stable after two years of follow-up.<sup>8</sup> Therefore, despite the statistically shorter follow-up among the patients receiving preoperative radiotherapy, we believe that the median follow-up of this group (35 months) is sufficient to make assessments of long-term results.

Both retrospective and prospective studies<sup>26,28–35</sup> have shown the short-term functional outcomes to be better with colonic J-pouch than with a straight reservoir. However, few of these reports have examined the long-term results of these types of reservoirs.<sup>36–38</sup> In our experience, patients with a J-pouch reservoir tended to have fewer symptoms on the defecation problem scale of the EORTC QLQ-CR38 compared with patients with a straight reservoir. This difference persisted even after adjusting for the need and timing of radiotherapy. Although our study was retrospective and the results were based on a posthoc analysis, these data contradict some studies with long-term follow-up,<sup>37,39,40</sup> which could not demonstrate a difference in the long-term functional results of patients with a J-pouch or a straight reservoir, yet confirming the findings of others<sup>41</sup> who demonstrated better long-term functional results in patients with a J-pouch reservoir compared with patients with a straight reservoir. However, all of these previous studies used nonvalidated, study-specific questionnaires to assess bowel function, which could account for these differences in functional results.

Traditionally, patients with a permanent stoma have been considered to have worse QOL.<sup>8,10</sup> Recent reports on QOL of stoma and nonstoma patients that used disease-specific validated QOL instruments like ours were unable to show significant differences<sup>24,42,43</sup> and in some instances actually showed better QOL in the stoma patients.<sup>9,44</sup> In our study, however, patients with intestinal continuity had better QOL scores than those who eventually required a stoma because of postoperative complications. Specifically, patients with intestinal continuity had higher scores indicating better outcomes for physical functioning, social functioning, and body image and lower scores indicating fewer symptoms for fatigue, nausea and vomiting, pain, dyspnea,

micturition problems, and chemotherapy side-effects. We believe that although having a stoma may be a contributor to decreased QOL, the fact that they suffered complications after sphincter preservation resulting in a permanent stoma may be the main reason for decreased QOL.

On the EORTC QLQ-C30 and CR38, certain items and scales not related to gastrointestinal function were found to be statistically different among groups. For instance, patients with intestinal continuity who received preoperative pelvic radiotherapy had scores indicating worse outcomes for future perspective, micturition problems, and chemotherapy side-effects compared with patients who did not receive pelvic radiotherapy or patients who received postoperative radiotherapy. Although these could represent actual clinical differences, other possible explanations must be considered. Statistically, a Type I error can occur, particularly whenever multiple comparisons are performed, as was done in our analysis. In context of QOL scores, it is necessary to consider the fact that "statistical difference" does not necessarily imply a "clinically meaningful" difference. Research in this topic has suggested that a difference of more than one-half a standard deviation can be considered a clinically relevant difference,<sup>45</sup> although it is not known if this consistently applies to scores at the extreme limits of a scale. It also is important when interpreting these scores to consider the relative number of responses and the fact that these outcomes are dependent on the preoperative symptoms of the patient. As more QOL studies are performed in these patient populations using validated instruments, a better understanding of the significance and relevance of these differences will take place.

## CONCLUSIONS

Coloanal anastomosis for distal rectal cancer preserves the sphincter, has favorable long-term functional results, and confers acceptable QOL. Preoperative or postoperative pelvic radiotherapy adversely effects bowel function. Patients who eventually require a stoma after attempted sphincter preservation have diminished QOL.

## REFERENCES

1. Castrini G, Toccaceli S. Cancer of the rectum-sphincter-saving operation. A new technique of coloanal anastomosis. *Surg Clin North Am* 1988;68:1383-90.
2. Cavaliere F, Pemberton JH, Cosimelli M, *et al.* Coloanal anastomosis for rectal cancer. Long-term results at the Mayo and Cleveland Clinics. *Dis Colon Rectum* 1995;38:807-12.
3. Gamagami RA, Liagre A, Chiotasso P, *et al.* Coloanal anastomosis for distal third rectal cancer: prospective study of oncologic results. *Dis Colon Rectum* 1999;42:1272-5.
4. Wagman R, Minsky BD, Cohen AM, *et al.* Sphincter preservation in rectal cancer with preoperative radiation therapy and coloanal anastomosis: long term follow-up. *Int J Radiat Oncol Biol Phys* 1998;42:51-7.
5. Rullier E, Goffre B, Bonnel C, *et al.* Preoperative radiochemotherapy and sphincter-saving resection for T3 carcinomas of the lower third of the rectum. *Ann Surg* 2001;234:633-40.
6. Read TE, Ogunbiyi OA, Fleshman JW, *et al.* Neo-adjuvant external beam radiation and proctectomy for adenocarcinoma of the rectum. *Dis Colon Rectum* 2001;44:1778-90.
7. Minsky BD. Sphincter preservation in rectal cancer. Preoperative radiation therapy followed by low anterior resection with coloanal anastomosis. *Semin Radiat Oncol* 1998;8:30-5.
8. Engel J, Kerr J, Schlesinger-Raab A, *et al.* Quality of life in rectal cancer patients: a four-year prospective study. *Ann Surg* 2003;238:203-13.
9. Rauch P, Miny J, Conroy T, *et al.* Quality of life among disease-free survivors of rectal cancer. *J Clin Oncol* 2004;22:354-60.
10. Camilleri-Brennan J, Steele RJ. Quality of life after treatment for rectal cancer. *Br J Surg* 1998;85:1036-43.
11. Zaheer S, Pemberton JH, Farouk R, *et al.* Surgical treatment of adenocarcinoma of the rectum. *Ann Surg* 1998;227:800-11.
12. Pemberton JH, Phillips SF, Ready RR, *et al.* Quality of life after Brooke ileostomy and ileal pouch-anal anastomosis. Comparison of performance status. *Ann Surg* 1989;209:620-8.
13. Aaronson N, Ahmedzai S, Bergman B, *et al.* The European Organization for Research and Treatment of Cancer QLQ-C30: a quality of life instrument for the use in international clinical trials in oncology. *J Natl Cancer Inst* 1993;85:365-76.
14. Sprangers M, Te Velde A, Aaronson N. The construction and testing of the EORTC colorectal cancer-specific quality of life questionnaire module. *Eur J Cancer* 1999;35:238-47.
15. Snedecor GW, Cochran WG. Statistical methods. Ames: Iowa State University Press, 1980:215-37.
16. Snedecor GW, Cochran WG. Statistical methods. Ames: Iowa State University Press, 1980:75-8.
17. Hollander M, Wolfe DA. Nonparametric statistical methods. New York: John Wiley and Sons, 1973:68-75.



18. Hollander M, Wolfe DA. Nonparametric statistical methods. New York: John Wiley and Sons, 1973:115–20.
19. Kruskal WH. A nonparametric test for the several sample problem. *Ann Math Stat* 1952;23:525–40.
20. Kruskal WH, Wallis WA. Use of ranks in one-criterion variance analysis. *J Am Stat Assoc* 1952;47:583–621.
21. Kollmorgen CF, Meagher AP, Wolff BG, Pemberton JH, Martenson JA, Illstrup DM. The long-term effect of adjuvant postoperative chemoradiotherapy for rectal carcinoma on bowel function. *Ann Surg* 1994;220:676–82.
22. Gervaz P, Rotholz N, Wexner SD, You SY, Saigusa N, Kaplan E, *et al.* Colonic J-pouch function in rectal cancer patients: impact of adjuvant chemoradiotherapy. *Dis Colon Rectum* 2001;44:1667–75.
23. Lewis WG, Williamson ME, Kuzu H, Stephenson BM, Holdsworth PJ, Finan PJ, *et al.* Potential disadvantages of post-operative adjuvant radiotherapy after anterior resection for rectal cancer: a pilot study of sphincter function, rectal capacity and clinical outcome. *Int J Colorectal Dis* 1995;10:133–7.
24. Allal AS, Bieri S, Pelloni A, *et al.* Sphincter-sparing surgery after preoperative radiotherapy for low rectal cancers: feasibility, oncologic results and quality of life outcomes. *Br J Cancer* 2000;82:1131–7.
25. Nathanson DR, Espat NJ, Nash GM, *et al.* Evaluation of preoperative and postoperative radiotherapy on long-term functional results of straight coloanal anastomosis. *Dis Colon Rectum* 2003;46:888–94.
26. Sailer M, Fuchs KH, Fein M, Thiede A. Randomized clinical trial comparing quality of life after straight and pouch coloanal reconstruction. *Br J Surg* 2002;89:1108–17.
27. Camilleri-Brennan J, Steele RJ. Prospective analysis of quality of life and survival following mesorectal excision for rectal cancer. *Br J Cancer* 2001;88:1617–22.
28. Willis S, Kasperk R, Braun J, Schumpelick V. Comparison of colonic J-pouch reconstruction and straight coloanal anastomosis after intersphincteric rectal resection. *Langenbecks Arch Surg* 2001;386:193–9.
29. Amin AI, Hallbook O, Lee AJ, *et al.* A 5-cm colonic J pouch colo-anal reconstruction following anterior resection for low rectal cancer results in acceptable evacuation and continence in the long term. *Colorectal Dis* 2003;5:33–7.
30. Dehni N, Parc R, Church JM. Colonic J-pouch-anal anastomosis for rectal cancer. *Dis Colon Rectum* 2003;46:667–75.
31. Lazorthes F, Chiotasso P, Gamagami RA, *et al.* Late clinical outcome in a randomized prospective comparison of colonic J pouch and straight coloanal anastomosis. *Br J Surg* 1997;84:1449–51.
32. Seow-Choen F, Goh HS. Prospective randomized trial comparing J colonic pouch-anal anastomosis and straight coloanal reconstruction. *Br J Surg* 1995;82:608–10.
33. Benoist S, Panis Y, Boleslawski E, *et al.* Functional outcome after coloanal versus low colorectal anastomosis for rectal carcinoma. *J Am Coll Surg* 1997;185:114–9.
34. Ortiz H, De Miguel M, Armendariz P *et al.* Coloanal anastomosis: are functional results better with a pouch? *Dis Colon Rectum* 1995;38:375–7.
35. Hallbook O, Pahlman L, Krog M, *et al.* Randomized comparison of straight and colonic J pouch anastomosis after low anterior resection. *Ann Surg* 1996;224:58–65.
36. Hida J, Yoshifuji T, Tokoro T, *et al.* Long-term functional outcome of low anterior resection with colonic J-pouch reconstruction for rectal cancer in the elderly. *Dis Colon Rectum* 2004;47:1448–54.
37. Joo JS, Latulippe JF, Alabaz O, *et al.* Long-term functional evaluation of straight coloanal anastomosis and colonic J-pouch: is the functional superiority of colonic J-pouch sustained? *Dis Colon Rectum* 1998;41:740–6.
38. Hida J, Yoshifuji T, Tokoro T, *et al.* Comparison of long-term functional results of colonic J-pouch and straight anastomosis after low anterior resection for rectal cancer: a five-year follow-up. *Dis Colon Rectum* 2004;47:1578–85.
39. Ho YH, Seow-Choen F, Tan M. Colonic J-pouch function at six months versus straight coloanal anastomosis at two years: randomized controlled trial. *World J Surg* 2001;25:876–81.
40. Barrier A, Martel P, Gallot D, *et al.* Long-term functional results of colonic J pouch versus straight coloanal anastomosis. *Br J Surg* 1999;86:1176–9.
41. Harris GJ, Lavery IC, Fazio VW. Function of a colonic J pouch continues to improve with time. *Br J Surg* 2001;88:1623–7.
42. Koller M, Lorenz W. Quality of life research in patients with rectal cancer: traditional approaches versus a problem-solving oriented perspective. *Langenbecks Arch Surg* 1998;383:427–36.
43. Ramsey SD, Andersen MR, Etzioni R, *et al.* Quality of life in survivors of colorectal carcinoma. *Cancer* 2000;88:1294–303.
44. Grumann MM, Noack EM, Hoffmann IA, Schlag PM. Comparison of quality of life in patients undergoing abdominoperineal extirpation or anterior resection for rectal cancer. *Ann Surg* 2001;233:149–56.
45. Sloan JA, Dueck A. Issues for statisticians in conducting analyses and translating results for quality of life end points in clinical trials. *J Biopharm Stat* 2004;14: 73–96.