

Original Research Article

## Outcomes of the Gant-Miwa-Thiersch Procedure Using the Leeds-Keio Mesh for Rectal Prolapse

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### Abstract

**Objectives:** Several procedures are available for treating rectal prolapse (RP). This study aimed to determine the effectiveness of the Gant-Miwa-Thiersch (GMT) procedure using the Leeds-Keio mesh (LKM) as a treatment for RP.

**Methods:** This retrospective observational study included all patients with RP who underwent the GMT procedure using the LKM at our hospital between January 2012 and December 2023. The surgery was performed under local or lumbar spinal anesthesia in the jackknife position. The outcome measures included perioperative complications, recurrence rate, and improvement in anal function.

**Results:** During the study period, 107 patients with RP underwent the GMT procedure. The median patient age was 81 years, the median length of prolapse was 7 cm, and the median duration of the surgery was 39 minutes. Postoperative complications were observed in 26 (24.3%) patients, including constipation in 21, mesh early exposure in three, mesh infection in one, and bleeding in one patient(s). The median observation period was 29 months, and recurrence of RP was observed in nine (10%) out of 90 patients evaluated for recurrence, with a cumulative 5-year recurrence rate of 10.9%. Of the 65 patients with preoperative fecal incontinence, 33 (50.8%) demonstrated improvement postoperatively.

**Conclusions:** The GMT procedure using the LKM has a low recurrence rate. The LKM is suitable as a prosthetic material for the Thiersch procedure due to its high elasticity, which can enhance the therapeutic efficacy of the GMT procedure.

### Keywords

rectal prolapse, Gant-Miwa-Thiersch procedure, Leeds-Keio mesh, perineal approach

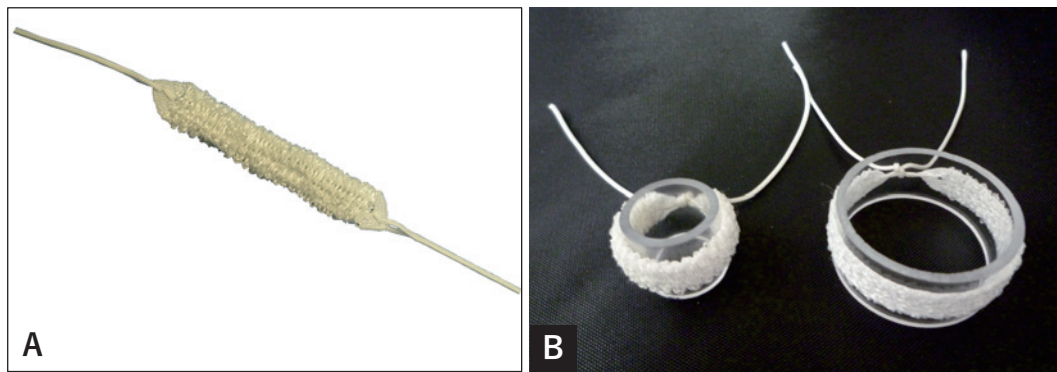
J Anus Rectum Colon 2025; 9(2): 252-259

### Introduction

Rectal prolapse (RP) occurs most commonly in older women and is caused by weakly supportive pelvic tissues[1]. To date, over 100 surgical procedures have been developed to restore RP, broadly categorized into the perineal and abdominal approaches[2]. Historically, the perineal approach has been considered inferior to the abdominal approach in terms of curability. Therefore, the perineal ap-

proach is traditionally employed in older patients with moderate-to-severe comorbidities as it can be performed under local and/or lumbar anesthesia[3]. Recurrence rates with the perineal approach are presumably higher than those of the abdominal approach, ranging from 14% to 27%[1]. However, the superiority of the recurrence rate of the abdominal approach over the perineal approach has been questioned based on recent randomized controlled trials[4,5].

Perianal approach surgeries include the Gant-Miwa-



**Figure 1.** A. Leeds-Keio mesh (LK-5T-130, Yufu Itonaga, Tokyo, Japan). B. The left panel displays the contracted state and the right panel demonstrates the dilated state.

Thiersch (GMT), Delorme, and Altemeier procedures. According to the Japanese clinical guidelines for RP[2], the perineal approach is recommended for patients who are unlikely to tolerate general anesthesia. The Altemeier procedure is recommended in cases with RP  $\geq 5$  cm in length, and the Delorme or GMT procedure is employed for RP  $< 5$  cm. Among perineal procedures, the GMT procedure is most commonly performed in Japan, especially in older individuals with poor general health[6]. The GMT procedure involves the “tie-dye method,” where the redundant rectum is shortened by ligating the rectal mucosa into numerous, small bean-like shapes, followed by the Thiersch procedure, which narrows the loose anus using a prosthesis. Even though the GMT procedure is minimally invasive and can be performed under local anesthesia, it has the disadvantage of a high incidence of complications associated with the Thiersch procedure[6-8].

Postoperative complications of the Thiersch procedure include perianal infection, breakage or exposure of the inserted materials, and difficulty in defecation[2]. Efforts have been made to improve the materials used, such as nylon threads and Teflon tape. These materials are favored due to their low risk of postoperative infection; however, they lack elasticity and thus cannot replicate the natural function of the anus, which relaxes during defecation and contracts afterward. Furthermore, owing to the lack of elasticity, these materials frequently cut off the organization and expose it to the intestinal lumen[8].

Iwadare et al.[9] reported the use of the Leeds-Keio mesh (LKM) (Figure 1), an elastic polyester tape based on a polyethylene mesh, for the Thiersch procedure in patients with RP. The LKM was developed in 1979 through an international collaboration between the Orthopedic Knee Group at Keio University and the Rheumatology Research Unit at the University of Leeds in the United Kingdom. The polyester has been utilized as an artificial ligament in knee ligament reconstruction for over 30 years[10].

We have been performing the GMT procedure using the

LKM since 2012, which has currently become the first-line treatment for RP. In this study, we aimed to determine the efficacy and safety of the GMT procedure using the LKM based on more than 100 cases with RP we have operated on over the past 10 years.

## Methods

This observational cohort study was a retrospective cross-sectional analysis conducted using a continuously maintained database. Data were collected and analyzed after the study was reviewed and approved by the Ethics Review Committee of the Japanese Society of Coloproctology. This study included patients with RP who underwent the GMT procedure using the LKM at our hospital between January 2012 and June 2023. All the patients provided written informed consent for the procedure. Young patients in whom maximum resting pressure (MRP) reduction was not observed on anal manometry and those with mental disorders unable to control straining during defecation were not indicated for the GMT procedure. Patients with RP who did not meet the inclusion criteria for the GMT procedure were referred to other hospitals primarily for laparoscopic rectopexy.

### Surgical technique

The surgery was performed under local or lumbar spinal anesthesia, with the patient placed in the jackknife position. The anesthesia method was determined based on the overall health status, antiplatelet or anticoagulant medication use, and patient preferences. Initially, the length of the prolapsed rectum was measured. Subsequently, the Gant-Miwa procedure was performed, involving “tie-dyeing” of the prolapsed rectum using silk thread, starting from the distal end. Specifically, the mucosa and submucosa were grasped with Alice-type forceps and ligated to form a small bean-like shape. The redundant rectum was shortened by repeating the tie-dyeing process while avoiding concentric ligation to pre-

vent stricture. Additionally, performing ligations sufficiently close to the dentate line is crucial to avoid recurrence (Figure 2).

After the completion of the Gant-Miwa procedure, all surgical instruments were replaced with sterilized ones. Thor-



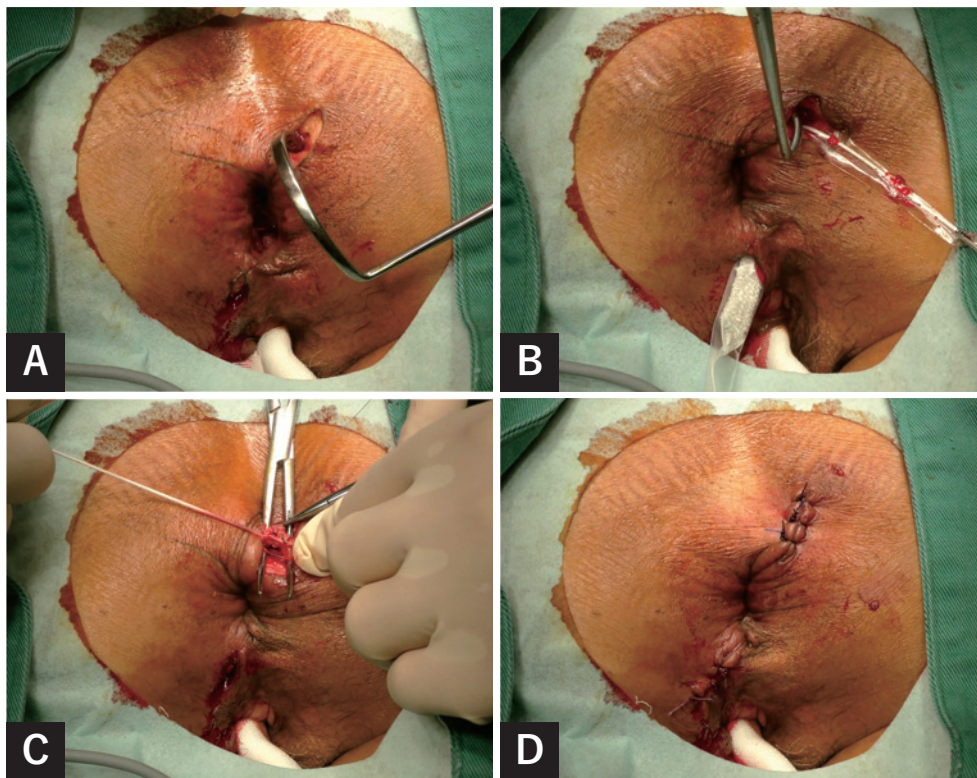
**Figure 2.** The Gant-Miwa procedure involves performing the “tie-dyeing” process on the prolapsed rectum using silk thread sufficiently close to the dentate line.

ough disinfection was repeatedly performed using iodine, and skin incisions were made at the 1 o'clock and 7 o'clock positions. From the incision site, the subcutaneous tissue was vertically dissected using Pean forceps, and a large-sized Deschamps was used to insert the LKM (Figure 2) outside the external sphincter muscle (Figure 3A, 3B). The LKM was encased in nylon to facilitate smooth placement. The tips at both ends of the LKM were tied together, and the ligation point was reinforced by passing a nylon thread through it to prevent loosening (Figure 3C). Finally, the incisions at the 1 o'clock and 7 o'clock positions were closed, completing the surgery (Figure 3D).

After the surgery, prophylactic antibiotics were administered for 2 days, and pain relieving medication for 5 days. During hospitalization, the incision site was observed and bowel movements were monitored. In patients with a tendency toward constipation, appropriate medications were administered, as needed.

#### Outcome measures

Outcome measures included intraoperative and postoperative complications, recurrence rates, postoperative bowel conditions, and changes in anorectal pressure before and af-



**Figure 3.** The skin incisions were made at the 1 o'clock and 7 o'clock positions (A). From the incision site, a large-sized Deschamps is used to insert the Leeds-Keio mesh outside the external sphincter muscle (B). The tips at both ends of the Leeds-Keio mesh are tied together, and to further prevent loosening, the ligation point is reinforced by passing a nylon thread through it (C). Finally, the incisions at 1 o'clock and 7 o'clock positions were closed, concluding the surgery (D).



**Table 1.** Patients’ Demographic and Postoperative Findings.

		Median
Age	40–97 years	81 years
Sex	Male:female=8:99	
Period of illness discomfort	1 month–47 years	12 months
Postoperative observation period	2–130 months	29 months
Rectal prolapse length	2–15 cm	7 cm
Anesthesia	local:lumbar=34:73	
Number of GM ligations	6–106	26
Surgical time	23–89 min	39 min
Postoperative hospital stay	2–14 days	6 days

GM, Gant-Miwa procedure

ter the surgery. The Clavien-Dindo classification (grade  $\geq$ II) was used for the evaluation of complications. Postoperative recurrence was defined as “the re-escape of the rectum or rectal mucosa from the anus.” MRP and maximum squeeze pressure (MSP) were assessed using high-resolution manometry performed before the surgery and 3-6 months after the procedure. Moreover, preoperative and postoperative bowel conditions were evaluated via interviews. Although specific symptom scores were not used, patients were inquired about constipation, fecal incontinence, and the use of laxatives as well as other medications. The patients were followed up on an outpatient basis, while those unable to visit the hospital due to advanced age or chronic illnesses were interviewed by telephone between June 2024 and October 2024. If the patient was deceased or had dementia, the family was interviewed.

**Statistical analyses**

All statistical analyses were performed using IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA). Data are expressed as medians (minimum-maximum). Changes in MRP and MSP before and after the surgery were analyzed using the Wilcoxon matched-pairs signed rank test. P values of  $<0.05$  were considered statistically significant. Time to recurrence was analyzed using the Kaplan-Meier estimator.

**Results**

During the study period, 107 patients with RP underwent the GMT procedure using the LKM and were enrolled in this study. Baseline characteristics and postoperative findings of the patients are presented in Table 1. The median patient age was 81 years, with 41 (38.3%) aged  $\geq$ 85 years. Seventeen (15.9%) patients were on antiplatelet or anticoagulant medications. The number of Gant-Miwa ligations per case ranged from 6 to 106 (median, 26).

No intraoperative complication was recorded, and the median amount of blood loss was  $<1$  mL. No complications re-

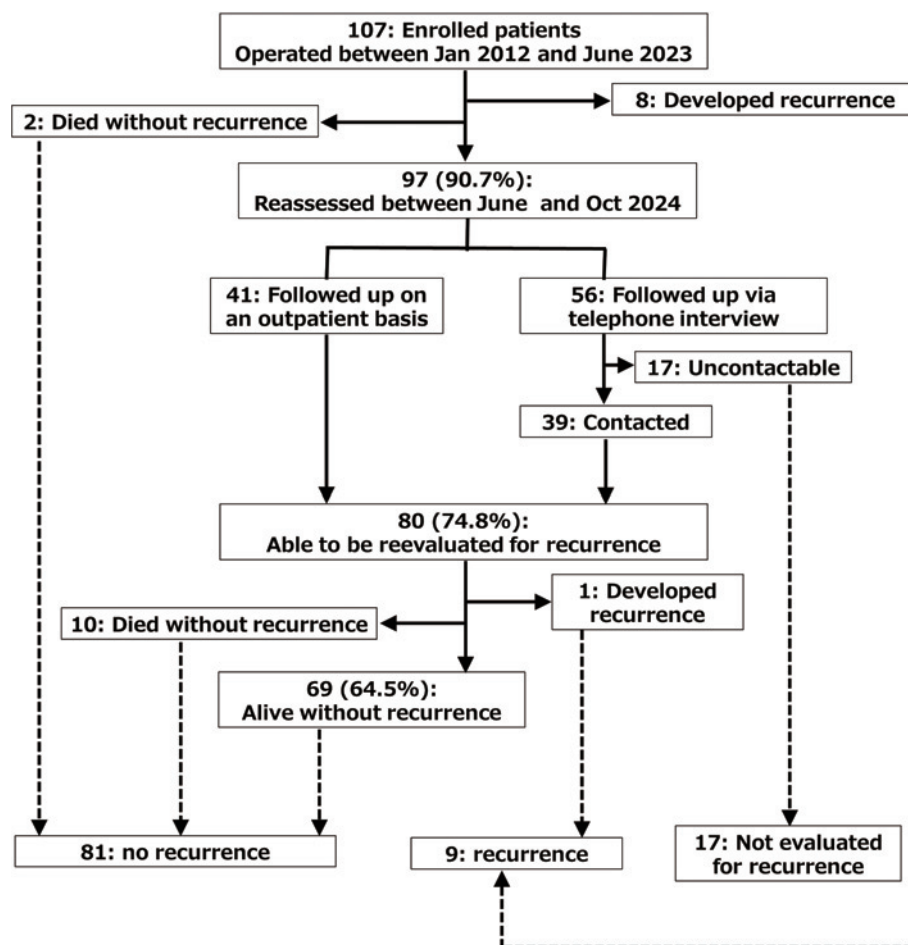
**Table 2.** Postoperative Complications.

	Number	%
Constipation	21	19.6
Fecal impaction requiring digital stool removal	4	3.7
Exposure of LKM	3	2.8
Late-onset infection of LKM	1	0.9
Postoperative bleeding	1	0.9
Total	26	24.3

LKM, Leeds-Keio mesh

lated to the respiratory or circulatory system were observed. However, postoperative complications were noted in 26 (24.3%) patients (Table 2). The most frequently encountered complication was constipation, noted in 21 (19.6%) patients, and all the patients demonstrated improvement with the use of laxatives. Four (3.7%) patients required digital stool removal due to fecal impaction; however, prolonged defecation difficulties were not observed in any case. The LKM was exposed to the intestinal mucosa in three (2.8%) patients 1-2 months postoperatively, and all patients had surgical removal of the LKM. In two of these patients, the LKM was reinserted 2 months after removal. In one patient, the LKM was not reinserted, yet no recurrence was observed. One patient with bullous pemphigoid taking prednisone (20 mg/day) for 3 months had a delayed (2 years postoperatively) infection involving the LKM. The LKM was removed and drained, after which the patient’s condition gradually improved, and RP did not recur even though the LKM was not reinserted. One patient experienced postoperative bleeding, requiring hemostasis at the suture site of the Gant-Miwa procedure. In this study, five cases of Clavien-Dindo grade IIIa complications were observed.

During follow-up, eight patients experienced recurrence of RP and two died without recurrence (Figure 4). Of the 107 enrolled patients, 97 (90.7%) were reassessed for recurrence between June and October 2024. Among them, 41 patients were reevaluated in the outpatient clinic and 56 were reassessed via telephone interview. Of the 56 patients interviewed via telephone, 39 could be contacted, whereas 17 could not be contacted for reasons including unanswered phone calls or inactive phone numbers. Ultimately, 80 (74.8%) patients were reassessed for recurrence; among them, 1 experienced recurrence, 10 died without recurrence, and 69 (64.5%) survived without recurrence. Thus, recurrence of RP was observed in 9 (10%) of the 90 patients with a confirmed prognosis for recurrence, while it remained unconfirmed in 17 patients. For the 90 patients who were reevaluated for recurrence, the median follow-up period was 33 (range: 3-130) months. In contrast, for the 17 patients who could not be reevaluated, the median follow-up period was 5 (range: 2-35) months. The 5-year cumulative recur-



**Figure 4.** Flow chart of the follow-up and recurrence in the study patients.

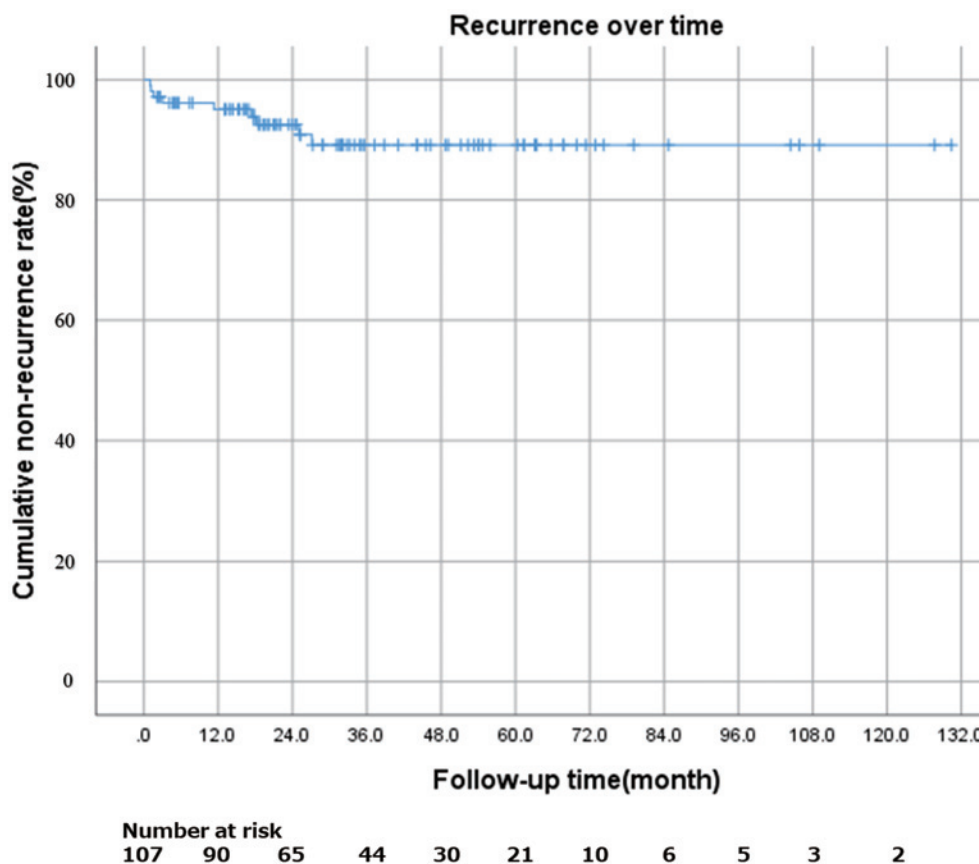
recurrence rate was 10.9% for the 107 enrolled patients (Figure 5), with a median follow-up period of 29 (range: 2-130) months.

In all patients, recurrences occurred between 1 and 27 months postoperatively, with a median RP length of 2 cm at recurrence. Three patients who experienced recurrence were treated with a repeat GMT procedure, meanwhile, two were managed with aluminum potassium sulfate and tannic acid (ALTA) sclerotherapy. The remaining four patients declined a reoperation and were managed with follow-up care (Table 3). Preoperative and postoperative anal manometry were performed in 76 (71.0%) patients. The median MRP increased significantly from 5.9 (range: 0-25.1) mmHg preoperatively to 9.2 (1.9-66.7) mmHg postoperatively ( $P<0.01$ ). Conversely, no significant change in MSP was observed before (median: 66.4 mmHg, 31.8-244.1) and after (67.1 mmHg, 42.1-190.5) the surgery ( $P=0.56$ ). Of the 89 patients with preoperative bowel condition assessments, 65 had fecal incontinence, and 33 (50.8%) achieved resolution after the surgery.

## Discussion

Although the recurrence rate of the GMT procedure ranges from 24% to 31%[7], recent reports have indicated an improvement in the rate from 7% to 14% with the modified GMT procedures[6,8]. The recurrence rates associated with the Altemeier and Delorme procedures, which are the most popular perineal approaches in Western countries, are 16-30% and 8-27%, respectively[11-16]. Therefore, the recent GMT procedure may be as effective as other perineal approaches, with a favorable recurrence rate of 10.9% observed in our study. Although the cumulative 5-year recurrence rate was 10.9% in this study, this figure could be underestimated due to potential bias from the relatively short follow-up period in some cases, because the follow-up period was less than 5 years in 86 patients (80%).

Abe et al.[17] investigated the long-term outcomes of combined ALTA sclerotherapy and Thiersch procedure using the LKM for RP. Their findings demonstrated that among 106 patients with RP, 18 (17%) experienced recurrence at a mean follow-up period of 22.1 months, and the cumulative recurrence rates at 3 and 5 years were 21.3% and 38.6%, respectively[17]. In our study, the 5-year cumulative recur-



**Figure 5.** Time to recurrence based on the Kaplan-Meier method. The postoperative 5-year cumulative recurrence rate was 10.9%.

**Table 3.** Details of the Nine Cases of Recurrence and Their Subsequent Progress.

Age (years)/sex	Length of initial prolapse	Time to postoperative recurrence	Length of prolapse at the time of recurrence	Retreatment method	Course
82/female	5 cm	2 months	1.5 cm	Aluminum potassium sulfate and tannic acid sclerotherapy	No recurrence
86/female	10 cm	15 months	2 cm	Aluminum potassium sulfate and tannic acid sclerotherapy	Recurrence after 23 months →LKM** additional insertion →No recurrence
83/female	8 cm	1 month	4 cm	GM* 16 ligations+ LKM** additional insertion	No recurrence
85/female	10 cm	1 month	5 cm	GM* 9 ligations+ LKM** additional insertion	No recurrence
84/female	10 cm	3 months	5 cm	GM* 6 ligations+ LKM** additional insertion	No recurrence
56/male	6 cm	18 months	2 cm	No additional treatment desired	-
80/female	8 cm	27 months	2 cm	No additional treatment desired	-
81/female	4 cm	25 months	2 cm	No additional treatment desired	-
81/female	8 cm	11 months	6 cm	No additional treatment desired Deterioration of dementia	-

GM\* Gant-Miwa procedure; LKM\*\* Leeds-Keio mesh

rence rate was 10.8%, suggesting that the Gant-Miwa procedure may be more effective than the ALTA sclerotherapy for treating RP. The mechanism through which the Gant-Miwa procedure facilitates the management of RP has not yet been elucidated. Yokoyama et al.[18] evaluated the perineal rectum after the Gant-Miwa procedure using computed tomography scans and reported an increased density of adipose tissue on the mesenteric side. Thus, they speculated that the mechanism of the Gant-Miwa procedure involves not only a direct mucosal plicating effect but also an adhesive rectosacral fixation due to the presence of inflammation extending to the mesorectum[18].

In this study, postoperative complications, except bleeding noted in one case, were attributed to the Thiersch procedure. Four studies have reported the use of the LKM in the Thiersch procedure[10,17,19,20]. In these studies, postoperative complications included wound infection in 8.4-23%, mesh exposure in 0-2.8%, mesh removal in 0-10.4%, and fecal impaction in 7.1-11.3% of the patients[10,17,19,20]. Abe et al.[20] reported the occurrence of constipation in 26% of the patients after the Thiersch procedure using the LKM, which is consistent with our rate of 19.6%. The incidence of other complications noted in our study is also consistent with the findings of previous reports, though the rate of mesh exposure was slightly higher in our study (2.8%). Intraoperative findings at the time of mesh removal suggested that this was due to a technical factor, as the LKM was inserted very close to the intestine. The removed LKM exhibited elasticity comparable to its initial state at the time of insertion, suggesting that the LKM can retain its elasticity for approximately 3 years after implantation.

The Thiersch procedure has also been used to treat fecal incontinence[19]. In our study, MRP increased significantly, and fecal incontinence improved in approximately half of the patients. Abe et al.[19] performed the Thiersch procedure using the LKM in 14 patients with fecal incontinence and reported that the Cleveland Clinic Florida Fecal Incontinence score decreased by more than 50% in seven patients (50%). Additionally, the mean MRP significantly increased from 16.8 mmHg to 22.6 mmHg. Therefore, the Thiersch procedure using the LKM may be effective for managing fecal incontinence.

The limitations of this study include its retrospective, single-institution, and observational design and the absence of a control group. In addition, the postoperative follow-up was performed via telephone survey in some patients, thus recurrence was determined without an anal examination. Furthermore, no specialized symptom score was used to assess constipation and fecal incontinence. Therefore, the results of this study should be validated by future prospective studies.

In conclusion, the GMT procedure using the LKM is minimally invasive and has a short surgical duration, making

it feasible to be performed under local anesthesia. The associated postoperative recurrence rate is low, and even if RP recurs, it is addressed using additional perineal procedures. Therefore, the GMT procedure using the LKM is considered an effective treatment option for older patients and for those who are deemed unsuitable for abdominal approaches.

#### Conflicts of Interest

There are no conflicts of interest.

#### Author Contributions

Naoto Nishigori is the corresponding author.

Yoshiyuki Sasaki and Shinsaku Obara performed the surgery in our hospital and also reviewed and proofread this paper.

#### Approval by Institutional Review Board (IRB)

This study was approved by the Japan Society of Coloproctology (IRB number: 6-JSCP · IRB-4).

#### Informed Consent

Informed consent was obtained from all patients.

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