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A New Technique to Repair Vesicorectal Fistula: Overlapping Rectal Muscle Plasty by Transanal Endoscopic Surgery

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Vesicorectal fistula · Rectovesical fistula · Surgical treatment · Transanal endoscopic microsurgery

Abstract
Objective: To evaluate clinical results of a novel surgical technique, we developed to repair vesicorectal fistula (VRF) occurring after prostatectomy, hospital records of the patients, who underwent the new surgical treatment, were assessed. ***Methods:*** The novel surgical technique is called "overlapping rectal muscle plasty," which is performed under transanal endoscopic microsurgery (TEM). During the new procedure, a complete fistulectomy was first performed, and then the proper muscle layer of the rectum was folded, overlapped, and sutured to create a thick wall between the rectum and urinary bladder. This operation was carried out in 15 patients with VRF following radical prostatectomy. ***Results:*** The operation was safely performed in all patients with an average time of 127.2 min. Fistula was corrected in 13 patients (86.7%), who were then freed from both urinary and intestinal diversions. ***Conclusions:*** Overlapping rectal muscle plasty by TEM is a safe procedure. The success rate seems to be acceptable in selected patients. This new repair method may be considered as a minimally invasive option in the surgical treatment of VRF after prostatectomy.

Introduction

Vesicorectal fistula (VRF) as a complication developing after radical prostatectomy is a relatively rare condition and often becomes persistent [1–3]. Symptoms, such as faecaluria and/or incontinent urination from the anus, significantly deteriorate patients' quality of life. In majority of cases, this complication results in permanent double diversion with enterostomy and suprapubic catheterization. Although a variety of surgical procedures has been attempted to treat VRF [4–8], none of them has been regarded as a standard treatment to date. Transanal endoscopic microsurgery (TEM), developed by Buess [9], was originally invented for en bloc resection of rectal tumors and closure of the full-thickness defect by suturing. Its application for repair of VRF has been reported by a few authors including our team [10–13]. After our previous report on operative outcomes of TEM to repair VRF [12], we developed a new method, "overlapping rectal muscle plasty," which is also performed by TEM, and put it into a clinical use. Herein, we demonstrate our new operative technique and report the clinical outcomes of 15 patients.

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Materials and Methods

Patients

Between August 2014 and March 2019, 15 consecutive male patients (average age 66.3 years, range 52–79 years) with iatrogenic VRF developing after radical prostatectomy for prostatic cancer were surgically treated at Medical Topia Soka, Saitama, Japan. Patients, who underwent radiation, HIFU (high-intensity focused ultrasound), or other type of ablation at the fistula site, were excluded. Patients with VRF caused by other disorders than radical prostatectomies, such as trauma, rectal cancer operation, were also excluded. Before the operation, all patients had given informed consent to undergo overlapping rectal muscle plasty by TEM.

The most common complaint was urinary drainage from the anus (n = 12; 80%), while pneumaturia (n = 9; 60%) or faecaluria (n = 7; 47%) was also noted as significant symptoms. At the first visit to our hospital, all patients had an indwelling silicone rubber Foley catheter and 12 patients (80%) had a diverting enterostomy (ileostomy in 8 patients, colostomy in 4). The time between the detection of the fistula and treatment in our hospital ranged from 7 to 34 months (average 12.9 months). None of the patients had an evident sign of recurrence or metastasis of the prostatic cancer. In all cases, rectoscopy, cystoscopy, and cystography were performed preoperatively. Rectoscopy demonstrated the orifice of the fistula on the anterior wall of the lower rectum in all patients. The diameter of the orifice ranged from 5 to 10 mm. In 7 patients (47%), the fistula tract was visualized by cystography, while it was not visualized in the other 8 patients. In 6 patients (40%), previous surgical attempts of fistula closure had been carried out in another hospital; 4 of these patients underwent the conventional transanal approach, 1 underwent the perineal approach, and 1 underwent the laparoscopic approach (Table 1).

Operative Technique

Under general anesthesia the patient is placed in the lithotomy position. Then, cystoscopy is performed, and both ureters are catheterized for protection during TEM. The patient's posture is then changed to the prone jackknife position with legs apart (Fig. 1). For the main session, the original TEM system (Richard-Wolf GmbH., Knittlingen, Germany) is utilized. The operative rectoscope is inserted gently through the anus into the rectum. The handle of the rectoscope is fixed to the supporting arm. A metal working insert with 5 channels is attached to the rectoscope to allow a binocular microscope and other operating instruments into the rectal cavity (Fig. 2). Through the eyepieces of the microscope, a magnified 3D view is obtained for the main surgeon, while a 2D view can be shared on a monitor. The fistula orifice is identified at the 6 o'clock direction in the endoscopic field of view. By the tip of the needle-shaped electrode with high-frequency coagulation and with a needle-shaped electrode, coagulation dots are drawn around the fistula orifice, so that the circle is approximately 3–4 cm in diameter (shown in Fig. 3A). Normal saline is injected into the submucosal layer underneath this circle. Then, the mucosa is dissected by electrocautery to expose the proper muscle layer. When the deep part of the fistula is not sufficiently exposed, it is ablated with high-frequency coagulation as much as possible, so that viable epithelia would not remain in the fistula tract (shown in Fig. 3B). After fistulectomy, the proper muscle layer of the rectum is incised circumferentially around the fistula orifice with a margin of approximately 1 cm from the edge of the orifice. The depth of this incision is full thickness of the proper muscle layer (shown in Fig. 3C).

First, the ring-shaped central part of the proper muscle layer around the fistula opening is closed by hand-sewn suturing with 3-0 monofilament absorbable thread. Usually, a horizontal mattress suture or 3 interrupted stitches are needed to close this central ring (shown in Fig. 3D).

Second, the oral side cutting edge of the proper muscle layer is pulled caudally to cover the central ring and sutured to the bottom of the anal side cutting edge of the proper muscle layer. Four to five interrupted stitches are applied to execute this part of the repair (first overlapping) (shown in Fig. 3E).

Then, the anal side cutting edge of the proper muscle layer is pulled cephalad to be approximated to the oral side proper muscle layer (second overlapping) by continuous running suture with 3-0

Color version available online

Fig. 1. Prone jackknife position with legs apart for fistula repair operation by TEM. TEM, transanal endoscopic microsurgery.

Color version available online

Fig. 2. Appearance of the surgeon operating with the original TEM system. TEM, transanal endoscopic microsurgery.

absorbable monofilament thread (shown in Fig. 3F). Instead of knot-tying, both ends of the thread (3-0 monofilament) are secured with suture clips (LapraTie®, Ethicon Endosurgery, Cincinnati, OH, USA). Last, the mucosal layer is approximated (third overlapping) by running suture with 3-0 absorbable monofilament thread (shown in Fig. 3G).

Postoperative Management

Patients start walking on POD 1, when water intake is also allowed. Soft diet is started on POD 2. Broad-spectrum antibiotics are administered intravenously for 3 days postoperatively. Patients are discharged on POD 6–7.

Six weeks after the operation, cystography, and rectoscopy are performed to observe the repaired part. When no recurrence of the fistula is found, the Foley catheter is removed. When no symptoms related to possible fistula recurrence are noted for approximately 1 month after removal of the urinary bladder catheter, the colonoscopy is performed again to check whether the repaired part is completely closed and whether there are any findings of fistula recurrence, such as air leakage to the urinary bladder. When the second

Table 1. Patients' characteristics (n = 15)

Age, years	Average 66.3, range 52–79
Duration of fistula, months	Average 12.9, range 7–34
Symptoms, *n* (%)	
Anal urination	12 (80)
Pneumaturia	9 (60)
Faecaluria	7 (47)
History of HIFU/irradiation, *n* (%)	0 (0)
Previous surgical attempt, *n* (%)	6 (40)
Transanal approach, *n* (%)	4 (26.7)
Perineal approach, *n* (%)	1 (6.7)
laparoscopic approach, *n* (%)	1 (6.7)
Foley catheter, *n* (%)	15 (100)
Enterostomy, *n* (%)	12 (80)

HIFU, high-intensity focused ultrasound.

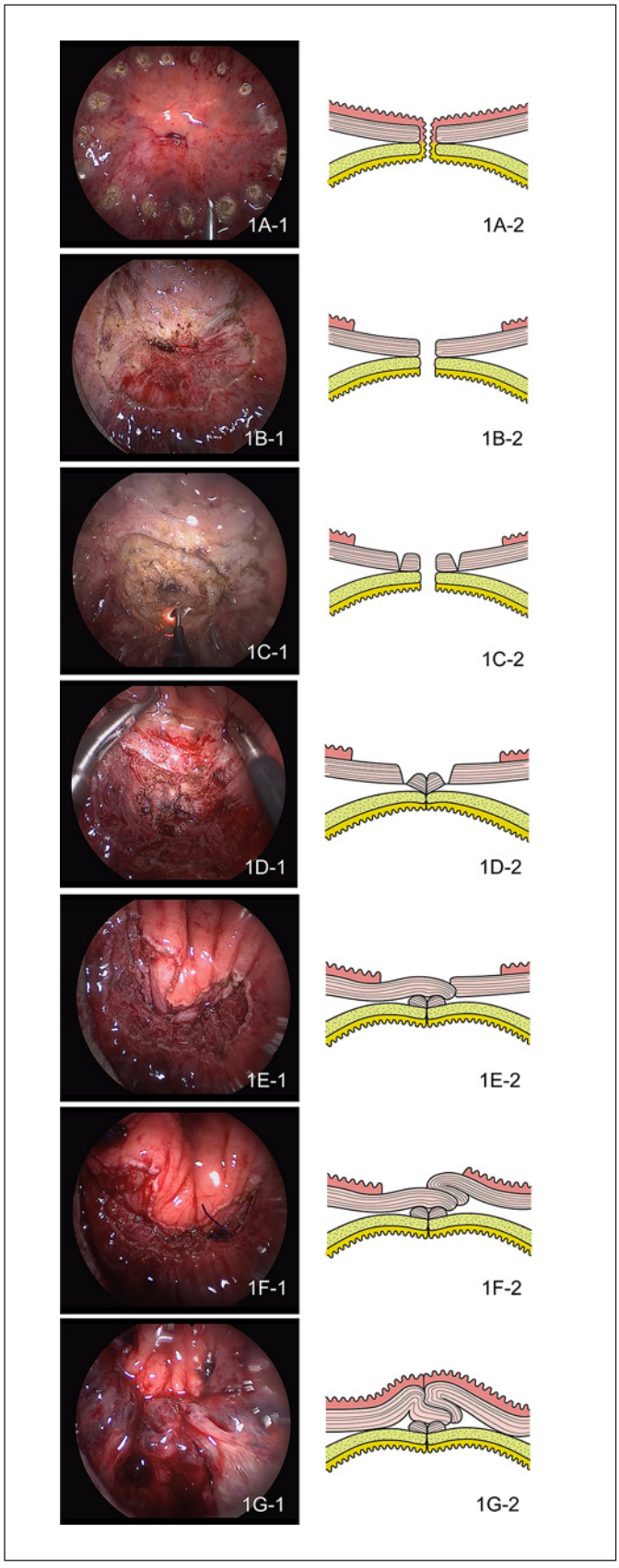

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Fig. 3. Rectoscopic pictures and schematic illustrations to demonstrate the operative technique of overlapping rectal muscle plasty by TEM. **A** Operative view via the rectoscope. The fistula orifice is visualized on the anterior wall of the lower rectum. Coagulation dots are drawn along the planned resection circle around the fistula orifice. **B** The mucosa around the fistula and the fistula epithelia are resected with a high-frequency needle electrode. **C** The proper muscle layer of the rectum is incised circumferentially around the fistula orifice. **D** The ring-shaped muscle layer around the fistula orifice is closed with hand-sewn suturing. **E** The cutting edge of the oral side proper muscle layer is pulled caudally to cover the central ring and sutured to the bottom of the anal side cutting edge of the proper muscle layer. **F** The anal side cutting edge of the proper muscle layer is pulled cephalad to be approximated to the oral side proper muscle layer by continuous running suture. **G** Finally, the mucosal layer is approximated by continuous running suture. TEM, transanal endoscopic microsurgery.

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Table 2. Operative outcomes (n = 15)

Operating time, min	Average 127.2, range 75–180
Conversion, *n* (%)	0 (0)
Complication (TEM-related), *n* (%)	
Bleeding	1 (6.7)
Mortality	0 (0)
Hospital stay, days	Average 7.8, range 6–14
Temporary anal urination, *n* (%)	7 (46.7)
Persistent fistula, *n* (%)	2 (13.3)
Successful correction, *n* (%)	13 (86.7)

TEM, transanal endoscopic microsurgery.

examination does not detect any sign of recurrence, enterostomy is revised thereafter.

The patients are further requested to visit the outpatient unit 6 months and 1 year after the restoration of enterostomy to be interviewed and checked up by rectoscopy. The hospital records of all included patients were reviewed and devoted to the current study. This retrospective study was approved by the Ethical Committee of Medical Topia Soka (reference number: MTC-019-0625-01). The current group of patients does not include any patient from our previous study [12].

Results

In none of the cases, the operation was converted to any other procedure. Operation time, without counting the time for catheterization of the ureters and construction of enterostomy, ranged from 75 to 180 min, with an average of 127.2 min. No intraoperative complication was encountered. Bleeding was less than 20 mL in all cases. Postoperative bleeding from the repaired site was noted in 1 patient and was controlled by endoscopic clipping. Otherwise, no TEM-related postoperative complication was encountered. Of the 3 patients, who underwent concomitant ileostomy construction, 2 had an infection at the surgical site. The postoperative hospital stay ranged from 6 to 14 days, with an average of 7.8 days.

Temporary anal urination was noted postoperatively in 5 patients (33.3%). Of those 5 patients, 3 had the symptom only once in the first week after discharge (days 1, 3, and 7). Two became aware of it twice or 3 times in the first and second weeks after discharge and the symptoms disappeared. For those who presented with such a symptom, no additional treatment was performed, and the subsequent course was carefully watched. The first postoperative examinations were postponed for these patients to postoperative weeks 10–23. Then, rectoscopy and cystography confirmed closure of the fistula in all those patients.

Two patients presented with persistent anal urination still in postoperative week 6. The Foley catheter was not removed for them to keep on decompression of the urinary bladder. Thereafter, their symptoms deteriorated with pneumaturia and turbid urine. Rectoscopy and cystography in postoperative week 12 confirmed recurred fistula in both of them. The size of the recurrent fistula orifice in those cases measured 4 and 6 mm in diameter, respectively. They were referred to another institute to undergo next treatment.

Both patients underwent gracilis muscle interposition and did well postoperatively. Time from TEM repair to the next operation was 5 and 22 months, respectively. In both of them, fistula was judged corrected, and the enterostomy was revised.

In 13 patients, including the 5 patients with temporary anal urination, the fistula was eventually corrected, and urinary bladder catheterization was terminated, followed by the reversal of the enterostomy. The overall success rate was then 86.7% (13/15) (Table 2). In these 13 patients, the time from TEM to reversal of enterostomy ranged from 3 to 8 months, with an average of 4.3 months.

Discussion and Conclusion

VRF, which is reported to occur in approximately 0.5–9% of the patients as a complication after radical prostatectomy, seriously deteriorates the patient's quality of life [1–3]. Especially incontinent urination from anus, the most unpleasant symptom, significantly affects patients' social life and limits their activities. Moreover, contamination of fecal fragments in the urinary tract can cause an infectious condition, which can eventually result in life-threatening sepsis.

Although there is a conservative treatment strategy for VRF, such as "wait and see with a hope of spontaneous closure" with or without Foley catheter and enterostomy, its success rate does not seem high [1–3]. If the decompression treatment with Foley catheter and enterostomy is executed late, and once the fistula is completely covered with epithelia, theoretically there should not be a chance of spontaneous closure. In case the fistula was not cured by conservative treatment, the patient may choose the option of surgical repair of the fistula or another option of double diversion (permanent vesicostomy and enterostomy).

Although a variety of operative procedures has been introduced in the past, none of them has gained recognition as a standard method to date [4–8]. The transperineal approach is the most frequently performed operation, mainly because it reaches the fistula site easily and can facilitate the interposition of a muscle graft from the thigh [8, 14–17]. There have been reports on gracilis muscle interposition with favorable success rates, and this can be regarded as the most reliable operative procedure so far [18–20]. In addition, the perineal approach can also be applied for complicated fistulas associated with irradiation, HIFU, or multiple previous surgical attempts. However, there remain a couple of drawbacks caused by sacrificing the gracilis muscle, such as pain, numbness, and/or weakness in the thigh [18, 19]. The transanal approach can be regarded as a minimally invasive operative method since it uses a natural orifice and does not cut any innocent tissue to create an approach route [5, 21, 22]. However, the drawbacks of the conventional transanal approach, namely, narrow operative field and poor visibility, are not negligible. There have been reports on the trans-sphincteric approach, in which healthy tissue is incised to counteract the drawbacks of the conventional transanal approach [23, 24]. Hadley et al. [25] have reported the largest series of York-Mason repair over 40 years with excellent outcomes. They also suggest that the patients who underwent irradiation and/or ablation in the fistula site prior to the repair had a tendency to fail and might not be good candidates for their procedure. A representative repair method in transanal or similar approaches is the "Latzko procedure," in which fistulectomy is followed by separate approximation of the epithelial layer and the nonepithelial layer [26, 27]. Another surgical option via transanal or similar approaches is the procedure called rectal flap advancement, in which, after the fistulectomy, a wide flap of rectal mucosa is slid to cover the fistula orifice. Several authors have reported favorable operative results when using the advanced rectal flap method [28, 29].

In our series, 4 patients had undergone a surgical attempt by conventional transanal approach before they were referred to us. But none of them had undergone either the Latzko' method or rectal flap advancement. Their primary surgical attempt was suturing of the fistula orifice without fistulectomy. This simple method should be theoretically incorrect because a surface of epithelia would not adhere to another surface of epithelia. As a result, their attempts failed, and the fistula remained.

Since Wilbert et al. [10] first reported 2 cases of VRF successfully corrected by TEM, some authors have published similar case reports [11], while there have been only 2 reports with a series of patients [12, 13]. Our previous report was the first publication on a series of VRF patients ($n = 10$) treated by TEM [12]. In our first publication, we applied the Latzko procedure as a repair method, which resulted in a success rate of 60%. A meta-analysis with 7 papers with 18 patients treated by TEM reported that the success rate in total was 78%, whereas Serra-Aracil et al. [13] reported that it was 25% in 10 patients [11].

The important difference between our previous report and the current study is the change in operative technique from Latzko procedure to overlapping rectal muscle plasty. In Latzko procedure, the mucosal and muscle layers are simply "layer-to-layer" approximated, while in our novel procedure, the proper muscle layer is folded and overlapped to create a thick wall, which is interposed between the urinary bladder and the rectal epithelia. To fold and overlap each layer, we alternate interrupted suture and continuous running suture to disperse the merits and demerits of these different suture techniques. This new idea was conceived with reference to the theory of gracilis muscle interposition, which has been reported with preferable outcomes. A larger volume of muscle with sufficient blood flow, which interposed between 2 organs, is supposed to play an important role [30]. In addition, we hypothesized that a zigzag-shaped approximation line of muscle layer (Fig. 3G) could be better suited as a preventive measure against fistula recurrence than a straight approximation line.

In our current series, recurrence was confirmed in 2 cases, while in the other 13 patients (86.7%) the fistula was completely cured. Overall success rate of the current study looks better than our past report [12] (86.7 vs. 60%), although the data from the 2 studies cannot be simply compared because patients with a history of irradiation or HIFU were excluded in the current study.

As described in the previous studies [9, 31, 32], TEM has a lot of technical uniqueness and advantages when compared with the conventional transanal approach. As the fistula is on the anterior wall of the rectal cavity, the prone position (jackknife position), in which the target is located at 6 o'clock in the operative field, is ideal for stable ergonomics during TEM procedure. The magnified 3D image obtained via the binocular endoscope enables surgeons to identify, among others, tiny tissue structures, or differences between healthy tissues and ischemic tissues. This ability plays an important role in stitching the cor-

rect layer of the proper muscle in multiple layer suturing. The wide operation field in TEM enhances the maneuverability of curved instruments. Although the original TEM system is not widely used, the operative technique we describe in the current report should be reproducible with conventional instruments by TAMIS (transanal minimally invasive surgery), which was originally developed for the rectal cancer operation [33].

There may be room for improvement in surgical techniques of the current operation. In the current surgical procedure, the urinary tract side is the only point, which is poorly visualized, which possibly results in insufficient resection of epithelia. That is why, in our technique, the urinary tract side is ablated with high-frequency energy from the rectal cavity. But this can cause burn in the urinary tract, which can disturb healing process of the wound. To solve this problem, such a urological collaboration, as transurethral endoscopic or transpubic approach may play an important role in future [34–36]. When ergonomics of TEM is further discussed, there is another issue as single-port surgery. The diameter of TEM rectoscope is only 4 cm, in which 4 instruments are working. They often conflict with each other, and the surgeon must be well trained to avoid it. There may be a possibility to lessen this difficulty, when such a single-port manipulator as Davinci SP1098 is utilized [37].

Overlapping rectal muscle plasty was safely carried out by TEM, and chronic VRF after radical prostatectomy was successfully corrected in 86.7% of the selected patients. As the number of the patients in the current study is limited, further clinical trial is neccesary to reconfirm the safety and effects of this surgical treatment in a convincingly large series.

Statement of Ethics

This retrospective study was approved by the Ethical Committee of Medical Topia Soka (reference number: MTC-019-0625-01).

Conflict of Interest Statement

Eiji Kanehira, Takashi Tanida, Aya Kamei Kanehira, Kodai Takahashi, Yuichi Obana, Mitsuharu Iwasaki, and Koji Sagawa have no conflicts of interest or financial ties to disclose.

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Author Contributions

E. Kanehira: project development, main operator, data analysis, and manuscript writing. T. Tanida: project development, assisting operator, and data analysis. A.K. Kanehira: data collection, assisting operator, and manuscript editing. K. Takahashi: data collection, assisting operator, and postoperative patient care. Y. Obana: data collection and postoperative patient care. M. Iwasaki: data collection, data analysis, and urological part of surgery. K. Sagawa: data collection, data analysis, and urological part of surgery.

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