

A modified anal eversion technique for colorectal anastomosis in laparoscopic rectal cancer surgery

 Mehmet Aslan¹,  Oktay Karaköse²

¹Department of Surgical Oncology, VM Medicalpark Hospital, Kocaeli, Turkey

²Department of Surgical Oncology, Samsun Training and Research Hospital, Samsun, Turkey

Received: 01/08/2023

Accepted: 16/08/2023

Published: 22/09/2023

ABSTRACT

Aims: This study presents a modified colorectal anastomosis method that consists of multi-task use of a circular stapler and anal eversion to perform a safer anastomosis. We aimed to describe the anorectal eversion and anastomosis techniques in detail and compare the results of the modified technique with those of the standard laparoscopic surgical technique.

Methods: This retrospective study was conducted with fifty-five patients who underwent laparoscopic TME for middle and distal rectal cancer between 2016-2022. The patients were divided into two groups: those who underwent standard laparoscopic transabdominal surgery and those who underwent anorectal eversion (Modified ASET Method). The baseline features of the patients and the distribution of surgical outcomes between the two groups were statistically compared.

Results: The Modified ASET group consisted of twenty-one patients. The morbidity rate associated with this procedure was 14.2%. CRM was positive in 9.5% of patients, and a safe distal surgical margin was achieved in all patients. The local recurrence rate is 4.7%. No statistically significant difference was observed between the Modified ASET and standard TME groups in terms of oncological outcomes ($p=0.828$).

Conclusion: Anorectal stump eversion and extra-abdominal transection-based modified colorectal anastomosis are reliable approaches that provide satisfactory surgical outcomes.

Keywords: Rectal cancer, colorectal anastomosis, anal eversion

INTRODUCTION

Treatment approaches for rectal cancer continue to evolve. Non-surgical treatment of middle and distal rectal cancer has become popular as Habr-Gama's wait-and-see approach has become increasingly common with total neoadjuvant therapy.¹ The popularity of transanal approaches for the surgical treatment of this group of patients is also increasing. Despite current developments, transabdominal total mesorectal excision (TME) is still the most preferred treatment option.^{2,3} Compared with open surgery, minimally invasive interventions have favorable results; therefore, laparoscopic TME is highly preferred by colorectal surgeons.⁴

TME is a demanding procedure. There are some difficulties in transection of the distal rectum with an endoscopic linear stapler to achieve oncologically safe surgical margins using the transabdominal approach. Distally located tumors, narrow pelvis, and bulky mesorectum are challenging factors for the minimally invasive surgeons. Moreover, the use of multiple linear stapler firings for transection increases the risk of anastomotic leakage.⁵

Therefore, to obtain adequate results in the surgical treatment of middle and distal rectal tumors, it would be wise to visually determine the distal surgical margin to provide easier closure of the anorectal stump with an endoscopic linear stapler. Reducing the number of linear stapler firing would contribute to prevent possible anastomosis related complications.

In laparoscopic surgery for middle and distal rectal tumors, we offer a modified method including anorectal stump eversion and extra abdominal transection (ASET) of the rectum to overcome these limitations and obtain a more easily applicable anastomosis. In this study, we aimed to describe the anorectal eversion and anastomosis techniques in detail. Our second goal was to compare the results of the modified technique to those of the standard laparoscopic surgical technique.

METHODS

Patients

The data of fifty-five patients who underwent laparoscopic TME for middle and distal rectal cancer between 2016-2022 were

Corresponding Author: Mehmet Aslan, ege_mehmetaslan@hotmail.com

Cite this article as: Aslan M, Karaköse O. A modified anal eversion technique for colorectal anastomosis in laparoscopic rectal cancer surgery. *Kastamonu Med J.* 2023;3(3):144-149.



retrospectively evaluated. Tumor localization was determined by colonoscopy and pelvic MRI before treatment. All the patients received neoadjuvant treatment for rectal adenocarcinomas. Tumor response to treatment following neoadjuvant therapy was evaluated according to current guidelines.⁶ The local ethics committee (Kocaeli Health and Technology University) approved the study (Date:02.08.2023, Decision No: 2023-55). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. Flexible rectosigmoidoscopy was reapplied by the surgeon in charge following neoadjuvant therapy to evaluate the exact distance of the tumor from the anorectal junction. The patients were divided into two groups: those who underwent standard laparoscopic transabdominal surgery and those who underwent anorectal eversion. The standard laparoscopic approach group consisted of thirty-four patients (61.8%) and the eversion group consisted of twenty-one patients (38.2%). The rectal eversion method was preferred in cases in which rectal stump transection was difficult or insecure.

The indications for ASET were as follows: (1) histologically confirmed rectal adenocarcinoma; (2) tumor located in the middle or distal rectum (within 2-7 cm from the anorectal junction); (3) absence of external or internal sphincter invasion; (4) difficulty in obtaining adequate surgical margins with standard laparoscopic TME; and (5) multiple linear stapler firing may be required for rectal transection due to anatomical or interventional difficulties (three or more stapler firing).

The baseline features of the patients and the distribution of surgical outcomes of the two groups were analyzed and compared between each other. Postoperative morbidity and early mortality rates were also recorded. Early mortality was defined as death during the first 30 postoperative days. Stoma closure was conducted within 3-6 months after surgery. The follow-up protocol was in accordance with the NCCN recommendations. Local recurrence was defined as pathological confirmation of lesions visualized by imaging or colonoscopy within 5 cm of the surgical site.

Statistical Analysis

Statistical analyses were performed using SPSS 22.0. For the evaluation of categorical data, Pearson Chi-square and Fischer exact tests were performed. Since it is a two-group study, Student's t-test was used for scaled parametric data, and the Mann-Whitney U test was used for scaled non-parametric data. Statistical significance was set at $p < 0.005$.

Surgical Technique of ASET

The laparoscopic transabdominal approach was performed with five ports in the Trendelenburg position, with the legs open. The operating table tilted slightly to the right. The surgeon and camera assistant were located on the right side of the patient, while the first assistant was located on the left, and the nurse stood between the legs. The first portion of the operation prior to anorectal transection is the same as the standard TME and consists of mobilization of the splenic flexure by medial to lateral dissection, high ligation of the inferior mesenteric artery, ligation of the inferior mesenteric vein at the inferior border of the pancreas, detachment of the left colon from the retroperitoneum, dissection of the pelvis in the holy plane, and the TME. The anorectal transection phase differed from the standard technique. While the rectum is divided by multiple endoscopic stapler firings at the level of the levator muscle in

the standard procedure, in the Modified ASET method, to facilitate the anorectal eversion phase, dissection is continued as far down as possible into the levator muscle (**Fig 1**).

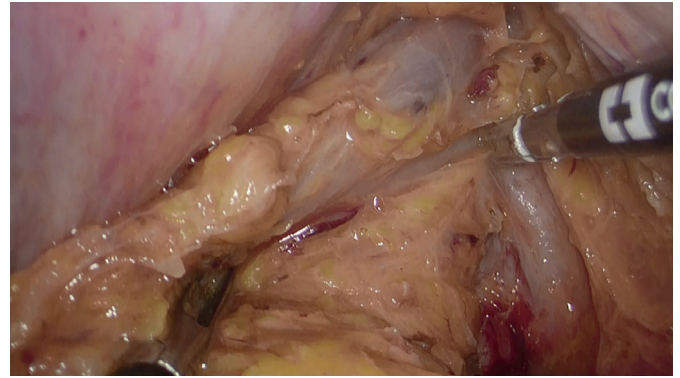


Figure 1. The pelvic dissection down to the levator muscle.

First, the upper rectum was primarily divided by a linear stapler 8-10 cm proximal to the tumor (**Fig 2**).

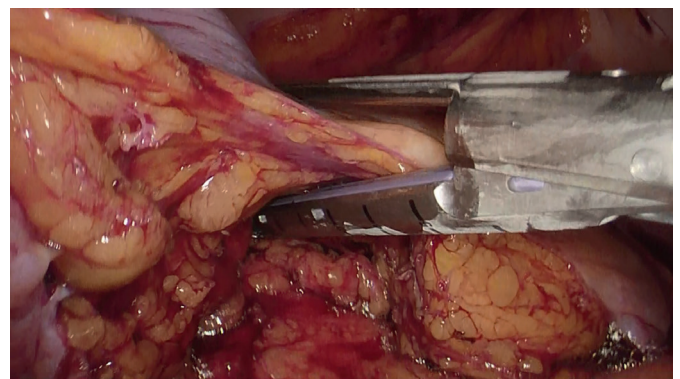


Figure 2. Division of the upper rectum 8-10 cm proximal to the tumor.

In this method, the same circular stapler is used for two different purposes: (1) eversion of the rectal stump and (2) formation of colorectal anastomosis. After mechanical washing of the rectal stump, a 29 mm Ethicon XL Sealed circular stapler with an attached anvil was inserted through the anus and advanced to the tip of the rectal stump. When the back of the anvil leans along the rectal stump transection line, the apparatus located at the rear of the main shaft is rotated by 1.5, which partially separates the anvil from the circular stapler shaft. An endo-loop is inserted into the abdomen. It is located in the area between the anvil and main body to compress the entire lumen of the remnant rectum. The apparatus located at the rear of the main body of the circular stapler rotated by 1.5, turning in the opposite direction to attach the anvil to the main body to detain the tip of the rectal stump, but no firing was performed. The rectal stump was grasped using a circular stapler and everted with the help of a circular stapler (**Fig 3**).

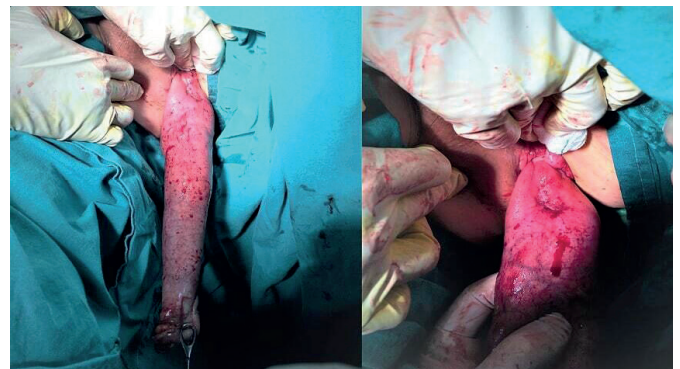


Figure 3. The tumor bearing rectal stump everted by a circular stapler.

The distance between the tumor and the anorectal junction was evaluated. The tumor-bearing rectum was visually transected away from the tumor to have a sufficient distal margin with only one 60 mm Ethicon linear stapler (Fig 4).



Figure 4. Visually transection of the tumor bearing rectum to secure surgical margins.

The newly formed stump was then returned to the abdomen. Colorectal anastomosis was performed using the same circular stapler. A drain was placed in the abdomen, and a protective loop ileostomy was performed in the right lower quadrant.

RESULTS

Demographic and clinicopathological features of the fifty-five patients are shown in **Table 1**. The cohort consisted of forty-two (76.4%) males and thirteen (23.6%) females with a mean age of 61.02 years (range, 37-85). Twenty-four patients (43.6%) were diagnosed with lower rectal cancer and thirty-one patients (56.4%) were diagnosed with middle rectal cancer. Surgical interventions applied to the patients were as follows: Standard TME thirty-four patients (56.4%); Modified ASET twenty-one patients (38.2%). All patients received neoadjuvant therapy, and a protective stoma was placed in 85.5% of patients.

Table 1. Demographic and clinico-pathological features of the patients

Age, year, mean±SD	61.02±12.46 (37-85)
Gender: n (%)	
Male	42 (76.4%)
Female	13 (23.6%)
Localization	
Lower Rectum	24 (43.6%)
Middle Rectum	31 (56.4%)
Type of Surgery	
Modified ASET	21 (38.2%)
LAR	34 (61.8%)
Protective Stoma	
Absent	8 (14.5%)
Present	47 (85.5%)
Neoadjuvant Treatment	
Short course RT	5 (9.1%)
CRT	50 (90.9%)
Pathological Response	
Complete Response	12 (21.8%)
Moderate Response	9 (16.4%)
Minimal Response	14 (25.5%)
Poor Response	20 (36.4%)
T Stage	
T1	9 (16.4%)
T2	19 (34.5%)
T3	21 (38.2%)
T4	6 (10.9%)
N Stage	
N0	40 (72.7%)
N1	12 (21.8%)
N2	3 (5.5%)
Differentiation	
Well	21 (38.2%)
Intermediate	28 (50.9%)
Poor	6 (10.9%)
LVI	
Negative	43 (78.2%)
Positive	12 (21.8%)
PNI	
Negative	41 (74.5%)
Positive	14 (25.5%)
Complications	
Absent	47 (85.5%)
Stricture	3 (5.5%)
Hemorrhage	3 (5.5%)
Neurogenic Bladder	2 (3.6%)
Tumor Distance from Anorectal Junction, cm, mean±SD	3.75±1.23 (2-6.1)
Stapler Firing in Distal Transection, number, mean±SD	1.84±0.83 (1-4)
Lymph Node Removal, number, mean±SD	13.76±4.67 (7-33)
Distal Surgical Margin, cm, mean±SD	1.68±0.58 (1-3)
CRM	
Negative	50 (90.9%)
Positive	5 (9.1%)
Recurrence	
Absent	43 (78.2%)
Local Recurrence	3 (5.5%)
Liver	4 (7.2%)
Lung	3 (5.5%)
Peritoneal	2 (3.6%)
Morbidity	
Absent	47 (85.5%)
Present	8 (14.5%)
Early Mortality	
Absent	55 (100%)
Present	0 (0%)

SD, standard deviation; LAR, Low Anterior Resection; RT, Radiotherapy; CRT, Chemoradiotherapy; LVI, Lymphovascular Invasion; PNI, Perineural Invasion; CRM, Circumferential Resection Margin.

Clinico-pathological Features

The distribution of the clinicopathological features of patients based on the surgical intervention groups is shown in **Table 2**. **Standard LAR with TME:** Of the patients who underwent Low anterior resection (LAR) with TME (standard laparoscopic TME procedure), twenty-eight were male and six were female, with a mean age of 60.79 years. The median

distance from the anorectal junction to the tumor was 4 cm. The median number of endoscopic linear stapler firings with the aim of distal rectal transection was 2 (range:1-4).

Modified ASET: Of the patients who underwent the Modified ASET procedure, fourteen were male and seven were female, with a mean age of 61.38 years. The median distance from the tumor to the anorectal junction was 2.8 cm. The median number of endoscopic linear stapler firing to transect the distal rectum was 1. We found a statistically significant difference in the number of endoscopic linear stapler applications between the two groups ($p < 0.001$).

Table 2. Distribution of clinicopathological characteristics of patients according to surgical intervention groups.

Clinicopathological Features	No. Of Patients (%) (21 patients, 38.2%)	Modified ASET LAR (34 patients, 61.8%)	P value
Age, year, mean±SD	61.38±13.01(40-79)	60.79±12.31(37-85)	$p=0.867^t$
Gender			$p=0.183^{x2}$
Male	14	28	
Female	7	6	
Localization			$p=0.112^{x2}$
Lower Rectum	12	12	
Middle Rectum	9	22	
Protective Stoma			$p=0.966^{x2}$
Absent	3	5	
Present	18	29	
Neoadjuvant Treatment			$p=0.380^{x2}$
Short course RT	1	4	
CRT	20	30	
Pathological Response			$p=0.293^{x2}$
Complete Response	7	5	
Moderate Response	4	5	
Minimal Response	5	9	
Poor Response	5	15	
T Stage			$p=0.125^{x2}$
T1	5	4	
T2	9	10	
T3	7	14	
T4	0	6	
N Stage			$p=0.560^{x2}$
N0	15	25	
N1	4	8	
N2	2	1	
Differentiation			$p=0.768^{x2}$
Well	7	14	
Moderate	12	16	
Poor	2	4	
LVI			$p=0.696^{x2}$
Negative	17	26	
Positive	4	8	
PNI			$p=0.677^{x2}$
Negative	15	26	
Positive	6	8	
Tumor distance from anorectal junction, cm, median(range)	2.8 (2-6.1)	4 (2.1-6)	$p=0.425^u$
Stapler firing in distal transection, number, median (range)	1 (1-1)	2 (1-4)	$p < 0.01^u$

SD, standard deviation; LAR, Low Anterior Resection; RT, Radiotherapy; CRT, Chemoradiotherapy; LVI, Lymphovascular Invasion; PNI, Perineural Invasion; χ^2 , Pearson Chi-square test; t, Student T test; u, Mann Whitney U test

Early Outcomes and Follow-up

Surgical and oncological outcomes of the procedures are listed in **Table 3**.

Table 3. Distribution of surgical and oncological outcomes of patients according to surgical techniques groups.

Surgical & Oncological Outcomes	No. Of Patients (%) Modified ASET LAR (21 patients, 38.2%) (34 patients, 61.8%)		P value
Complications			$p=0.981^{x2}$
Absent	18	29	
Stricture	1	2	
Hemorrhage	1	2	
Neurogenic Bladder	1	1	
Morbidity			$p=0.575^{x2}$
Absent	19	29	
Present	2	5	
Lymph node removal, number, median (range)	13 (7-33)	13 (8-30)	$p=0.607^u$
Distal surgical margin, cm, median (range)	1.4 (1-3)	1.5 (1-2.8)	$p=0.754^u$
CRM			$p=0.930^{x2}$
Negative	19	31	
Positive	2	3	
Recurrence			$p=0.828^{x2}$
Absent	16	27	
Local Recurrence	1	2	
Liver	1	3	
Lung	2	1	
Peritoneal	1	1	

SD, standard deviation; LAR, Low Anterior Resection; CRM, Circumferential Resection Margin; χ^2 , Pearson Chi-square test; t, Student T test; u, Mann Whitney U test

Standard LAR with TME: Five patients experienced postoperative complications, with a morbidity rate of 14.7%. A sufficient distal surgical margin was obtained in all patients, but a circumferential resection margin (CRM) was involved in 8.8% of the patients. The disease recurred in 20.5% of the patients (distant organ metastasis, 14.7%; local recurrence 5.8%, respectively).

Modified ASET: There was no statistically significant difference in the distribution of complication and morbidity rates between the two groups ($p = 0.981$ and $p=0.575$, respectively). Three patients experienced complications when using this method. An anastomotic stricture was detected in one patient while sigmoidoscopy was performed before ileostomy closure. Endoscopic balloon dilatation was then performed. The second complication in this group was bleeding from the anastomotic site. The patient was conservatively managed. In one patient, bladder function was delayed, and the patient was followed up with a urinary catheter for 10 days. The morbidity rate associated with this procedure was 14.2%. CRM was positive in 9.5% of patients, and a safe distal surgical margin was achieved in all patients. There was no statistically significant difference between the two methods in terms of oncological outcomes ($p = 0.828$). The recurrence rate of this procedure was 23.8%. The local recurrence rate was 4.7% and the distant organ metastasis rate was 19%.

DISCUSSION

Currently, laparoscopic TME is the preferred surgical method in the multidisciplinary treatment of rectal cancer.^{7,8} Some issues should be considered in the treatment of laparoscopic rectal cancer surgery, especially when the tumor is localized in the middle or distal rectum. Limitations during pelvic dissection and rectal transection compromise the oncological outcomes of surgical intervention and may increase morbidity and mortality.

Therefore, we defined a modified method consisting of multi-task circular stapler usage to overcome these limitations in the treatment of laparoscopic middle and distal rectal cancer surgery. In the current study, it was shown that the oncological, intervention-related postoperative, and functional outcomes of this method were comparable with those of the standard laparoscopic method. The Modified ASET is based on the use of a circular stapler in both the rectal eversion and anastomosis phases in cases where rectal transection is difficult or unsafe with the transabdominal approach.

This method has three main differences from the standard TME. The first is the additional division of the rectum 8-10 cm proximal to the tumor, the second is the circular stapler-assisted eversion of the rectal stump, and the third is the extra-abdominal re-division of the rectal stump bearing the tumor by a linear stapler at a safe distance from the tumor.

Rectal stump eversion is a challenging step in the Modified ASET technique. After sufficient distal dissection at the level of the levator ani muscle, different eversion methods have been described. In previous studies, grasping forceps were advanced from the anus and rectal eversion was achieved using this tool.⁹⁻¹¹ Unlike others, a circular stapler with a loop suture was used for eversion in the current study. The purpose of using a circular stapler is to grasp the rectal stump with a larger surface area in order to prevent unintentional rupture of the rectum during eversion. Rectal stump rupture was not encountered in any of the patients using this method.

Achieving safe surgical margins is one of the main goals of cancer surgery. Circumferential resection margin (CRM) is one of the most important parameters that reflect oncological outcomes in rectal cancer surgery.¹² A tumor within 2 mm of the resected margin is defined as a threatened CRM.¹³ In this study, three patients (8.8%) in the standard laparoscopic TME group and two patients in the Modified ASET group were CRM-positive (9.5%). Similar to the current study, in a large-scale study that included patients who had undergone rectal cancer surgery (240 patients laparoscopic, 222 patients open), negative CRM was achieved in 87.9% of patients after laparoscopic surgery.¹⁴

To achieve a negative distal bowel wall margin in distal rectal cancer, transection of the rectal wall 1-2 cm distal to the tumor is recommended. In the Modified ASET method, eversion of the tumor-bearing rectum after meticulous dissection of the mesorectum allows visualization of the estimated distal resection line. With this method, visually transecting the everted rectum from a safe distance from the tumor allows us to obtain a safe distal surgical margin. We obtained an average of 1.68 cm distal surgical margin with this modified method, and sufficient distal surgical margin was achieved in all patients. Similarly, previous studies examining eversion-based resection have obtained a safe distal surgical margin.^{15,16} Oncologically favorable outcomes have also been reported with transanal microinvasive approaches applied to obtain adequate distal surgical margins.¹⁷ Although transanal approaches have successful results, the fact that there is a certain learning curve and the need for additional tools that increase the cost of the intervention limits the feasibility of transanal minimally invasive approaches.¹⁸ From this perspective, Modified ASET can be an alternative solution in cases where it is difficult to obtain an adequate distal surgical margin, similar to transanal approaches.

Distal transection of the rectum affects both early surgical and oncological outcomes as it is an important and challenging

phase of the operation. There is an increase in postoperative anastomosis related complications associated with the number of linear staplers fired for transection.⁵ Ideally, fewer than three applications of linear staplers are recommended with the aim of transection.¹⁹ With the Modified ASET method, only one linear stapler application was sufficient for distal transection after eversion. In the laparoscopic TME group, an average of two (range 1-4) linear staplers were used. A significant difference was observed between the two groups in terms of the number of staples used for distal rectum transection. Theoretically, using fewer endoscopic linear staplers in the Modified ASET group should have reduced anastomotic related complications, but there is no significant difference between the two groups. No anastomotic leakage was observed in either group.

In previous studies where rectal eversion and distal transection were applied, the neurological functions of the remaining rectum were discussed in detail.^{10,20,21} Findings that may indicate anal dysfunction, such as fecal incontinence and soiling, were not observed in our study, and the results were comparable to those of previous reports. The most common functional complaint in the modified ASET group was tenesmus after the ostomy closure. Similarly, a study using the rectal eversion method reported no neurological damage to the remnant rectum.²²

Difficulties during pelvic dissection, difficulties in anastomosis stage and presence of anastomosis related complications are the most common factors affecting morbidity in surgical treatment of distal rectal cancer. In the current study, there was no significant difference between the two groups in terms of surgery-related complications, functional outcomes, morbidity, and mortality. The results were similar to those of previous studies published on the same subject.^{10,15,16,21} The morbidity rate in the Modified ASET group was 14.2%.

As a component of the modified ASET method, early division of the rectum proximal to the tumor appears to be debatable in terms of oncological outcomes of the procedure. To reduce tumor dissemination, the rectum was divided 10 cm proximal to the tumor, and the rectal stump was mechanically washed before eversion. In our study, the local recurrence rate of the Modified ASET group was 4.7%, which was similar to that of the standard laparoscopic TME group. In a study that examined the data of 735 patients treated for stage 2-3 rectum cancer, the five-year local recurrence rate was similarly reported as 4.6%.²³ Approximately half of the local recurrences occur in the lower pelvic region, particularly in the presacral area.²⁴

In the Modified ASET method, since additional sigmoid colon resection, including lymphovascular package like standard TME, was performed in the later stage of the operation, there was no significant difference between the two groups in terms of the number of lymph nodes removed. Recent studies, including the rectal eversion method with a laparoscopic approach, have reported that the procedure is also oncologically reliable.^{21,22}

The main limitation of this study was that the number of patients in both groups did not match. The standard laparoscopic approach is the primary treatment option, and the rectal eversion method is preferred because of the difficulties encountered with the standard method. This may be the reason for the disparity in the number of patients between the two groups. Another limitation is that this study was retrospective.

CONCLUSION

In conclusion, this method is a safe alternative in patients who will not obtain sufficient distal surgical margins with standard laparoscopic TME or who may need multiple linear stapler firings during rectal transection.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was approved by the Kocaeli Health and Technology University Ethics Committee (Date:02.08.2023, Decision No: 2023-55).

Informed Consent: Due to the retrospective design of the study no written informed consent form was obtained.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study did not receive any funding.

Author Contributions: Mehmet Aslan contributed to study design. Mehmet Aslan and Oktay Karakose contributed to data collection and statistical analysis. Mehmet Aslan led the analysis and interpretation. All authors contributed to the writing and review of the paper and approved the final version of the manuscript.

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