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## The Role of Transanal Endoscopic Microsurgery for Rectal Tumors

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### Abstract

**Purpose:** The management of rectal tumors is complex, because of the balance between preserving rectoanal function and curing the patient. Transanal endoscopic microsurgery (TEM) is both an effective treatment for benign rectal tumors and early cancers, and a diagnostic tool for determining tumor depth, or for residual tumors of post endoscopic mucosal resection. In the present study, we evaluated the role of TEM in the management of rectal tumors.

**Methods:** Twenty-six patients with rectal tumors underwent TEM from December 2000 through March 2005 in our department. The operations were performed by a single surgeon, and the indications were mainly limited to a) benign tumors for which endoscopic resection was difficult, b) early cancers that had invaded the submucosa within 500  $\mu$ m of the muscularis mucosae, c) submucosal tumors, i.e., gastrointestinal stromal tumor, carcinoid tumors, d) local excision for diagnosis, and e) palliative resection for high-risk cases. Anesthesia, operation time, sizes of the tumor and of resected specimens, postoperative complications, length of hospitalization, pathological results, and postoperative recurrence rate were reviewed.

**Results:** The mean age of patients was 61.9 years, and the cases included 14 rectal cancers, 7 adenomas, 1 gastrointestinal stromal tumor, and 3 rectal carcinoid tumors. The mean operation time was 96 min (range, 40~235 min.). The average postoperative hospital stay was 4.8 days. All tumors were resected with horizontal and vertical safety margin. The mean size of the resected specimens was 9.0 cm<sup>2</sup>. In one case, the tumor had infiltrated the proper muscle layer, as shown by intraoperative frozen sectioning, which necessitated abdominoperineal resection. In 3 cases, pathological examination revealed massive infiltration into the submucosal layer. 2 patients underwent low anterior resection, and the remaining patient refused additional surgery despite our recommendation. No deaths occurred. No major postoperative complications were noted. The mean follow-up period was 27.2 months. Only one case of lymph node metastasis was observed, in the left iliac lymph node 3 years after TEM.

**Conclusions:** TEM is a minimally invasive surgical procedure for rectal tumors, which allows the whole depth of the rectal wall to be resected with a safety surgical margin. Although TEM requires technical skill and accurate preoperative diagnosis, the procedure is safe, facilitates accurate diagnosis of tumor depth, and limits the need for additional surgery.

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**Key words:** treatment, rectal cancer, minimally invasive surgery

## Introduction

Recent advances in colorectal surgery have proceeded in two directions. One is toward cumulative therapy, including adjuvant and neoadjuvant chemotherapy, chemoradiotherapy, extensive lymph node dissection, and simultaneous resection of metastatic organs, all of which contribute to survival. Another direction is toward functional preservation and minimally invasive surgery. Furthermore, advances in colorectal fiberoptic endoscopy and medical examination have contributed to the earlier discovery of colorectal cancers.

In early colorectal cancers, and T0 (Tis) cancers, which are within the mucosal layer, can be cured with endoscopic mucosal resection (EMR) or local excision; however, T1 cancers that infiltrate the submucosal layer have a 10% risk of lymph node metastasis. Therefore, it is important to make the correct choice of treatment from the following according to tumor depth and the presence of lymph node metastasis: EMR, local excision, and intestinal resection with lymph node dissection<sup>1</sup>.

According to the progress of the preoperative tumor depth analysis by pit pattern diagnosis and endoscopic ultrasonography, reduction surgery, such as transsacral sleeve resection with regional lymph node dissection and local excision without lymph node dissection, have been utilized.

When the tumor is in the colon, functional disorders due to colectomy are minimal. If the tumor is in the rectum, especially in the lower rectum, reduction surgery or local excision is recommended for benign tumors or early cancers that require no lymph node dissection, because of the difficulty of functional preservation.

Transanal endoscopic microsurgery (TEM) is a

minimally invasive surgical technique originally designed by Buess *et al.* in 1988 for the treatment of rectal tumors<sup>2</sup>. The procedure uses a transanal approach with a rectoscope and surgical instruments that can reach further into the rectum than can instruments for conventional transanal local resection. Middleton *et al.* described the clinical safety of TEM in their review, introducing several randomized controlled trial studies<sup>3</sup>.

In our department, TEM was first performed in December 2000 and has been used to treat 26 cases of benign rectal tumors and early rectal cancers. Herein, we illustrate the surgical procedure and review the clinical results.

## Patients and Method

### Patients

Of the cases of rectal tumor referred to our department from December 2000 through March 2005, 26 cases were treated with TEM according to the indications, (**Table 1**).

Each patient was given a full explanation about the safety and minimally invasive concept of TEM and saved informed consent before surgery.

### Method

1) Instruments: We used a remodeled rectoscope tube with a stereoscope that provided a 3-dimensional image directly to the operator and a 2-dimensional image to the assistant through a video system (**Fig. 1**), and operating instruments (**Fig. 2**). ( Wolf Co. Tuttlingen, Germany ) A pneumoperitoneum unit that supplied CO<sub>2</sub> and maintained endoluminal pressure was used.

2) Anesthesia: A subarachnoid block or epidural anesthesia is applied, and general anesthesia is available in some cases.

3) Preoperative bowel preparation: Mechanical

Table 1 Indications for TEM

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1. Benign rectal tumors that were difficult to treat with endoscopic resection
  2. Early rectal cancers within the submucosal layer, excluding massive infiltration
  3. Submucosal tumors, i.e., GIST, carcinoid tumors.
  4. Local excision for diagnosis
  5. Palliative resection for high-risk cases
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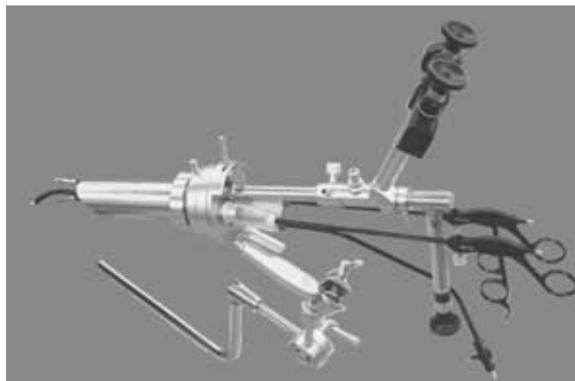


Fig. 1 The rectoscope tube with inserted surgical instruments and stereoscope

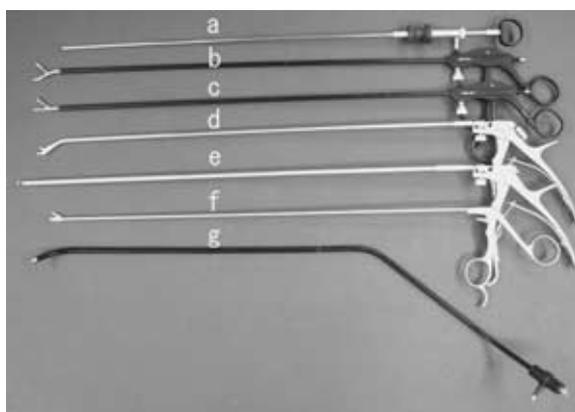


Fig. 2 Operating instruments: a) an injection needle, b) an angled forceps, c) a straight forceps, d) a needle holder, e) a clamp closing forceps, f) a scissors, g) a coagulation suction device

bowel preparation with a laxative and an enema is required. Chemical preparation is not necessary.

4) Surgical position: Because the rectoscope allows manipulation only from 3 to 7 o'clock of the circumference of the rectum, the surgical position is designed so that the tumor is located from 3 to 7 o'clock. When the size of the tumor is more than one third of the luminal circumference, we rotate the surgical table. According to the tumor location, left lateral position is appropriate for 12 to 3 o'clock tumors, the lithotomy position for 3 to 7 o'clock tumors, right lateral position for 7 to 10 o'clock tumors, and the prone position for 10 to 12 o'clock tumors (Fig. 3).

5) Treatment after operation: The patient consumes water on the day of surgery and a meal the next day. Usually, no analgesic is necessary.

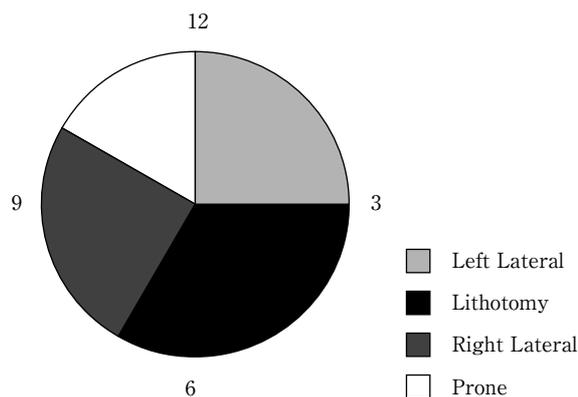


Fig. 3 Tumor location on the rectal circumference and surgical position

### Surgical Procedure

The surgical procedure described by Buess<sup>24</sup> is applied. Briefly, after the initial setting of the rectoscope, a minor adjustment is made so that the lesion is visualized with the stereoscope in 4 to 6 o'clock position. The operator views a 3-dimensional image through the stereoscope. A pneumoperitoneum unit is applied, and an endoluminal pressure of 6 to 8 mmHg with CO<sub>2</sub> is maintained. An incisional marking around the tumor is made to secure the incisional boundary. A saline solution with 0.001% epinephrine is injected beneath the submucosal layer inside the marked area to lift the tumor and examine submucosal tumor infiltration. The tumor is circumcised with a high-frequency knife with countertraction by angled forceps. If bleeding occurs, a high-frequency knife is effective for hemostasis. After the resection is completed, the mucosal defect is closed with a continuous suture using absorbable thread. Both sides of the thread are fixed with silver clips. If the full thickness of the rectal wall has been incised, the defect is closed layer by layer. Finally, haemostasis is established, and the operation is completed.

### Results

Eleven men and 15 women aged 40 to 86 years underwent TEM (Table 2). Eleven tumors were in the upper rectum, and 15 tumors were in the lower rectum. The distance from the anal edge of the tumor to the anal verge was 3 to 13 cm. The mean tumor size was 4.4 cm<sup>2</sup>, and the largest tumor was

Table 2 Patients and tumor characteristics

Sex (M/F)	11/15
Mean age, years (range)	61.9 ± 10.2 (40 ~ 86)
Location (Ra/Rb)	11/15
Mean distance from anal verge (range)	5.1 ± 2.3 cm (3 ~ 13 cm)
Mean tumor size (maximum)	4.4 cm <sup>2</sup> (4.0 × 5.0 cm)
Tumor depth (m/sm)	16/10
Mean excision size (maximum)	9.0 cm <sup>2</sup> (5.0 × 6.0 cm)
Excision depth (sm/mp/full thickness)	13/8/5

Table 3 Surgical position

Position	n
Lithotomy	8
Prone	3
Right Lateral	12
Left Lateral	3

4.0 cm by 5.0 cm. The mean size of resected specimens was 9.0 cm<sup>2</sup> and the largest specimen was 5.0 cm by 6.0 cm. Full thickness incisions were made in 5 cases in which the tumor was in the lower rectum (**Table 2**).

The surgical position was defined according to the tumor location as described above: lithotomy in 8 cases, prone in 3 cases, right lateral in 12 cases, and left lateral in 3 cases (**Table 3**).

In accordance with the patient's condition, subarachnoid block was performed in 15 cases, epidural anesthesia in 2 cases, and general anesthesia in 9 cases. The mean anesthesia and operation times were 162 min and 96 min, respectively. The mean blood loss was 14 ml (**Table 4**).

The postoperative course in all cases was uneventful, and the mean hospital stay after surgery was 4.8 days. No analgesic was needed after surgery. No postoperative complications occurred.

Pathological examinations showed that 21 resected specimens contained mucosal lesions, including 5 tubular adenomas, 2 tubulovillous adenomas, 5 carcinoma in adenomas, 8 well-differentiated adenocarcinomas, and 1 moderately differentiated adenocarcinoma. Five specimens contained submucosal lesions, which included 3 carcinoid tumors, 1 gastrointestinal stromal tumor (GIST), and 1 inflammatory tumor after a previous surgery for

anal fissure (**Table 5**). Of the 14 cases of carcinoma, 8 cases were carcinoma in situ, and 6 cases had infiltrated the submucosal layer. For tumor depth in submucosal layer, we defined "sm slight" as when tumors were within 500 µm of the muscularis mucosae and "sm massive" as when tumors had infiltrated more than 500 µm from muscularis mucosae. Three cases showed sm slight and had no lymphatic or venous invasion and the remaining 3 cases showed sm massive. Two cases of sm massive showed lymphatic and venous invasion. No additional treatment was done for CIS and sm slight. Because of the 10% risk of lymph node metastasis in sm massive<sup>1</sup>, we recommended an additional treatment to the patients with sm massive. Two patients agreed and underwent abdominoperineal resection (APR), but one patient refused. No recurrence was observed in CIS, sm slight, or sm massive with APR; unfortunately lymph node metastasis occurred in the case of sm massive without additional treatment (**Table 6**).

The postoperative observation period was 2 to 52 months, with only one observed recurrence (3.8%) in a left iliac lymph node 3 years after TEM. A few patients complained of slight anal pain during defecation which resolved without treatment. No anal dysfunction has been observed to date (**Table 7**).

Table 4 Anesthesia and operation

Anesthesia	Subarachnoid block	15
	Epidural	2
	General	9
Anesthesia time	162 ± 73 min	(73 ~ 320 min)
Operation time	96 ± 50 min	(40 ~ 235 min)
Blood loss	14 ± 49 ml	(0 ~ 150 ml)

Table 5 Pathological diagnosis

Mucosal	n	Submucosal	n
tubular adenoma	5	carcinoid	3
tubulovillous adenoma	2	GIST	1
carcinoma in adenoma	5	Miscellaneous*	1
Well-differentiated adenocarcinoma	8		
moderately differentiated adenocarcinoma	1		
Total	21	Total	5

Miscellaneous\* inflammation

Table 6 Depth of carcinoma and outcome

Depth	n	Additional treatment	Recurrence
m (CIS)	8	No	8
		Yes	0
sm slight	3	No	3
		Yes	0
sm massive	3	No	1 lymph node metastasis
		Yes (APR)	2 None
Total	14		

Table 7 Postoperative course

Mean hospital stay (range)	
postoperative	4.8 ± 3.1 days (2 ~ 15 days)
total	13.5 ± 9.9 days (5 ~ 37 days)
Analgesic required	none
Complications	none
Mean follow up (range)	27.2 months (2 ~ 52 months)
Recurrence (%)	1 (3.8%) (Iliac lymph node metastasis)

## Discussion

Treatment for rectal tumors should be carefully chosen, because postoperative quality of life depends on preservation of rectal and anal function. Because the aim of the treatment is radical cure, rectal resection or amputation with lymph node dissection should be chosen for advanced cancers or tumors that have infiltrated the submucosal layer and have a high risk of lymph node metastasis. For early cancers or laterally spreading benign tumors for which complete EMR is difficult, the selection of treatment is difficult.

TEM was introduced by Buess *et al.* in 1988 as a new minimally invasive and anal function-preserving method for the treatment of rectal tumors<sup>2</sup>. In our department, we have used TEM to treat 26 cases of rectal tumors since December 2000. No intraoperative or postoperative complications have been observed, and there has been little bleeding or pain. The mean postoperative observation period was 27 months; no late rectal or anal dysfunction was observed.

TEM reaches upper rectal tumors whereas transanal local resection is limited to lower rectal tumors. The microscopic view provided by TEM allows the tumor to be resected with a safety surgical margin and a continuous layer, which contributes to the precise pathological diagnosis of the specimen.

Several earlier studies and our own experience suggest that TEM is a safe and minimally invasive method that is extremely useful for treating benign tumors and early cancers of the rectum<sup>3,5</sup>. However, several issues have arisen that require resolution.

First, postoperative recurrence was observed in one case (3.8%) in which the tumor had infiltrated slightly into the submucosal layer preoperatively; however, the resected specimen showed massive invasion of the submucosal layer with a high risk of lymph node metastasis. Additional surgical treatment should have been performed. In spite of our recommendation of rectal resection with lymph node dissection, the patient refused surgery because she was a 75-year-old woman with a severe

bronchial asthma and a drug allergy. She recognized the risk of lymph node metastasis. She was followed up with periodic examinations. Three years after TEM, metastasis to a left iliac lymph node was found with a periodic computed tomography scan. The patient underwent iliac lymph node dissection; no recurrence has been observed after 6 months. Thus, when we consider the indications for TEM, the precision of tumor depth diagnosis becomes essential. The risk of underestimating or overestimating tumor depth remains, in spite of recent progress in preoperative tumor depth analysis with pit pattern diagnosis and endoscopic ultrasonography<sup>6,7</sup>. Therefore, we should not hesitate to perform additional surgery if the resected specimen shows massive cancer infiltration into the submucosal layer. In our study, 3 cases showed massive submucosal infiltration and 2 of them required additional surgery.

A second issue is technical training. Maneuver of the instruments through the rectoscope, 4 cm in diameter and 15 cm or 20 cm in length, has limited left-right and up-down directional movement, so the maneuver should be converted to front-rear directional movement, which requires time for technical training and experience<sup>8,9</sup>. Although training seminars are held annually and training instrument sets are available, it is not easy for every colorectal surgeon to acquire enough clinical experience with TEM at a single institution, because of the limited numbers of TEM operations.

Third, the fee for TEM has not been defined in the Japanese medical insurance system, so surgeons are paid only for the traditional transanal local excision. Consequently, the lack of adequate payment to offset the TEM technique and expensive TEM instruments is one reason that the use of TEM in general hospitals is not widespread.

Because the indications for TEM are limited, it is difficult to evaluate its benefit by controlled clinical trials. Wind *et al.* performed a randomized controlled trial comparing TEM and anterior resection which suggested that there was no significant difference in safety and mortality between them but found that operating time and hospital stay were significantly shorter with TEM than with anterior resection<sup>10</sup>.

Middleton *et al.* have reported in their review that TEM has limited applications to rectal tumors and no obvious benefits in terms of postoperative complications and long-term clinical results however, the minimal pain and a short hospital stay are significant advantages<sup>3</sup>.

In our 26 cases treated with TEM, 11 tumors were in the upper rectum, where thorough resection is difficult with a conventional transanal procedure. In these cases, rectal resection or amputation was avoided and anal function was preserved with TEM.

In summary, the indications for TEM are similar to those of conventional transanal resection and the incidence of the postoperative complications is less. However, TEM has several advantages. One is that TEM is able to reach tumors higher in the rectum than conventional transanal resection, and another is that en-bloc tumor resection with a safe surgical margin is possible with TEM's microscopic observation. We conclude that although TEM has limited indications and issues to resolve concerning technical training and fee payment, its benefits are significant for appropriate patients.

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