Analysis of Clinical Factors Associated with Anal Function after Intersphincteric Resection for Very Low Rectal Cancer

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PURPOSE: The purpose of this study was to identify factors that have a negative impact on anal function after intersphincteric resection.

METHODS: We evaluated postoperative anal function in 96 patients with very lower rectal cancer who underwent intersphincteric resection by having patients fill out detailed questionnaires at 3, 6, 12, and 24 months after surgery. Univariate and multivariate analysis based on the Wexner incontinence score were used to identify factors associated with poor anal function after intersphincteric resection.

RESULTS: The mean Wexner score at 12 months after stoma closure was 10.0. Patients with frequent major soiling showed a Wexner score of \( \geq 16 \), and this score was used as a cutoff value of poor anal function. In the univariate analysis, poor anal function was significantly associated with a greater extent of excision of the internal sphincter and with preoperative chemoradiotherapy. In the multivariate analysis, preoperative chemoradiotherapy was the only independent factor associated with poor anal function after intersphincteric resection (odds ratio = 10.3; 95 percent confidence interval, 2.3–46.3, \( P < 0.01 \)).

CONCLUSIONS: Preoperative chemoradiotherapy was identified as the risk factor with the greatest negative impact on anal function after intersphincteric resection, regardless of extent of excision of the internal sphincter.

KEY WORDS: Rectal cancer; Intersphincteric resection; Preoperative chemoradiation; Anorectal function; Incontinence.

Since Miles reported abdominoperineal resection in the 1920s, this procedure has been the standard treatment for low rectal cancer. However, standard abdominoperineal resection leaves many rectal cancer patients with permanent stomas. Recently, innovative treatment for lower rectal cancer has tended toward preservation of the anus. Low anterior resection with coloanal anastomosis (CAA) and intersphincteric resection (ISR) are advanced anus-preserving operations for treating low rectal cancer while avoiding a colostomy. Anastomoses are made near or under the dentate line in the anal canal, and the result has been a tolerable local recurrence rate that we have been able to accept clinically. Several studies have also investigated the functional outcome after ISR. The results suggested that satisfactory anal function was preserved in most patients who underwent ISR, but some patients had severe dysfunction, and conversion to colostomy was necessary.

We prospectively collected questionnaires concerning anal function from our patients every three months for two years after closure of the diverting stomas. The aims of the present study were to accurately determine the status of anal function and to identify factors associated with postoperative incontinence after ISR.

PATIENTS AND METHODS

Patients

Between November 1999 and March 2007, 150 patients underwent ISR for very lower rectal cancer at the National Cancer Center Hospital East (NCCHE), Chiba, Japan. A diverting stoma was constructed in every patient, and the stoma had been closed in 109 of the patients as of March 2007. Diverting stomas had not been closed in 41 patients when the data were analyzed. The reasons were...
as follows: 13 patients had recurrences or died, 15 were receiving adjuvant chemotherapy, 3 required an emergency resection because of postoperative bleeding or necrosis, 8 had severe leakages or strictures of the anastomosis, and 2 were in the planning phase for the stoma closure. Questionnaires about postoperative anal function were prospectively collected from 96 of the 109 patients with closure, and these 96 patients were enrolled in the present study.

Our indications for ISR were tumor edge 5 cm above the anal verge or 3 cm above the dentate line, histologically confirmed adenocarcinoma, and age less than 76 years. Patients in whom invasion of the external sphincter muscle had occurred or distal spread of the primary cancer was suspected were excluded from this study. Digital examination, anoscopy, and fiber colonoscopy were performed preoperatively to measure the distance between the tumor edge and the anal verge, dentate line, or anal ring. Invasion of the external sphincter muscle was diagnosed by pelvic magnetic resonance imaging, and distant metastasis was diagnosed by chest, abdominal, and pelvic CT scans. We determined preoperative stage according to the UICC classification.

**Surgical Procedure**

ISR was performed according to the method described previously. The surgical procedure included both an abdominal and a perineal approach. First, dissection was performed by the abdominal approach until total mesorectal excision was complete. The puborectal muscle surrounding the lateral and posterior wall of the rectum was exposed at the pelvic diaphragm. The outside layer of the internal sphincter muscle was then exposed and circumferentially divided from the puborectal muscle and the external sphincter. Lateral lymph node dissection was generally performed for stage T3 and T4 disease.

After the part of the operation performed via the abdominal approach was completed, perianal resection was performed. The mucosa and the internal sphincter muscle were incised 1 cm to 2 cm distal to the tumor. The anal orifice was closed with pursestring sutures to avoid tumor cell dissemination during the perianal operation. Once the intersphincteric space was entered, careful dissection was continued upward between the smooth and striated sphincters under constant guidance by an assistant from the abdominal side.

Total ISR involved complete excision of the internal sphincter muscle for tumors that had spread to or beyond the dentate line. The distal line of resection was at the intersphincteric groove. Total ISR was unnecessary when the tumor was located ≥2 cm from the dentate line. In such cases, subtotal ISR was performed instead. In subtotal ISR, the distal line of resection was between the dentate line and the intersphincteric groove, and the dentate line was included in the resection. Partial ISR was performed when the tumor was located 2 cm to 3 cm from the dentate line, with the distal line of resection on or above the dentate line. Partial ISR sometimes includes a conventional coloanal anastomosis procedure. The definitions of each type of ISR are shown in Figure 1. If the tumor had invaded the external sphincter, ISR plus partial resection of the external sphincter was performed, but at least the subcutaneous part of the external sphincter was preserved. The distal margin was pathologically evaluated during surgery; if cancer cells were found at the distal margin, additional resection was performed. The decision whether to create a pouch—either a J-pouch or a transverse coloplasty pouch (TCP)—was left to the discretion of the surgeon.

**Preoperative Therapy**

Forty patients, most with T3 tumors, agreed to preoperative chemoradiotherapy (CRT). During a five-week

![FIGURE 1. Classification of intersphincteric resection (ISR) based on extent of excision of the internal sphincter.](image-url)
period, a dose of 45 Gy was administered, along with continuous intravenous infusion of 5-fluorouracil (250 mg/m²/day) to increase the efficacy of radiotherapy. Resection was performed two weeks after the preoperative CRT was completed.¹¹

**Assessment of Function**

Functional outcome was assessed with our functional questionnaire,² which asked about stool frequency (number of bowel movements per 24 hours), ability to distinguish between feces and flatus, urgency (inability to defer stool evacuation for >15 minutes), fragmentation (more than two evacuations in one hour), soiling during the day or during the night, use of pads, use of medications, and alimentary restriction. Incontinence was assessed by using the continence score of Jorge and Wexner¹² (Wexner score) and the classification proposed by Kirwan et al.¹³ Questionnaires were obtained from the patients during consultation in the doctor’s office, but the patients had filled out the questionnaires by themselves at their homes. To evaluate the Wexner score, we obtained questionnaires from 88 of 96 patients at 3 months after stoma closure, 84 of 96 at 6 months, 73 of 96 at 12 months, and 60 of 96 at 24 months. In this study, evaluation of risk factors for poor anal function after ISR was performed on the basis of the Wexner score at 12 months after stoma closure. We defined poor anal function as a Wexner score of 16 points or more. Because 18 of the 19 patients with a Wexner score of 16 points or more were classified as Kirwan grade 4, this suggested that a Wexner score of 16 points or more represented frequent major soiling. The cutoff value in this study was similar to the value in Chamlou’s report,¹⁴ in which the mean Wexner score of the incontinent group was 15 points.

**Statistical Analysis**

Student’s t-test and Fisher’s exact test were used to evaluate changes over time in symptoms related to anal dysfunction, Wexner score and Kirwan classification after stoma closure following ISR. Clinical factors that might negatively affect anal function, i.e., sex, age, type of reconstruction, anastomotic leakage, extent of excision of the internal sphincter, partial resection of the external sphincter, lateral lymph node dissection, and preoperative CRT, were evaluated as potential confounding factors in univariate and multivariate analyses. The differences in the distribution of these factors between patients with Wexner scores <16 and those with Wexner scores ≥16 at 12 months were analyzed for significance with the chi-squared test. The effect of these variables on poor anal function was evaluated by calculating odds ratios. The patients were divided into two groups according to the extent of excision of the internal sphincter: a total ISR group and a nontotal ISR group. Nontotal ISR included partial ISR and subtotal ISR. All of the analyses were conducted with adjustment for all of the potential confounding factors by logistic regression. Next, we evaluated the effect of preoperative CRT separately in the total ISR group, subtotal ISR group, and partial ISR group.

All statistical analyses were performed with the STATISTICA data analysis software system, version 6 (StatSoft, Inc. [2003]; www.statsoft.com.). P values less than 0.05 were considered statistically significant.

**RESULTS**

Table 1 shows the clinical characteristics of the 96 patients analyzed, including mean tumor distance from the anal verge, dentate line, and anal ring; preoperative CRT; extent of excision of the internal sphincter muscle; resection of the external sphincter; type of reconstruction, and lateral lymph node dissection. Postoperative anastomotic leakage occurred in 15 (16 percent) of the 96 patients. Perioperative mortality was 0 percent.

Overall, cancer was classified as stage I in 29 (30 percent) of the 96 patients, stage II in 18 (19 percent), stage III in 37 (39 percent), and stage IV in 4 (4 percent). Of the 40 patients with preoperative CRT, 8 patients had clinical (c) T2 tumors, 31 had cT3 tumors, and 1 had a cT4 tumor. Of 56 patients without preoperative CRT, 4 had cT1 tumors, 11 had cT2 tumors, 37 had cT3 tumors,

| TABLE 1. Clinical background of patients treated by intersphincteric resection (n = 96) |
|---------------------------------|-----------------|
| **Characteristic**              | **Value**       |
| Age (yr)                        | 58 (27–81)      |
| Sex                             |                 |
| Male                            | 72              |
| Female                          | 24              |
| Tumor distance (cm) from        |                 |
| Anal verge                      | 3.8             |
| Dentate line                    | 2.0             |
| Anal ring                       | 1.0             |
| Preoperative CRT                |                 |
| +                               | 40              |
| –                               | 56              |
| Extent of excision of the internal sphincter | |
| Total ISR                       | 26              |
| Subtotal ISR                    | 43              |
| Partial ISR                     | 27              |
| Partial resection of the external sphincter |       |
| +                               | 21              |
| –                               | 75              |
| Reconstruction                  |                 |
| Straight anastomosis            | 84              |
| J pouch                         | 4               |
| TCP                             | 8               |
| Lateral lymph node dissection   |                 |
| +                               | 64              |
| –                               | 32              |

CRT = chemoradiotherapy; ISR = intersphincteric resection; TCP = transverse coloplasty pouch. * Age is given as mean with range in parentheses. Other data are number of patients.
and 4 had cT4 tumors. There were no significant differences in clinical stage between patients with and those without preoperative CRT. In the group with preoperative CRT, 8 patients (20 percent) had histologically complete remission after CRT, according to the UICC TNM classification; 4 patients (10 percent) had a pT1 tumor; 10 (25 percent) had a pT2 tumor; and 1 (3 percent) had a pT4 tumor. In the group without preoperative CRT, 6 patients (11 percent) had a pT1 tumor, 17 (30 percent) had a pT2 tumor, 31 (55 percent) had a pT3 tumor, and 2 (4 percent) had a pT4 tumor.

Pathologic examination showed that the mean distal margin of all patients was 1.5 cm (range, 0.2–5.5 cm). We routinely performed pathologic examination of the distal margin during the operation, and positive margins were diagnosed in three patients. In such cases, additional resections of distal margins were performed during the operation, and we made sure that the distal margins in all patients were free from cancer cells. Of all 96 patients who underwent ISR, 3 patients were found to be positive for circumferential margins, and an R0 operation was achieved in 93 patients (97 percent).

Median follow-up was 37 months (range, 1–90 months). The three-year disease-free survival rate was 67 percent and three-year overall survival rate was 81 percent. The three-year local disease-free survival rate was 87 percent. Three patients underwent abdominoperineal resection or Hartman’s operation and were converted to permanent stomas within one month after ISR because of early complications, which included two episodes of postoperative bleeding and one necrosis of the anastomosis.

Table 2 shows the clinical course of anal dysfunction based on the patients’ answers to the questionnaires 3, 6, 12, and 24 months after the diverting stoma was closed. At 24 months after the stoma was closed, 26 percent of patients reported more than five bowel movements a day; 25 percent reported daily incontinence of gas; 23 percent reported incontinence of loose stools; 17 percent reported incontinence of solid stools; and 52 percent reported stool fragmentation. The percentage of patients who could not discriminate between feces and flatus decreased gradually from 22 percent at 3 months to 5 percent at 24 months. A very low level of satisfaction with anal function was reported by 25 percent of patients at 3 months, but by only 14 percent at 12 months, and 17 percent at 24 months.

Table 3 shows the Wexner scores and Kirwan classification over time for all patients for whom data were available. Gradual improvement in the Wexner score was seen from 3 to 6 months, and slight further improvement was observed between 6 and 24 months. In the Kirwan classification, the percentage of patients with frequent major soiling decreased over 24 months (particularly

| TABLE 2. Clinical course of anal dysfunction in patients who underwent ISR followed by stoma closure |
|---------------------------------------------------------------|
| Symptoms related to anal function                             | 3 months | 6 months | 12 months | 24 months |
| Bowl movements ≥5 per day                                     | 53/90 (59) | 41/85 (48) | 27/76 (36)** | 15/58 (26)** |
| Incontinence of gas                                           | 20/84 (24) | 23/80 (29) | 17/71 (24) | 14/56 (25) |
| Incontinence of loose stools                                  | 34/88 (39) | 22/84 (26) | 20/74 (27) | 14/60 (23)* |
| Incontinence of solid stools                                  | 24/88 (27) | 18/84 (21) | 17/74 (23) | 10/60 (17) |
| Soining during the day                                         | 35/90 (39) | 22/85 (26)* | 20/74 (27) | 14/60 (23)* |
| Soining during the night                                       | 21/90 (23) | 13/85 (15) | 13/74 (18) | 11/60 (18) |
| Pad wearing                                                    | 67/87 (77) | 54/85 (64) | 42/74 (57)** | 37/59 (63)* |
| Cannot discriminate between feces or flatus                   | 19/88 (22) | 10/85 (12) | 8/74 (11) | 3/58 (5)** |
| Urgency                                                        | 16/87 (18) | 11/85 (13) | 9/74 (12) | 10/58 (17) |
| Stool fragmentation                                            | 45/87 (52) | 35/85 (35) | 34/74 (46) | 30/58 (52) |
| Very low satisfaction                                          | 21/85 (25) | 10/85 (12)* | 10/72 (14) | 10/58 (17) |

ISR = intersphincteric resection. • Data are proportion of patients reporting daily problems via questionnaire, with percentages in parentheses. Percentages with each anal dysfunctions in 6, 12 and 24 months were statistically compared with those in 3 months using Fisher’s exact test. *: P < 0.05 **: P < 0.01.

| TABLE 3. Incontinence scores after stoma closure in patients who underwent ISR |
|-----------------------------------------------|
| Wexner score                                   | 3 months (n=88) | 6 months (n=84) | 12 months (n=73) | 24 months (n=60) |
| Perfect                                        | 11.7 (5.3) | 10.3 (5.8) | 10.0 (6.0) | 9.6 (5.3)* |
| Incontinence of flatus                         | 8 (9) | 15 (18) | 18 (25)** | 13 (22)* |
| Occasional minor soiling                       | 9 (10) | 8 (10) | 8 (11) | 11 (18) |
| Frequent major soiling                         | 36 (41) | 39 (46) | 27 (37) | 22 (37) |
| Incontinent (required colostomy)               | 35 (40) | 22 (26)* | 20 (27) | 14 (23)* |

Data are means with standard deviation in parentheses for Wexner score and numbers of patients with percentages in parentheses for Kirwan classification. Wexner score and Kirwan classification in 6, 12 and 24 months were statistically compared with those in 3 months. *: P < 0.05 **: P < 0.01.
from 40 percent at 3 months to 26 percent at 6 months), and the percentage with perfect function increased during the first year (from 9 percent at 3 months to 18 percent at 6 months, and to 25 percent at 12 months).

As shown in Table 4, in the univariate analysis, poor anal function assessed by the Wexner score at 12 months was significantly associated with greater extent of excision of the internal sphincter (total ISR) \( (P = 0.04) \) and with preoperative CRT \( (P < 0.01) \). Sex, age, type of reconstruction, presence of anastomotic leakage, partial resection of the external sphincter, and lateral lymph node dissection were not associated with poor anal function after ISR. In the multivariate analysis, preoperative CRT was the only independent factor associated with poor anal function after ISR \( (P < 0.01) \).

As shown in Table 5, mean Wexner scores in each type of ISR were higher in patients who received preoperative CRT than in those who did not. This difference was significant in the group with subtotal ISR \( (P < 0.01) \).

**DISCUSSION**

Of the factors investigated in our study, preoperative CRT had the greatest negative impact on anal function after ISR. Total ISR was more strongly associated with anal dysfunction than either subtotal or partial ISR. Moreover, a negative effect of preoperative CRT on anal function was found regardless of the extent of preservation of the internal sphincter muscle. This study confirmed the recent report by Chamlou et al.\(^\text{14}\) that functional results after ISR are altered by preoperative CRT.

We evaluated postoperative anal function after ISR on the basis of prospective data obtained from questionnaires on function that were filled out by the patients themselves. Self-report data are important in obtaining an accurate picture regarding anal function.\(^\text{15}\)

Previous reports have mentioned postoperative dysfunction after ISR, mostly regarding incontinence of gas or stools.\(^\text{5-7}\) Rullier et al.\(^\text{16}\) found that 10 percent (2/21) of patients with major soiling after ISR had received preoperative radiotherapy. A long-term study by Shiessel et al.\(^\text{17}\) showed incontinence of gas or liquid stools in 13.7 percent of patients. The rate of incontinence in our study was similar to that found by Chamlou et al.,\(^\text{14}\) but worse than that found by others. Comparison is difficult.

| TABLE 4. Analysis of variables associated with poor Wexner scores after ISR |
|-----------------|-----------------|------------------|
| Variable | Wexner score | Univariate analysis | Multivariate analysis |
| | <16 | ≥16 | Odds ratio (95% CI) | P value | Odds ratio (95% CI) | P value |
| Sex | | | | | |
| F | 15 | 2 (12) | 3.3 (0.7–16.3) | 0.1 | 2.1 (0.4–12.9) | 0.4 |
| M | 39 | 17 (30) | | | |
| Age (yr) | | | | | |
| <70 | 49 | 18 (27) | | | |
| ≥70 | 5 | 1 (17) | 0.5 (0.06–5.2) | 0.5 | | |
| Reconstruction | | | | | |
| Straight | 46 | 17 (27) | 0.7 (0.1–3.6) | 0.6 | | |
| Pouch | 8 | 2 (20) | | | |
| Anastomotic leakage | | | | | |
| – | 44 | 16 (27) | 0.8 (0.2–3.5) | 0.7 | | |
| + | 10 | 3 (23) | | | |
| Extent of excision of the internal sphincter | | | | | |
| Subtotal ISR or partial ISR | 42 | 10 (19) | 3.2 (1.0–9.7) | 0.04 | 1.2 (0.3–4.5) | 0.8 |
| Total ISR | 12 | 9 (43) | | | |
| Partial resection of the external sphincter | | | | | |
| – | 43 | 13 (23) | 1.8 (0.5–5.9) | 0.3 | | |
| + | 11 | 6 (35) | | | |
| Lateral lymph node dissection | | | | | |
| – | 22 | 3 (12) | 3.7 (0.9–14.4) | 0.06 | 3.8 (0.8–18.8) | 0.1 |
| + | 32 | 16 (33) | | | |
| Preoperative CRT | | | | | |
| – | 35 | 3 (9) | 9.8 (2.5–38.9) | <0.01 | 10.3 (2.3–46.3) | <0.01 |
| + | 19 | 16 (46) | | | |

CRT = chemoradiotherapy; 95% CI = 95 percent confidence interval. * Data for Wexner score are number of patients, with percentage in parentheses for the category ≥16 points. Data for odds ratios are relative likelihood of having a Wexner score ≥16 (poor anal function), with 95% CI in parentheses.

| TABLE 5. Effect of preoperative CRT on anal function (Wexner score) in patients who underwent partial ISR, subtotal ISR, or total ISR |
|-----------------|-----------------|------------------|
| ISR (n=17) | ISR (n=36) | ISR (n=20) |
| Preoperative CRT | | | |
| – | 6.1 (14) | 6.9 (19)* | 8.6 (5) |
| + | 13.3 (3) | 13.6 (17)* | 13.1 (15) |

CRT = chemoradiotherapy; 95 percent CI = 95 percent confidence interval; ISR = intersphincteric resection. * P < 0.01. • Data are mean Wexner score with number of patients in parentheses.
because most reports did not clearly state the time after stoma closure at which results for function were assessed or what methods were used for assessment. Moreover, the effects of preoperative CRT or extent of excision of the internal sphincter were not investigated. At 12 months after stoma closure, 25 percent of the patients in our study were continent (“perfect” according to the Kirwan classification), and this rate was similar to the 29.6 percent reported by Kohler et al.\textsuperscript{5} and the 20 percent reported by Teramoto et al.\textsuperscript{18} The long-term study by Bretagnol et al.,\textsuperscript{8} in which anal function was evaluated by means of a questionnaire similar to the one used in our own study, yielded a mean Wexner score of 10.8, comparable to our 2-year mean score of 9.6.

The cause of the negative effects of conventionally fractionated chemoradiotherapy on anorectal function is still unclear. Lim et al.\textsuperscript{19} attributed poor anorectal function after a conventionally fractionated 45-Gy dose of preoperative CRT to damage to the pudendal nerve. Other reports\textsuperscript{20,21} showed that, after radiotherapy, rectal function was worsened by radiation proctitis and reduced rectal compliance from fibrosis of the rectal wall. Moreover, anal sphincter dysfunction after irradiation may be a result of direct radiation injury to the internal anal sphincter muscle.\textsuperscript{22} Incontinence after ISR with preoperative CRT might be at least partially explained by these findings. Our results also showed that conventional CRT was associated with anal dysfunction 12 months after stoma closure, and the adverse effects had occurred at only 3 months. We cannot clearly explain why this adverse effect of preoperative CRT occurred so early after irradiation. Moreover, we do not know whether this anal dysfunction caused by preoperative CRT will continue permanently or improve in the future. It will be important to determine whether the anal dysfunction caused by CRT improves in a long-term follow-up. The mechanism responsible for the anal dysfunction caused by preoperative CRT should also be further investigated.

Despite its potential negative effects on anal function, preoperative CRT has been shown to increase the sphincter-saving rate, thus avoiding permanent colostomy.\textsuperscript{23} Guillem et al.\textsuperscript{24} reported that after preoperative combined-modality therapy, a 1-cm margin of distal clearance beyond the mucosal edge should assure a negative distal margin in the majority of rectal cancer patients. We agree that some patients could avoid permanent stoma by ISR if a 1-cm distal clearance is achieved after preoperative CRT.

Consistent with results reported by Gamagami et al.,\textsuperscript{25} our study indicated that total resection of the internal sphincter also had an impact on anal function. One year after stoma closure, the mean Wexner score in our patients who underwent total ISR without preoperative CRT was 8.6, which was higher than the mean of 6.9 found in patients with subtotal ISR group or the 6.1 in patients with partial ISR. However, these scores were lower than those in patients who received preoperative CRT, who had mean Wexner scores above 13 points whether they had undergone partial ISR, subtotal ISR, or total ISR. These results suggested that, in the absence of irradiation, anus preservation with tolerable function can be expected even after total ISR.

Our results did not clearly show superiority of a J-pouch or a TCP after low anterior resection\textsuperscript{26,27} or ISR.\textsuperscript{28,29} In our early experience of ISR, anastomosis of a colonic J-pouch down to the level of the dentate line was often not technically feasible because of the bulk of mesocolic fat or inadequate length of preserved colon. Thus, we had only 12 patients with a J-pouch or TCP. Fazio et al.\textsuperscript{30} also commented that some patients were ineligible for a J-pouch because of a bulky mesocolon. However, we agree that creation of a pouch is widely accepted as a better means of preserving of anal function and reducing postoperative morbidity.\textsuperscript{26,31,32} and this issue should be addressed by other studies of ISR for very low rectal cancer.

It is also important to decide on the indications for ISR in elderly patients. We generally excluded patients who had anal dysfunction before surgery. Old age itself affects anal function and should be considered in the decision to perform ISR. However, before surgery, most patients with rectal cancer have poor anal function because of irritation from a tumor near the anus. Thus, it is difficult to clearly identify an indication for ISR based on preoperative anal symptoms in either elderly or younger patients. In our series, the postoperative anal function of patients 70 years and older was comparable to that of patients under 70 years of age, and our results were similar to those of Dehni et al.\textsuperscript{34} These findings suggest that ISR may be acceptable in elderly patients who do not require preoperative CRT or total ISR.

The local recurrence rate of 13 percent in our patients was higher than the 8.8 percent reported by Chamlou et al.\textsuperscript{14} The difference may be due to a higher proportion of patients with stage III cancer in our study than in that of Chamlou et al. (39 percent vs. 28 percent). Moreover, 15 of our 37 patients with stage III had more than 3 lymph nodes involved and were potentially in a high risk group for recurrences.

In conclusion, preoperative CRT was found to be the factor most strongly associated with poor anal function after ISR, suggesting that patients with rectal cancer who undergo ISR after preoperative CRT are very likely to experience incontinence. This information should be given to patients when they are offered a choice of treatment. Since postoperative anal function after ISR with reconstruction by a straight anastomosis can be predicted based on our results, additional treatment to rescue poor anal function will be needed for patients who...
are expected to have poor postoperative anal function. Prospective trials of ISR with preoperative CRT for very low rectal cancer should be performed to clarify both its survival benefit and adverse effects on anal function.

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