doi: 10.36922/sti.0273

Retrospective Study Comparing Prognosis and Anorectal Function Outcomes Between Laparoscopic and Transanal Total Mesorectal Excision in Middle- and Low-rectal Cancer

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ABSTRACT

Introduction: Colorectal cancer (CRC), particularly rectal cancer, remains a significant global health issue, with low- and middle-rectal cancers making up a large proportion of cases. Surgical resection through total mesorectal excision (TME) is the standard treatment for rectal cancer, with various approaches including laparoscopic (LaTME) and transanal (TaTME) techniques. LaTME has long been considered a reliable method for middle- and low-rectal cancer, offering favorable oncological outcomes with minimal invasiveness. However, challenges remain in obtaining clear distal resection margins and ensuring anal preservation, especially for tumors located near the anus. This study aimed to compare prognostic outcomes and anorectal function between laparoscopic total mesorectal excision (LaTME) and transanal total mesorectal excision (TaTME) in patients with middle- and low-rectal cancer.

Methods: A retrospective analysis was conducted on data from rectal cancer patients in our medical group between January 2018 and December 2022. Differences in prognosis and anorectal function between LaTME and TaTME were evaluated. The primary endpoint was the 2-year overall survival (OS) rate, while secondary endpoints included the 2-year disease-free survival (DFS) rate, 2-year local recurrence rate, and low anterior resection syndrome (LARS) score.

doi: 10.36922/sti.0273

Results: A total of 156 patients were included in the final analysis, with 91 undergoing LaTME and 65 undergoing TaTME. The 2-year OS rates were 86.8% in the LaTME group and 86.2% in the TaTME group. The DFS rates were 75.8% and 73.8%, respectively; the 2-year local recurrence rates were 1.1% and 1.58%; and the 2-year cancer-specific mortality rates were 8.8% and 10.8%, respectively. There were no statistically significant differences between the two surgical approaches. The mean LARS score was 17.13 ± 8.70 in the LaTME group and 18.98 ± 9.05 in the TaTME group, with no statistically significant difference (t (134.72) = –1.28, p = 0.20; 95% confidence interval: –4.71–1.01).

Conclusion: There were no statistically significant differences between TaTME and LaTME in terms of 2-year OS, 2-year DFS, or local recurrence rate. Although the TaTME group had a slightly higher LARS score, the difference was not statistically significant.

***Keywords*:** Laparoscopic total mesorectal excision, Low anterior resection syndrome, Rectal cancer, Transanal total mesorectal excision

INTRODUCTION

Colorectal cancer remains a global health issue and is the third most common malignancy worldwide, with approximately 740,000 patients diagnosed with rectal cancer annually.[1] Low rectal cancer accounts for over 65% of all malignant rectal tumors.[2] The primary treatment for middle- and low-rectal tumors is total mesorectal excision (TME), which can be performed using various approaches, including open, laparoscopic, robotic, and transanal methods.[3] In recent years, laparoscopic TME (LaTME) has become a widely adopted surgical method for low-rectal cancer.[4] Evidence-based studies have validated its safety, practicality, and effectiveness in achieving complete tumor removal.[1,5]

However, for middle- to low-rectal cancer, obtaining a clear intraoperative distal resection margin and achieving anal preservation through the traditional transabdominal approach remains challenging.[6] Transanal TME (TaTME) was developed to improve patient outcomes and dissection quality, particularly in anatomically challenging cases.[7,8] TaTME has shown comparable short-term and long-term outcomes to LaTME in patients with colorectal cancer.[6,9] Although previous studies have confirmed the feasibility of TaTME in terms of prognosis, the proximity of the anastomotic site to the dentate line raises concerns about long-term anal function after surgery.[10] In this study, we analyzed the low anterior resection syndrome (LARS) score and other prognostic indicators in a single dedicated rectal surgery team to evaluate the impact of these two surgical methods on clinical prognosis and anorectal function in patients with middle- to low-rectal cancer.[11] Therefore, recurrence and LARS should be carefully considered when choosing the surgical technique for treatment. The use of TaTME for low anal sphincter preservation is increasing, but differences in recurrence rates and LARS compared to LaTME remain the focus of this study.[12]

PATIENTS AND METHODS

Data were collected from the First Affiliated Hospital of the Medical College of Xi'an Jiaotong University, including patients who underwent surgery from 2018 to 2022. The dataset included demographic information, tumor characteristics, treatment details, and follow-up outcomes. LARS scores were recorded to assess postoperative functional outcomes. Data were collected from an independent rectal cancer surgical group in the Department of Oncology at the First Affiliated Hospital of Xi'an Jiaotong University School of Medicine to minimize the influence of surgical quality on the results. Patients who underwent surgery between January 1, 2018, and December 31, 2022, were included and followed up until December 2024 to ensure a minimum follow-up period of 2 years. The inclusion criteria were as follows: patients who underwent TME surgery with anal preservation; preoperative magnetic resonance imaging (MRI) showing a tumor with its lower edge located ≤10 cm from the dentate line; and a pathological diagnosis of adenocarcinoma. The LARS scoring system was used to evaluate patients' anorectal function during follow-up, consisting of five components.[13]

Statistical analyses were performed using IBM SPSS Statistics version 27 (IBM Corp, USA) and (Posit Software, PBC, USA). Continuous variables were expressed as mean ± standard deviation or median and inter-quartile range, as appropriate, whereas categorical variables were expressed as counts and percentages. Welch's two-sample t-test, Chi-square test, and two-tailed Fisher's exact test were used for group comparisons. Descriptive statistics, independent sample tests, and Kaplan–Meier were performed to calculate means, median survival, and survival curves. A p-value < 0.05 was considered statistically significant. The specific causes of death of patients were also recorded.

doi: 10.36922/sti.0273

RESULTS

Baseline characteristics

A total of 180 patients with low- and middle-colorectal cancer were enrolled. Of these, 156 patients were successfully followed up by telephone, while 24 patients were lost to follow-up. As of December 31, 2024, 21 deaths had occurred among 156 patients, including 6 deaths due to non-tumor causes. Specific details regarding metastasis, recurrence, and causes of death are shown in **Figure 1**.

Among the 156 patients included in the final analysis, 91 (58.3%) underwent LaTME surgery and 65 (41.7%) underwent TaTME surgery. The age, sex, average follow-up duration, and postoperative pathological tumor-node-metastasis stage of the two groups are presented in **Table 1**. Statistical analyses, such as Welch's two-sample *t*-test, Chi-square test, and two-tailed Fisher's exact test, revealed no statistically significant differences in baseline characteristics between the two groups, except for the distance from the lower edge of the tumor to the dentate line measured by MRI, which was shorter in the TaTME group.

Follow-up results and prognostic factors

All patients were followed up by telephone, with a minimum follow-up period of 24 months and an average follow-up time of 46.0 months. Among the 156 patients followed, 117 survived without recurrence. The 2-year overall survival (OS) rates were 86.8% (79/91) in the LaTME group and 86.2% (56/65) in the TaTME group ($p = 0.91$). The 2-year disease-free survival (DFS) rates were 75.8% (69/91) and 73.8% (48/65), respectively ($p = 0.82$). The 2-year local recurrence rates were 1.1% (1/91) and 1.58% (1/65), respectively ($p = 0.99$), indicating no statistically significant difference in DFS between the two surgical groups. Among deceased patients, four and two cases were due to coronavirus disease 2019 and cardiovascular/cerebrovascular disease, respectively, resulting in cancer-specific mortality rates of 8.8% (8/91) in the LaTME group and 10.8% (7/65) in the TaTME group.

There were 18 cases of recurrence and metastasis: 2 lung metastases, 9 liver metastases, 2 abdominal metastases, 2 local recurrences, 1 bone metastasis, 1 lymph node metastasis, and 1 cervical lymph node metastasis. All patients underwent reoperation and/or chemotherapy and remained alive at the 2-year follow-up. Among them, two patients with local recurrence but no distant metastasis achieved clinical cure after reoperation (without anal preservation).

The causes of the 21 deaths are listed in **Table 2**. Kaplan–Meier survival curves for OS and DFS between the LaTME and TaTME groups are shown in **Figures 2** and **3**. No statistically significant differences were observed between the two groups for either OS or DFS.

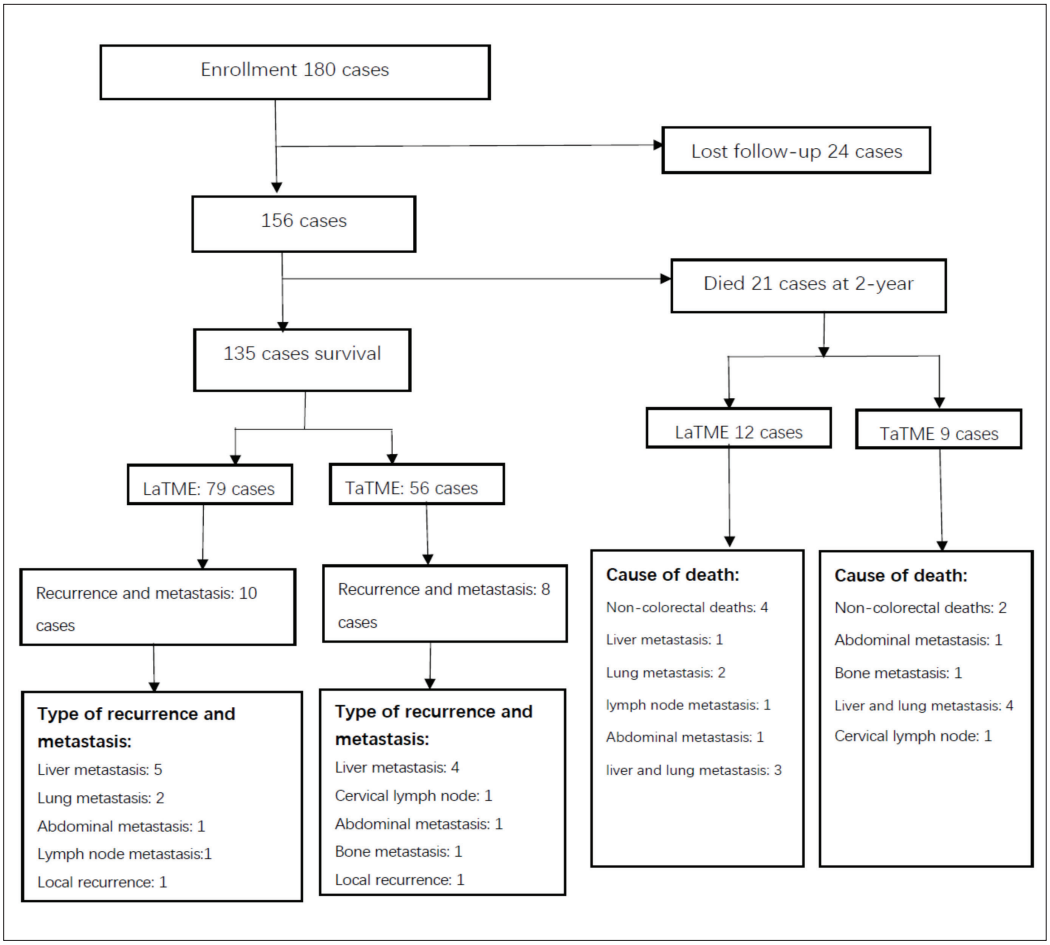

Figure 1. Flow chart (Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram).

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Table 1. Clinical characteristics of patients in two groups			
Characteristic	**LaTME**	**TaTME**	***p*-value**
N	**91**	**65**	
Gender Male Female	 50 (54.9%) 41 (45.1%)	 39 (60%) 26 (40%)	0.12
Age	61.24 ± 12.10	59.95 ± 10.42	0.48
Follow-up duration (months)	44.22 ± 16.35	47.54 ± 14.12	0.18
TNM			
ypT0N0M0 II III IV	2 15 37 37 0	3 23 18 20 1	0.66 0.01 0.13 0.27 0.42
Distance from the tumor's lower edge	6.54±1.99	4.45±1.48	<0.05
Abbreviation: TNM: Tumor-node-metastasis.			

Table 2. Survival and causes of death				
Outcome/Variable	**N**	**LaTME**	**TaTME**	***p*-value**
Total patients	156	91	65	
2-year OS	135 (86.5%)	79 (86.8%)	56 (86.2%)	0.91
2-year DFS	117 (75.0%)	69 (75.8%)	48 (73.8%)	0.82
2-year local recurrence	2	1.1% (1/91)	1.58% (1/65)	>0.99
No recurrence and metastasis	135 (86.5%) 117	79 (58.5%) 69	56 (41.5%) 48	0.05
Recurrence or metastasis	18	10	8	0.79
Local recurrence	2	1	1	a
Liver metastasis	9	5	4	a
Abdominal metastasis	2	1	1	a
Lung metastasis	2	2	0	0.51
Lymph node metastasis	1	1	0	a
Bone metastasis	1	1	0	a
Cervical lymph node metastasis	1	1	0	a
Cause of death	21	12	9	0.84
Non-colorectal cancer death	6	4	2	a
Liver metastasis	1	1	0	a
Lung metastasis	2	2	0	0.49
Abdominal metastasis	2	1	1	a
Bone metastasis	1	0	1	0.40
Cervical lymph node metastasis	1	0	1	0.40
Lymph node metastasis	1	1	0	a
Lung and liver metastasis	7	3	4	0.62
Cancer-specific mortality rates	15(9.6%)	8(8.8%)	7(10.8%)	0.89
Note: ap-value ≥ 1, no statistically significant difference between laparoscopic total mesorectal excision (LaTME) and transanal total mesorectal excision (TaTME) for the outcomes.				

doi: 10.36922/sti.0273

Postoperative anorectal function assessed using the low anterior resection syndrome score

All patients had exceeded 2 years post-operation at the time of follow-up, with some surpassing 4 years. The LARS scores were comparable between the two groups, with slightly higher scores observed in the TaTME group. The overall mean score was 17.90 ± 8.85. During follow-up, 5 (5.5%) patients in the LaTME group and 8 (12.3%) patients in the TaTME group achieved a LARS score of 30, the maximum value, with no statistically significant difference between the two groups. Anorectal function was evaluated using the LARS score based on the standardized questionnaire developed by Emmertsen and Laurberg,[13] as shown in **Figure 4**.

DISCUSSION

With advancements in surgical technology, including single-port laparoscopic techniques and constant pressure pneumoperitoneum equipment, as well as the increasing emphasis on anal function preservation, TaTME has become increasingly popular, and numerous medical institutions have adopted it. Most previous studies have focused on the oncological outcomes of TaTME, such as 3-year OS, DFS, and local recurrence rates, which showed no significant differences compared with LaTME.[14,15] However, few studies have investigated differences in postoperative defecatory function between these two surgical approaches, and the number of cases analyzed remains relatively small.[16] Given that TaTME is often performed in rectal cancer patients requiring anal preservation for tumors located close to the anus, the anastomotic site is correspondingly closer to the anus, resulting in frequent clinical observations of poor bowel function after TaTME. Nevertheless, some studies have suggested that long-term postoperative bowel function may improve over time.[17,18] In this study, we followed up patients who underwent LaTME and TaTME for more than 2 years postoperatively, comparing the 2-year OS, DFS, local recurrence rates, and anorectal function between the two groups to clarify potential differences in long-term postoperative anorectal function between LaTME and TaTME.

We clinically observed that postoperative anal defecatory function is closely related to postoperative anastomotic leakage and secondary anastomotic stricture. In addition to patient-specific factors (such as age, gender, diabetes, and preoperative treatment),[19] anastomotic leakage is also associated with surgical techniques (such as intestinal wall blood supply and anastomotic tension). Therefore, we focused on a medical team specialized in rectal cancer surgery and proficient in TaTME.[20] Existing literature indicates that anorectal function is impaired in the short-term following rectal surgery.[21,22] In our survey, although there were no explicit records, patients in both groups expressed dissatisfaction with daily bowel movement frequency and urgency within 6 months to over a year after surgery. However, as time progressed, along with patients' increased awareness of the relationship between bowel movements and dietary habits, supported by pelvic floor exercises and occasional home enema use,[23,24] most cases of severe anorectal dysfunction were alleviated after 2 years, without significantly impacting patients' quality of life. These findings are consistent with results from a previous meta-analysis.[22,25] Our analysis indicated that the 2-year LARS score for the LaTME was 17.13 ± 8.70, while that for the TaTME group was 18.98 ± 9.05 (p = 0.20; relative risk = 2.24; 95% confidence interval [CI]: 0.77–6.53). Categorical analysis of different degrees of LARS scores (**Table 3**) showed that patients with severe anal dysfunction (LARS score > 30) accounted for 5.5% in the LaTME group and 12.3% in the TaTME group. Although the difference was not statistically significant, the proportion of severe dysfunction was still higher in the TaTME group. Further analysis revealed that in patients with LARS scores >30, the distance from the lower edge of the tumor to the dentate measured by MRI was ≤8 cm, with an average of 4.72 ± 1.56 cm. This suggests that, in cases requiring ultra-low anal preservation,

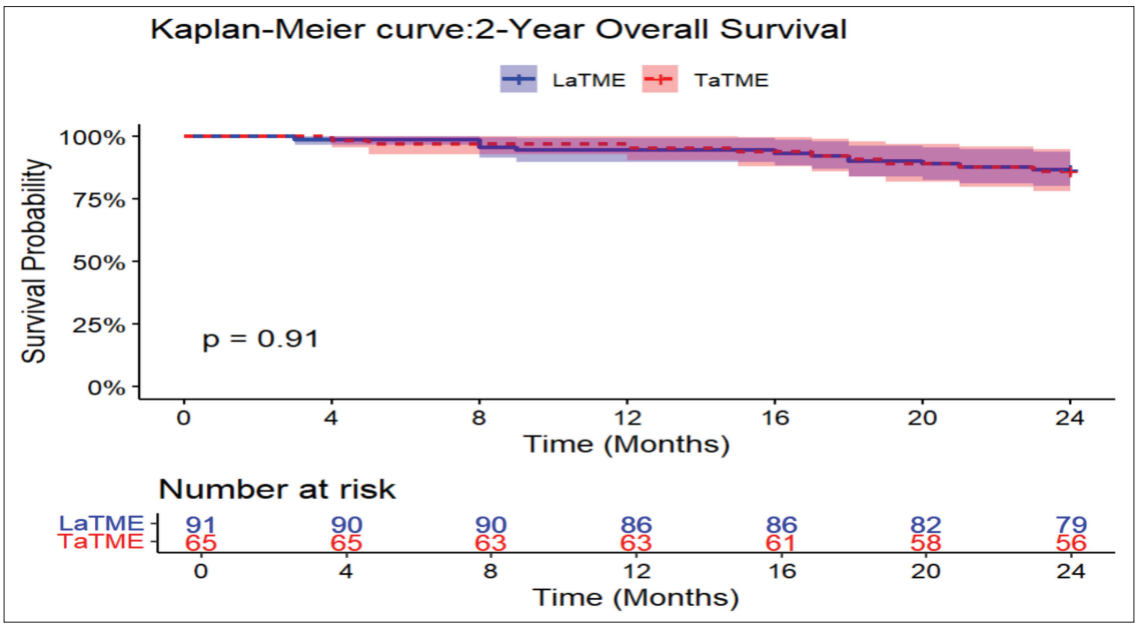

Figure 2. Overall survival plot.

doi: 10.36922/sti.0273

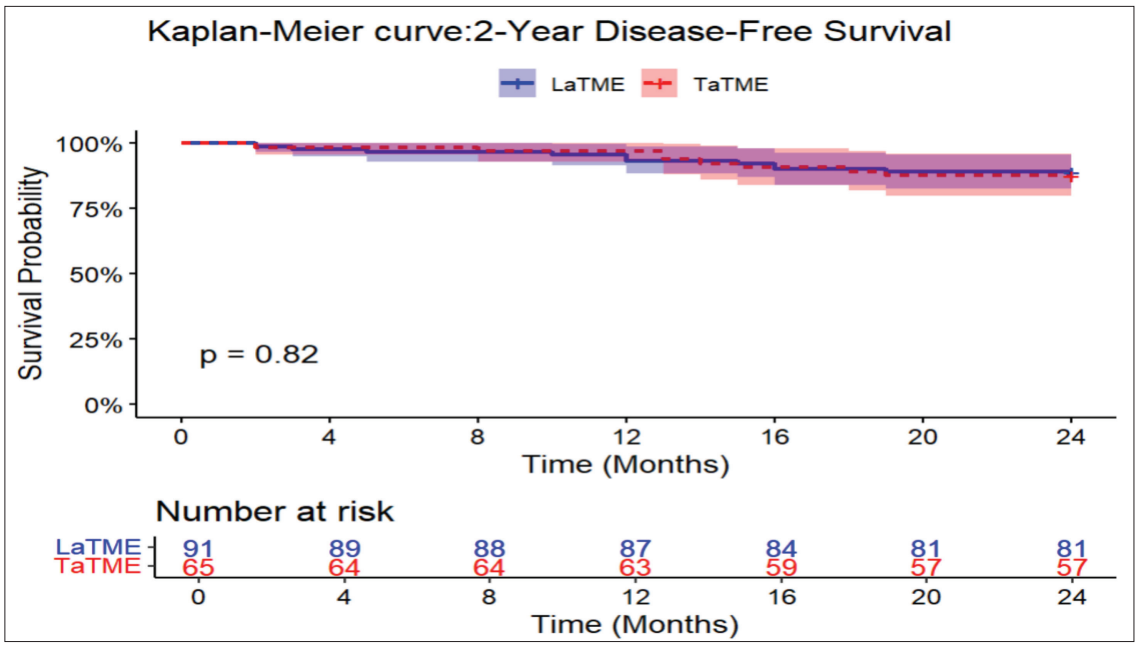

Figure 3. Disease-free survival plot.

Instructions: Read each question and all the answer options carefully before choosing. Please select the **ONE** answer option under each question that best describes your experience after surgery.

1. Do you ever have occasions when you cannot control your flatus (wind)?

☐ No, never
☐ Yes, less than once per week
☐ Yes, at least once per week

2. Do you ever have any accidental leakage of liquid stool?

☐ No, never
☐ Yes, less than once per week
☐ Yes, at least once per week

3. How often do you open your bowels?

☐ More than 7 times per day (24 hours)
☐ 4–7 times per day (24 hours)
☐ 1–3 times per day (24 hours)
☐ Less than once per day (24 hours)

4. Do you ever have to open your bowels again within one hour of the last bowel opening?

☐ No, never
☐ Yes, less than once per week
☐ Yes, at least once per week

5. Do you ever have such a strong urge to open your bowels that you have to rush to the toilet?

☐ No, never
☐ Yes, less than once per week
☐ Yes, at least once per week

Figure 4. Low anterior resection syndrome score questionnaire.

doi: 10.36922/sti.0273

Table 3. Postoperative low anterior resection syndrome (LARS) score			
LARS score	**LaTME**	**TaTME**	***p***
No LARS	54	34	0.42
Minor LARS	32	23	>0.99
Major LARS	5	8	0.15
Average LARS	17.13 ± 8.70	18.98 ± 9.05	0.20
Note: 0–20: no LARS; 21–29: minor LARS; 30–42: major LARS.			

patients should be informed of the higher likelihood of postoperative anal dysfunction. If the function remains poor for a prolonged period, reoperation for a permanent stoma may be necessary. Overall, although the TaTME group exhibited a slight decline in anal function, the difference was not statistically significant. Considering that the average tumor location in the TaTME patients was lower (4.4 cm from the dentate line; **Table 1**), patients found postoperative defecatory function acceptable compared with the alternative of a permanent stoma.

Regarding oncological outcomes, the 2-year OS rates were 86.8% (79/91) in the LaTME group and 86.2% (56/65) in the TaTME group. During the study period, the COVID-19 pandemic occurred, and some elderly patients died from secondary pulmonary failure. The 2-year cancer-specific mortality rates were 8.8% (8/91) in the LaTME group and 10.8% (7/65) in the TaTME group. These results are consistent with those reported in other research. For example, the 3-year OS was 92.6% (95% CI: 90.4–94.8%) for TaTME and 90.7% (95% CI: 88.3–93.2%) for LaTME.[26] Large-sample retrospective studies have shown 2-year DFS and OS rates of 77% (95% CI: 75–79%) and 92% (95% CI: 91–93%) for TaTME, respectively.[27] Clinical investigations have revealed that the primary cause of mortality following rectal cancer surgery is distant metastasis. Through rigorous postoperative follow-up, local recurrence can often be detected early via digital rectal examination. Although repeat surgery typically does not preserve the anus, it can still achieve secondary clinical cure.

This study is limited by treatment-related confounding factors (such as radiotherapy and postoperative management protocols), which were not thoroughly examined and may have influenced the outcomes.

CONCLUSION

In conclusion, among medical teams proficient in TaTME, despite the lower tumor location in the TaTME group, LaTME and TaTME demonstrated comparable oncological and functional outcomes during the 2-year follow-up period, with long-term anal defecatory function being acceptable to patients. These findings confirm that TaTME is a safe and effective surgical approach for middle- to low-rectal malignancies.

AUTHORS' DISCLOSURE

All authors meet the criteria for authorship, have approved the final version of the manuscript, and agree to be accountable for all aspects of the work. The authors declare that they have no competing interests relevant to the content of this article. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The datasets supporting the conclusions of this article are available from the corresponding author upon reasonable request. Ethical clearance was not required for this study due to its retrospective nature. The participants provided consent for participation and publication of their data.

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