



## Original Article

## Impact of defecation dysfunction on quality of life in mid-low rectal cancer patients following sphincter-sparing surgery

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## ABSTRACT

**Objectives:** A large proportion of mid-low rectal cancer patients develop low anterior resection syndrome (LARS) after Sphincter-sparing surgery. This study aimed to investigate the effect of low anterior resection syndrome (LARS) on quality of life (QoL) in Chinese rectal cancer patients following sphincter-sparing surgery.

**Methods:** This was a comparative cross-sectional study. Between Jan 2019 to Jun 2020, 146 mid-low rectal cancer patients following sphincter-sparing surgery were enrolled. The low anterior resection syndrome (LARS) score was used to assess bowel dysfunction. According to the LARS score, patients were divided into three levels, no LARS ( $n = 34$ ), minor LARS ( $n = 60$ ), and major LARS ( $n = 52$ ). The Functional Assessment of Cancer Therapy-Colorectal (FACT-C) was used to assess the QoL of the patients.

**Results:** The major LARS group had a significantly shorter level of tumor from the dentate line than the no LARS group. The total FACT-C score of 146 patients was  $98.45 \pm 17.83$ . The total FACT-C score and the score of each dimension (physical, emotional, functional dimensions, and colorectal cancer subscale) were significantly different between the minor LARS and major LARS groups, as well as between the no LARS and major LARS groups. Subgroups analyses of the FACT-C score stratified by each item in the LARS scales showed that except for flatus incontinence, patients with different frequencies of other symptoms (bowel frequency, liquid stool incontinence, liquid stool incontinence, stool clustering, urgent bowel movement) had a significantly different total score of FACT (all  $P < 0.01$ ).

**Conclusions:** The LARS had a significant impact on the QoL in Chinese mid-low rectal cancer patients following sphincter-sparing surgery, especially in patients with major LARS.

## Introduction

According to GLOBOCAN 2020 data, colorectal cancer is the third most common malignant tumor and the fourth leading cause of death worldwide.<sup>1</sup> In Asia, rectal cancer accounts for more than 50% of all colorectal cancers.<sup>2</sup> With the advance in neoadjuvant radiotherapy and chemotherapy, sphincter preservation is a priority for surgical management of rectal cancer patients, especially for those with a distal edge of the tumor more than 2 cm from the dentate line. The proportion of sphincter preservation surgery for rectal cancer is about 62%–85%, with a 5-year survival rate of 70%.<sup>3,4</sup>

Sphincter-sparing surgery can preserve the continuity of the intestinal tract to a large extent so that the patient can still maintain the original defecation method after the operation.<sup>5</sup> However, 80%–90% of patients experience varying degrees of postoperative complications, such as

urgent bowel movement, frequent defecation, fecal incontinence, and difficulty defecation, which are defined as low anterior resection syndrome (LARS).<sup>6</sup> Studies have shown that the symptoms of defecation dysfunction are particularly evident in the early postoperative period, and persist for a long time, which seriously affects the quality of life (QoL) of patients.<sup>7,8</sup>

The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC QLQ-C30) is commonly used to evaluate the QoL of patients with LARS.<sup>9–12</sup> The Functional Assessment of Cancer Therapy-Colorectal (FACT-C) is a questionnaire developed to assess QoL of colorectal cancer patients.<sup>13</sup> For example, FACT-C has been used to compare the QoL of rectal cancer patients receiving rectal surgery using side-to-end anastomosis (SEA), colon J-pouch (CJP), and straight colorectal anastomosis (SCA).<sup>14</sup> However, FACT-C is rarely used to assess the QoL in rectal cancer patients following

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anal sphincter-preserving surgery.<sup>15</sup> In addition, studies on QoL of Chinese rectal cancer patients following sphincter-sparing surgery are limited. Therefore, the purpose of this study was to investigate the effect of LARS on QoL in Chinese rectal cancer patients following sphincter-sparing surgery.

## Methods

### Research design and subjects

This was a single-center comparative cross-sectional study. Between Jan 2019 and Jun 2020, 325 patients who received sphincter-sparing surgery for mid-low rectal cancer and were followed up in a defecation dysfunction specialist outpatient department of a Tertiary Hospital in Guangzhou city were recruited. Inclusion criteria were: (1) age  $\geq 18$  years; (2) diagnosis of mid-low rectal cancer was based on pathological analysis of the surgical specimen and pelvic magnetic resonance imaging (MRI) showing the inferior margin of the tumor 2–8 cm from the dentate line, and anal preservation surgery was expected according to digital anus examination; (3) Surgical treatment by transanal low anterior resection (LAR) or LAR with temporary ileostomy, which had been closed, and patients can defecation through the anus for more than one month. Patients with other diseases that affect bowel function before surgery, such as Crohn's disease, irritable bowel syndrome, and ulcerative colitis, were excluded.

A total of 144 patients were excluded due to death from other diseases ( $n = 20$ , including five cases for respiratory failure caused by tumor lung metastasis; four cases for severe anastomotic fistula septic shock; seven cases for multiple metastases complicated with organ failure; two cases for car accident; one case for massive hemorrhage caused by tumor recurrence and rupture) and 124 cases due to the exclusion criteria (25 cases with low rectal cancer failed to receive anal preservation surgery after assessed by a colorectal surgeon; 37 cases for no neoadjuvant radio chemotherapy, 28 cases for abdomino-perineal resection; 34 cases for ileostomy failed to get closure after LARS surgery with ileostomy).

cases for multiple metastases complicated with organ failure; two cases for car accident; one case for massive hemorrhage caused by tumor recurrence and rupture) or the exclusion criteria ( $n = 124$ , including 25 cases with low rectal cancer failed to receive anal preservation surgery after assessed by a colorectal surgeon; 37 cases for no neoadjuvant radio chemotherapy, 28 cases for abdomino-perineal resection; 34 cases for ileostomy failed to get closure after LARS surgery with ileostomy). The 181 eligible patients entered the trial, and 162 patients returned their questionnaires (return rate = 89.5%). Of them, 16 patients without final LARS score because of missing items were excluded. Finally, 146 patients were included in the analyses. The flowchart for the enrollment is shown in Fig. 1. This study was approved by the institutional review board of Sun Yat-Sen University Cancer Center (approval number GYX2019-008). Written informed consent was obtained from all the patients.

### LARS scale

Questionnaires were distributed immediately after patients were confirmed to meet the inclusion criteria. Defecation dysfunction was assessed using the LARS score.<sup>16</sup> The LARS score is a self-administered questionnaire that was developed to assess bowel dysfunction after anterior rectal resection.<sup>16</sup> The LARS is comprised of five items assessing flatus incontinence, liquid stool incontinence, defecation frequency, clustering, and urgency. The score from each item is added to obtain a total LARS score of 0–42. Bowel dysfunction severity is graded as no LARS (score 0–20), minor LARS (score 21–29), and major LARS (score 30–42).<sup>11</sup> In this study, the Chinese version of the LARS questionnaire<sup>17</sup> was used, with a sensitivity and specificity of 0.938 and 0.767,

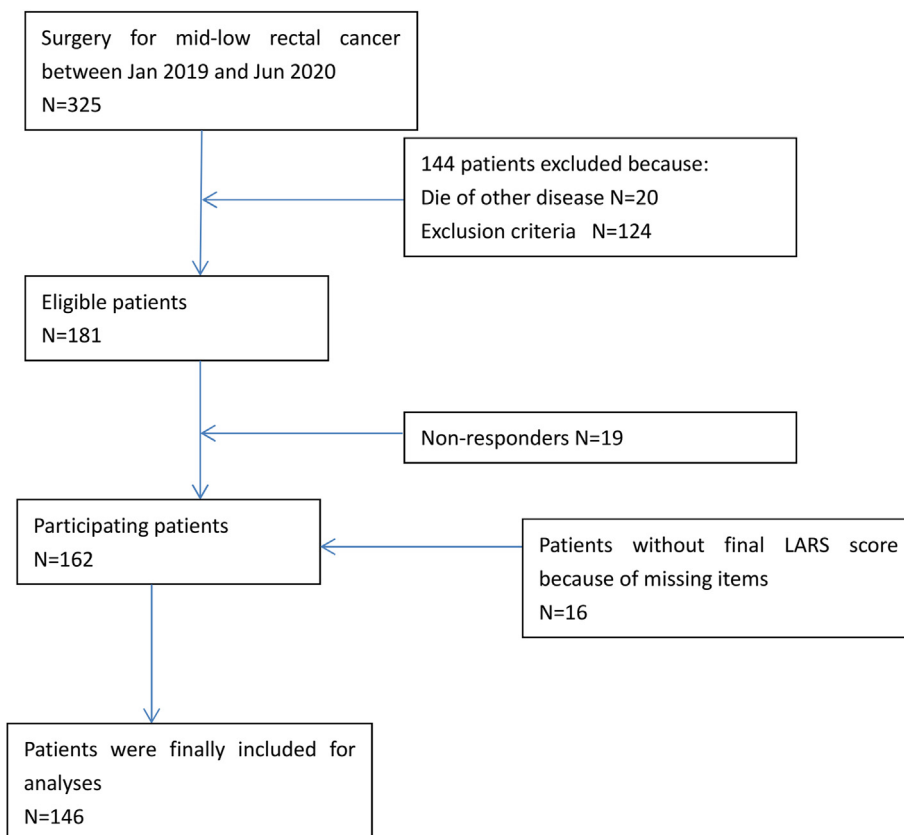


Fig. 1. Flowchart for the enrollment. The exclusion of 144 patients included 20 cases of death due to other diseases (five cases for respiratory failure caused by tumor lung metastasis; four cases for severe anastomotic fistula septic shock; seven cases for multiple metastases complicated with organ failure; two cases for car accident; one case for massive hemorrhage caused by tumor recurrence and rupture) and 124 cases due to the exclusion criteria (25 cases with low rectal cancer failed to receive anal preservation surgery after assessed by a colorectal surgeon; 37 cases for no neoadjuvant radio chemotherapy, 28 cases for abdomino-perineal resection; 34 cases for ileostomy failed to get closure after LARS surgery with ileostomy).

respectively, and retest reliability of 0.935.<sup>18</sup>

*Functional assessment of cancer therapy-colorectal (FACT-C) scale*

The patient’s QoL was assessed by the FACT-C scale (Version 4.0), which is comprised of 27 items of the general version of the Functional Assessment of Cancer Therapy (FACT-G) and a disease-specific subscale with nine colorectal cancer-specific (CCS) items.<sup>19</sup> The Chinese version of FACT-C (V4.0) consists of five dimensions (physical, emotional, social, functional dimensions, and colorectal cancer subscale), 36 items. Each item uses a five-level scoring method (score 0–4). The score from each item is added to obtain a total FACT-C score of 0–136. The higher the total FACT-C score, the better the QoL. The retest correlation coefficients of the five dimensions of the Chinese version of the FACT-C scale are all above 0.76. Except for the colorectal cancer subscale (0.56), the Cronbach’s  $\alpha$  is larger than 0.80 in the remaining four dimensions.<sup>20</sup>

*Data collection*

Patients’ demographic (age, education, marital status, occupation status, family monthly income per capita, payment method of medical expenses) and clinical characteristics (the distance between the lower edge of the mass and the anus, operation method, time from restoration of bowel continuity, postoperative complications, and radiotherapy or chemotherapy) were collected by a self-designed questionnaire.

Questionnaires are distributed to patients via on-site distribution or electronic links (online questionnaires). The questionnaires distributed on-site should be explained using unified instructions. Patients needed to fill out all questionnaires with the assistance of their family members if necessary. The online questionnaires used unified instructions, and the questionnaires must be completed before submission.

*Data analysis*

The adjusted mean score of FACT-C (total and subscale score) for the three LARS groups (no LARS, minor LARS, and major LARS) and the LARS Score questions were calculated using the ANCOVA regression model with adjustment for predefined confounders. The adjusted model consists of age (per year), gender, level of tumor from the dentate line (per cm), surgical approach (open surgery, laparoscopy), and neoadjuvant chemoradiotherapy (yes or no). LARS score for response groups on the question of the impact of LARS on QoL in the LARS questionnaire was analyzed by ANCOVA regression models, with the adjusted above-mentioned predefined confounders. Pearson correlation analysis was performed to analyze the correlation between the FACT-C score and LARS Score.

**Results**

*Demographic and clinical characteristics*

A total of 146 mid-low rectal cancer patients following sphincter-sparing surgery were enrolled, including 90 males and 56 females. The demographic and clinical characteristics of all patients were summarized in Table 1. The mean age was 57.87 ± 12.49 years (range: 22–83). The preoperative colonoscopy examination showed that the mean distance between the lower edge of the tumor and the anal edge was 5.20 ± 1.40 (range: 2–8) cm. Of them, 89.7% of the patients had received neoadjuvant chemoradiotherapy (NACRT). As for time from the restoration of bowel continuity, 45.2% of cases were longer than 12 months, 29.5% of cases were shorter than 6 months, and 25.3% were between 6 and 12 months (Table 1).

*LARS assessment*

Defecation function was assessed by LARS score. According to the LARS score, patients were divided into three levels, no LARS (score 0–20,

**Table 1**  
Demographic and clinical characteristics of the patients (N = 146).

Characteristics	n (%)
Gender, N (%)	
Female	90 (61.6)
Male	56 (38.4)
Age (years), Mean (SD)	57.87 (12.49)
<60	75 (51.4)
≥60	71 (48.6)
BMI (kg/m <sup>2</sup> )	
<20	29 (19.9)
20–30	106 (72.6)
>30	11 (7.5)
Clinical staging	
I	26 (17.8)
II	30 (20.5)
III	90 (61.6)
Type of surgery, N (%) (n = 136)	
LAR	130 (89.0)
LAR + protective ostomy	16 (11.0)
Surgical approach, N (%) (n = 136)	
Open surgery	15 (10.3)
Laparoscopy	131 (89.7)
NACRT	
Yes	131 (89.7)
No	15 (10.3)
Level of tumor from the dentate line, N (%)	
Low (0–5 cm)	50 (34.2)
Mid (6–8 cm)	96 (65.8)
Time from restoration of bowel continuity	
<6 months	43 (29.5)
6–12 months	37 (25.3)
>12 months	66 (45.2)
LARS score, N (%)	
No LARS	34 (23.3)
Minor LARS	60 (41.1)
Major LARS	52 (35.6)

NACRT, neoadjuvant chemoradiotherapy; LARS, low anterior resection syndrome.

n = 34), minor LARS (score 21–29, n = 60), and major LARS (score 30–42, n = 52) (Table 1). The scores of each item are shown in Table 2. It was found that the mean bowel movements frequency for 146 patients was 5.31 ± 4.61 times/day, of which 34.2% of patients have 4–7 times/day, and about 22.6% of patients have more than seven bowel movements per day (Table 2). Notably, 88% of patients suffered from stool clustering (27.4% and 61.6% of patients had this symptom more or less than once per week, respectively). These results suggest that mid-low rectal cancer patients following sphincter-sparing surgery in this study had frequent bowel movements.

**Table 2**  
LARS score.

LARS score items				
Frequency	Q1: Flatus incontinence			
	N0	N0	N0	
	40.4%	47.3%	12.3%	
	Q2: Liquid stool incontinence			
	N0	N0		N0
	45.2%	47.3%	7.5%	
	Q3: Bowel frequency			
	1-3 times/day	4-7 times/day	> 7 times/day	< 1 time/day
	38.4%	34.2%	22.6%	4.8%
	Q4: Stool clustering			
	N0	< 1/week	> 1/week	
	11.0%	61.6%	27.4%	
	Q5: Urgency			
	N0	< 1/week	> 1/week	
	11.0%	66.4%	22.6%	

LARS, low anterior resection syndrome.

Comparison of characteristics among the three LARS groups

Demographic and clinical characteristics were compared among the three LARS groups. There was no significant difference in gender, age, clinical staging, and laparoscopy surgery among the three groups (all  $P > 0.05$ , Table 3). However, protective ileostomy ( $P = 0.002$ ), the level of tumor from the dentate line ( $P = 0.019$ ), and the proportion of patients with NACRT ( $P = 0.007$ , Table 3) were significantly different among the three groups. Among the 16 patients with ileostomy, only one case (6.3%) had no LARS, and 13 cases (81.3%) had minor LARS. It was found that the no LARS group had the longest level of tumor from the dentate line while the severe LARS group had the shortest one. The proportion of patients with NACRT was lowest in the no LARS group (76.5%).

Comparison of the overall quality among the three LARS groups

The patient's QoL was assessed by the Functional Assessment of Cancer Therapy-Colorectal (FACT-C) scale. The total FACT-C score of 146 patients was  $98.45 \pm 17.83$ .

Regarding the question "impact of defecation dysfunction on the quality of life," 93 (63.7%) patients answered that defecation dysfunction had some or a lot of impact on their QoL, while 29 (19.9%) cases answered that defecation dysfunction had a little impact on their QoL (Table 4).

The scores of each dimension of the FACT-C scale were compared among the three LARS groups (Table 5). It was found that there were significant differences in the scores of physical, emotional, functional dimensions, and colorectal cancer subscale (all  $P = 0.001$ , Table 5), as well as the total scores ( $P < 0.001$ , Table 5) among the three LARS groups. The score of the social dimension was not significantly different among the three LARS groups ( $P = 0.534$ , Table 5).

Pairwise comparison of the FACT-C score among the three LARS groups was shown in Table 6. The results showed that the total FACT-C score and the score of each dimension were significantly different between the minor LARS and major LARS groups, as well as the no LARS and major LARS groups (all  $P < 0.05$ , Table 6).

**Table 3**  
Comparison of characteristics among the three LARS groups.

	No LARS (N = 34)	Minor LARS (N = 60)	Major LARS (N = 52)	P <sup>b</sup>
Age (years) <sup>a</sup>	61.47 (11.32)	56.50 (13.06)	57.12 (12.33)	0.155
Gender, N (%)				
Female	12 (35.3)	26 (43.3)	18 (34.6)	0.585
Male	22 (64.7)	34 (56.7)	34 (65.4)	
Clinical staging, N (%)				
Stage I	10 (20.4)	16 (26.7)	17 (32.7)	0.325
Stage II & III	24 (70.6)	44 (73.3)	35 (67.3)	
Type of surgery, N (%)				
LAR	33 (25.4)	47 (36.2)	50 (38.5)	0.002
LAR + protective ileostomy	1 (6.3)	13 (81.3)	2 (12.5)	
Surgical approach, N (%)				
Open surgery	5 (14.7)	4 (6.7)	6 (11.5)	0.436
Laparoscopy	29 (85.3)	56 (93.3)	46 (88.5)	
NACRT#, N (%)				
Yes	26 (76.5)	56 (93.3)	49 (94.2)	0.014
No	8 (23.5)	4 (6.7)	3 (5.8)	
Level of tumor from the dentate line (cm) <sup>a</sup>	9.56 (3.74)	7.86 (3.54)	7.38 (3.40)	0.019

P of Inter-Group Comparison:  
 No LARS vs Minor LARS: 0.027;  
 No LARS vs Major LARS: 0.006;  
 Minor LARS vs Major LARS: 0.481

Values are shown as percentages.  
 NACRT#, neoadjuvant chemoradiotherapy.  
 LARS, low anterior resection syndrome.

<sup>a</sup> Values are shown as mean (SD).

<sup>b</sup>  $\chi^2$  or ANOVA.

Subgroups analyses of the FACT-C score stratified by each item in the LARS scales

The FACT-C scores were compared among the subgroups from each item in the LARS scales (Table 7).

Except for flatus incontinence, patients with different frequencies of other symptoms (bowel frequency, liquid stool incontinence, liquid stool incontinence, stool clustering, urgent bowel movement) had significant different total FACT-C scores (all  $P < 0.01$ , Table 7), suggesting that these symptoms had an impact on the QoL.

Pearson correlation analysis between FACT-C score and LARS score

Pearson correlation analysis showed that the total LARS score and the score of each dimension were all negatively correlated with the total score of FACT-C (Table 8,  $P < 0.05$ ). These results suggested that the defecation problems significantly impacted the overall QoL in patients receiving sphincter-sparing surgery. The more severe the defecation dysfunction patients have, the worse their QoL would be.

Discussion

Following sphincter-sparing surgery, rectal cancer disease itself and surgery-induced physiological and pathological changes inevitably alter the physical/physiological function. In patients with mid-to-low rectal cancer, the part of the rectum close to the dentate line is often needed to be excised in sphincter-sparing surgery,<sup>21</sup> and many defecation receptors are concentrated in this rectal region. Surgery causes damage to defecation receptors, loss of rectal storage function, reduction of rectal volume, and abnormal sensation, leading to frequent and urgent defecation.<sup>22</sup> Supporting this notion, our results showed that the severe-LARS group had a significantly shorter level of tumor from the dentate line than the no LARS group. In this study, 76.7% (112/146) of patients had minor (40.1%) or major LARS (35.6%), suggesting that rectal cancer patients following sphincter-sparing surgery generally have post-operative defecation dysfunction, and a certain number of patients have

**Table 4**

Pairwise comparison of the question about the impact of defecation dysfunction on the quality of life.

Response to question	Comparison of LARS scores			Groups	Score difference	Pn <sup>a</sup>
	No. of patients	LARS score				
Not at all	24	10.00 (6.52, 13.48)		1 vs 2	-12.28 (- 15.36, - 9.21)	< 0.001
A little	29	22.28 (20.22, 24.33)		1 vs 3	-20.59 (- 23.11, - 8.01)	< 0.001
Some & a lot	93	30.60 (29.56, 31.56)		2 vs 3	-8.28 (- 10.65, - 5.91)	< 0.001

Values are shown as mean (SD). LARS, low anterior resection syndrome.

<sup>a</sup> ACNOVA regression model, adjusted for age, gender, level of tumor from the dentate line, surgical approach, and neoadjuvant chemoradiotherapy.

**Table 5**

FACT-C score among the three LARS groups.

	No LARS	Minor LARS	Major LARS	P
Total score	105.21 (17.72)	101.83 (14.89)	90.13 (18.15)	< 0.001
Physical	24.74 (4.60)	23.77 (2.85)	21.65 (4.23)	0.001
Emotional	19.41 (3.65)	18.25 (4.30)	15.92 (4.74)	0.001
Social	22.18 (6.65)	21.63 (6.00)	20.73 (5.83)	0.534
Functional	19.06 (5.49)	18.27 (5.13)	15.02 (4.74)	0.001
Colorectal cancer subscale	19.82 (5.28)	19.92 (3.86)	17.10 (4.23)	0.001

Values are expressed as mean (SD) LARS, low anterior resection syndrome; FACT-C: Functional Assessment of Cancer Therapy-Colorectal.

severe defecation dysfunction. In line with this observation, previous studies have reported that more than 80% of patients with rectal cancer experience defecation dysfunction after sphincter-sparing surgery, and about 20%–50% of patients develop severe defecation dysfunction.<sup>23–26</sup>

It is known that the use of ileostomy is a risk factor for LARS.<sup>27</sup> Consistent with this finding, our result showed among the 16 patients undergoing ileostomy, 93.8% of cases had LARS (including 81.3% of minor LARS and 12.5% of major LARS). The mean number of defecations of the patients in this study exceeded 5 times/days. Approximately 15.1% of patients had more than 10 times of defecation per day. Nearly 30% of our patients had severe stool clustering and urgent bowel movement,

**Table 6**

Pairwise comparison of FACT-C score among the three LARS groups.

	No LARS-Minor LARS		Minor LARS-Major LARS		No LARS-Major LARS	
	Score difference	P <sup>b</sup>	Score difference	P <sup>b</sup>	Score difference	P <sup>b</sup>
Total score	3.37 (-3.75, 10.49)	0.351	11.70 (5.42, 17.98)	0.001 <sup>a</sup>	15.07 (7.76, 22.38)	0.000 <sup>a</sup>
Physical	0.97 (-6.5, 2.6)	0.541	2.11 (0.68, 3.54)	0.003 <sup>a</sup>	3.08 (1.41, 4.74)	0.000 <sup>a</sup>
Emotional	1.16 (-0.77, 3.00)	0.364	2.33 (0.71, 3.95)	0.002 <sup>a</sup>	3.49 (1.60, 5.38)	0.005 <sup>a</sup>
Social	0.54 (-2.04, 3.13)	0.342	0.90 (-1.38, 3.19)	0.023 <sup>a</sup>	1.45 (-1.21, 4.10)	0.017 <sup>a</sup>
Functional	0.79 (-1.57, 3.15)	0.841	3.25 (1.17, 5.34)	0.005 <sup>a</sup>	4.04 (1.62, 6.46)	0.001 <sup>a</sup>
Colorectal cancer subscale	-0.09 (-1.95, 1.76)	0.693	2.82 (1.19, 4.46)	0.005 <sup>a</sup>	2.73 (0.83, 4.63)	0.000 <sup>a</sup>

Score differences are shown as mean (SD).

<sup>a</sup> Difference was statistically significant ( $P < 0.05$ ).

<sup>b</sup> ACNOVA regression model, adjusted for age, gender, level of tumor from the dentate line, surgical approach, and neoadjuvant chemoradiotherapy.

LARS, low anterior resection syndrome; FACT-C: Functional Assessment of Cancer Therapy-Colorectal.

further suggesting that mid-low rectal cancer patients following sphincter-sparing surgery generally have bowel dysfunction, such as frequent defecation, stool clustering, and urgent bowel movement, which is consistent with previous studies.<sup>28,29</sup>

It has been shown that QoL is an independent factor associated with the prognosis of colorectal cancer patients.<sup>30</sup> In this study, the mean total FACT-C score of 146 patients was  $98.45 \pm 17.83$ . Among them, the physiological dimension had the highest score, which may be attributed to the fact that 65.7% (96/146) of the patients had received surgery for more than 6 months. Surgery and adjuvant treatments (such as radiotherapy and chemotherapy) have been completed, and physiological functions are gradually recovering. The score of the social dimension was also high, indicating that the patients had better relationships with friends and family members, and they could obtain great support from relatives and friends.

To further investigate the impact of LARS on patients' QoL, the correlation between LARS score and FACT-C score was analyzed. Our results showed that the total FACT-C score and the score of each dimension (physical, emotional, functional dimensions, and colorectal cancer subscale) were significantly different between the minor LARS and major LARS groups, as well as between the no LARS and major LARS groups. Despite small differences in scores of several dimensions (such as physical and colorectal cancer subscale) of FACT-C among the three LARS groups, it reached statistical significance in all dimensions (except for the social dimension) and total scores. These results indicated that the QoL was affected by the severity of LARS in rectal cancer patients following sphincter-sparing surgery. Subgroups analyses of the FACT-C score stratified by each item of the LARS scales showed that except for flatus incontinence, patients with different frequencies of other symptoms (bowel frequency, liquid stool incontinence, liquid stool incontinence, stool clustering, urgent bowel movement) had significant different total FACT-C score (all  $P < 0.01$ ). These results suggested that defecation dysfunction had a significant impact on QoL of rectal cancer patients following sphincter-sparing surgery, which is consistent with previous reports.<sup>31,32</sup>

Our Pearson correlation analysis showed that compared with incontinence (gas incontinence and loose stool incontinence), frequent defecation, an urgency to defecate, and stool clustering were more correlated to the total score of the FACT-C scale ( $r = -0.407 \sim -0.287$ ,  $P < 0.001$ ). These findings suggested that in addition to the increase in



**Table 7**  
Pairwise comparison of FACT-C score among the subgroups of LARS score questions.

Questions	N (%)	Total score	P <sup>a</sup>	Physical	P	Emotional	P	Social	P	Function	P	CCS	P
<b>Stool frequency</b>													
1–3times/day	56 (38.3)	105.47 (101.54, 109.40)	0.000 <sup>b</sup> (F = 6.794)	24.45 (23.48, 25.42)	0.005 <sup>b</sup> (F = 3.835)	18.43 (17.41, 19.44)	0.129 (F = 1.816)	22.56 (21.23, 23.89)	0.165 (F = 1.652)	1.978 (18.52, 21.04)	0.000 <sup>b</sup> (F = 7.68)	20.30 (19.27, 21.32)	0.002 <sup>b</sup> (F = 4.64)
4–7times/day	50 (34.2)	93.98 (89.71, 98.25)		22.00 (20.95, 23.07)		17.05 (15.95, 18.16)		20.60 (19.15, 22.04)		16.28 (14.91, 17.65)		18.41 (17.30, 19.52)	
> 7times/day	33 (22.6)	93.76 (88.73, 98.78)		22.56 (21.32, 23.81)		17.53 (16.23, 18.83)		21.73 (20.03, 24.43)		14.90 (13.29, 16.52)		17.32 (16.00, 18.63)	
< 1time/day	7 (4.8)	115.42 (101.64, 129.20)		25.55 (21.15, 28.96)		21.24 (17.68, 24.80)		25.09 (20.43, 29.75)		20.95 (16.53, 25.37)		22.58 (18.99, 26.17)	
<b>Flatus incontinence</b>													
No	59 (40.4)	101.86 (98.14, 105.59)	0.327 (F = 2.973)	23.94 (22.97, 24.90)	0.197 (F = 1.581)	18.41 (17.15, 19.14)	0.774 (F = 0.372)	22.19 (20.89, 23.49)	0.773 (F = 0.372)	18.23 (16.93, 19.54)	0.200 (F = 1.567)	19.50 (18.46, 22.54)	0.09 (F = 0.690)
< 1/week	68 (46.6)	97.22 (92.80, 101.64)		22.65 (21.71, 23.59)		17.45 (16.48, 18.42)		21.52 (20.25, 22.78)		17.28 (15.93, 18.47)		18.80 (17.79, 19.81)	
> 1/week	19 (13.0)	96.35 (87.23, 105.48)		22.48 (20.62, 24.34)		18.05 (16.13, 19.96)		21.39 (18.89, 23.90)		15.48 (12.96, 18.20)		18.03 (16.02, 20.03)	
<b>Liquid stool incontinence</b>													
No	66 (45.2)	103.47 (99.61, 107.22)	0.002 <sup>b</sup> (F = 5.040)	24.13 (23.24, 25.02)	0.003 <sup>b</sup> (F = 4.760)	18.81 (17.89, 19.73)	0.002 <sup>b</sup> (F = 5.194)	27.11 (21.46, 23.96)	0.152 (F = 1.791)	18.17 (16.88, 19.45)	0.312 (F = 1.201)	19.89 (18.91, 20.87)	0.013 <sup>b</sup> (F = 3.719)
< 1/week	42 (28.8)	99.61 (95.01, 104.22)		23.57 (22.50, 24.65)		18.06 (16.94, 19.17)		21.39 (19.86, 22.90)		17.60 (16.04, 19.16)		19.24 (18.05, 20.42)	
> 1/week	38 (26.0)	90.66 (85.30, 96.02)		21.30 (20.04, 22.55)		15.67 (14.37, 16.98)		20.41 (18.65, 22.16)		16.23 (14.42, 18.04)		17.08 (15.70, 18.46)	
<b>Stool clustering</b>													
No	16 (13.0)	103.81 (91.52, 116.10)	0.006 <sup>b</sup> (F = 4.359)	23.99 (22.12, 25.85)	0.001 <sup>b</sup> (F = 6.101)	19.40 (17.45, 21.35)	0.023 <sup>b</sup> (F = 3.267)	23.41 (20.80, 26.02)	0.406 (F = 0.975)	18.80 (16.15, 21.44)	0.115 (F = 2.008)	20.70 (18.64, 22.76)	0.063 (F = 2.496)
< 1/week	90 (61.6)	101.98 (99.07, 104.88)		23.99 (23.23, 24.76)		18.25 (17.45, 19.01)		21.90 (20.83, 22.91)		17.99 (16.90, 19.07)		19.32 (18.48, 20.17)	
> 1/week	40 (27.4)	91.15 (85.54, 97.76)		21.15 (19.99, 22.30)		16.35 (15.14, 17.55)		21.02 (19.39, 22.62)		15.93 (14.20, 17.58)		17.70 (16.43, 18.98)	
<b>Urgency</b>													
No	16 (13.0)	107.88 (95.81, 119.94)	0.002 <sup>b</sup> (F = 5.259)	24.38 (22.67, 26.09)	0.002 <sup>b</sup> (F = 5.300)	19.92 (18.13, 21.71)	0.033 (F = 3.621)	23.56 (21.20, 25.92)	0.222 (F = 1.482)	19.29 (16.90, 21.69)	0.062 (F = 2.496)	21.06 (19.22, 22.90)	0.006 <sup>b</sup> (F = 4.379)
< 1/week	97 (66.4)	100.50 (97.64, 103.35)		23.78 (23.02, 24.52)		17.86 (17.07, 18.65)		21.91 (20.87, 22.95)		17.84 (16.78, 18.90)		19.32 (18.51, 20.13)	
> 1/week	33 (22.6)	91.24 (84.88, 97.61)		20.96 (19.65, 22.27)		16.75 (15.38, 18.12)		20.58 (18.77, 2.39)		15.56 (13.74, 17.41)		17.04 (15.63, 18.45)	

Score differences are shown as mean (SD).

<sup>a</sup> ACNOVA regression model, adjusted for age, gender, level of tumor from the dentate line, surgical approach, and neoadjuvant chemoradiotherapy.

<sup>b</sup> Difference was statistically significant ( $P < 0.05$ ).

LARS, low anterior resection syndrome; FACT-C: Functional Assessment of Cancer Therapy-Colorectal.

**Table 8**Pearson correlation analysis between FACT-C score and LARS score ( $n = 146$ ).

	FACT-C score	Physical	Emotional	Social	Functional	Colorectal cancer subscale
LARS score	-0.332 <sup>b</sup>	-0.374 <sup>b</sup>	-0.280 <sup>b</sup>	-0.166 <sup>a</sup>	-0.277 <sup>b</sup>	-0.287 <sup>b</sup>
Frequency	-0.407 <sup>b</sup>	-0.332 <sup>b</sup>	-0.232 <sup>b</sup>	-0.223 <sup>b</sup>	-0.432 <sup>b</sup>	-0.354 <sup>b</sup>
Flatus incontinence	-0.130 <sup>a</sup>	-0.198 <sup>a</sup>	-0.105	-0.078	-0.145	-0.127
Liquid stool incontinence	-0.214 <sup>a</sup>	-0.239 <sup>b</sup>	-0.219 <sup>b</sup>	-0.185 <sup>a</sup>	-0.098	-0.158
Clustering	-0.298 <sup>b</sup>	-0.342 <sup>b</sup>	-0.271 <sup>b</sup>	-0.100	-0.223 <sup>b</sup>	-0.200 <sup>a</sup>
Urgency	-0.287 <sup>b</sup>	-0.322 <sup>b</sup>	-0.229 <sup>b</sup>	-0.150	-0.2021 <sup>a</sup>	-0.255 <sup>b</sup>

<sup>a</sup>  $P < 0.05$ .<sup>b</sup>  $P < 0.01$ .

the frequency of defecation, more attention should be paid to the defecation sensation in rectal cancer patients receiving sphincter preservation. Previous studies also found that defecation dysfunction has a more serious impact on the QoL as compared with defecation incontinence.<sup>4,33</sup> The patient needs to go to the toilet immediately due to an urgent bowel movement, which leads to the suspension of ongoing work or activities. Nearly 70% of the patients in this study were in an off-job state and had postoperative defecation dysfunction. Even at home, it is difficult for patients to do daily household chores due to defecation problems.

There are still some limitations to this study. First, this was a single-center study with a relatively small sample size. In addition, the sample was further reduced by exclusions (146 cases), so the results may not be generalizable. The LARS score and FACT-C questionnaires were used in a cross-sectional assessment, so they may not represent persisting outcomes for patients. This study was a cross-sectional questionnaire survey, and no follow-up was conducted. Moreover, the level of anastomosis was not collected in this study. In the future, a well-designed prospective trial should be conducted to validate the findings of this study.

## Conclusions

In summary, this study showed that mid-low rectal cancer patients following sphincter-sparing surgery had varying degrees of defecation dysfunction, significantly affecting the QoL.

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## Authors' contributions

We declare that all the listed authors have participated actively in the study, and all meet the requirements of the authorship. Drs. Xia Yang and Mei-Chun Zheng designed the study and wrote the protocol, Drs. Bao-Jia Luo, Cong Li, Ying Zhu, and Xue Qiu acquired the data, Drs. Bao-Jia Luo, Cong Li, Li-Ren Li, and Zhi-Zhong Pan analyzed the data, Drs. Bao-Jia Luo and Cong Li wrote the first draft of the manuscript and mainly revised the manuscript. All authors approved the final version of the manuscript.

## Declaration of competing interest

None declared.

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