

Single-stage laparoscopic transanal pull-through modified Swenson procedure without leaving a muscular cuff for short- and long-type Hirschsprung disease: A comparative study

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Abstract

Purpose: The Soave procedure (SO) is performed most commonly for Hirschsprung disease. SO reduces the risk of injury to the pelvic structures; however, a residual aganglionic muscle cuff could interfere with bowel movement and lead to obstructive enterocolitis. The Swenson procedure is considered ideal in terms of peristalsis. Currently, laparoscopic surgery provides better visualization and facilitates precise dissection, possibly leading to feasible performance of the laparoscopic modified Swenson procedure (SW). We present our operative technique and the efficacy of the SW compared with that of SO.

Methods: We retrospectively reviewed the records of 16 and 27 patients who underwent SW and SO, respectively, between 2012 and 2017.

Results: Operative time, blood loss, length of stay, and frequency of bowel movements showed no significant difference between the two groups. In the SW group, temporary dysuria occurred in one patient, postoperative enterocolitis in two, wound infection in one, and severe perianal excoriation in four, whereas in the SO group, obstructive symptoms occurred in three patients, small-bowel obstruction in one, and severe perianal excoriation in three. The complications and outcomes were comparable between both groups.

Conclusion: Laparoscopic SW was safe and feasible for the short-term follow-up outcomes.

Keywords: Hirschsprung disease, Swenson, Muscular cuff, Laparoscopy, Aganglionosis, Single stage

Introduction

Hirschsprung disease (HD), one of the most commonly encountered diseases among pediatric surgeons, has an incidence rate of approximately 1 in 5000 live births [1]. Definitive treatment of HD is the resection of the aganglionic bowel and reconstruction with transanal pull-through of ganglionic bowel. Currently, in Japan, the Soave procedure is performed most commonly, followed by the Duhamel procedure, and the Swenson procedure is seldom selected [2,3]. The Soave procedure reduces the risk of mucosal dissection-caused injury to the pelvic structures [4,5]. However, a residual aganglionic muscle cuff could interfere with bowel movement and lead to obstructive enterocolitis [6–10,11]. The Swenson procedure is considered ideal in terms of peristalsis, but it is a technically difficult operation with a high rate of injury to pelvic structures [2,3]. These complications might be due to an extensive dissection around the rectum. Advancement in laparoscopic clear vision, techniques, and instruments has resulted in thorough delineation of pelvic structures, and it enables precise dissection in the appropriate plane without injury to pelvic structures [3,4,12,13]. In addition, development of the transanal technique showed that the modified Swenson procedure using these approaches results in excellent long-term outcomes for fecal and urinary continence and sexual activities. Recently, some studies reported that the laparoscopic modified Swenson procedure does not increase the risk of injury to intrapelvic structures and produces favorable outcomes that are comparably good, if not better, than those by the other procedures [3,4,6,13].

We performed a single-stage, laparoscopic transanal pull-through without leaving a muscular cuff, as with the modified Swenson procedure, that produced good results by enabling complete removal of aganglionic

bowel without leaving an aganglionic cuff or pouch. On the other hand, the modified Swenson procedure might result in urinary dysfunction [1–3,5,9,11]. We examined whether the short-term outcomes of our laparoscopic modified Swenson procedure were comparable with those of the laparoscopic Soave procedure with a short cuff.

Patients and Methods

From October 2011 to September 2017, 43 patients diagnosed with HD, including short and long segments, underwent surgical treatment at Saitama Children's Medical Center or Nagoya University Hospital. HD was diagnosed preoperatively on the basis of the findings of barium enema and increased acetylcholinesterase staining in a rectal suction biopsy. All patients underwent a single-stage radical operation. A total of 36 patients with short-segment HD controlled bowel movements with glycerin enemas or intestinal lavage, whereas in seven patients with long-segment HD, a transanal decompressive tube was inserted with its tip in the ganglionic colon; the colon was irrigated daily until the day of the radical operation.

The following information was recorded: age, sex, operative time, blood loss, weight at operation, length of stay, length of follow-up, transitional zone level, postoperative complications, and frequency of bowel movements per day. In this study, since the purpose was to compare short-term results, the observation period was within 3 years postoperatively. Univariate analyzes were performed using Fisher's exact test for comparing complications and the Mann–Whitney *U*-test for comparing operative time, blood loss, and length of hospital stay between the modified Swenson and Soave procedures. $P < 0.05$ was considered statistically significant. This retrospective survey was approved by the Ethics Committee of Saitama Children's Medical Center

(2018-01-014) and Nagoya University Hospital (2018-0045).

Surgical procedure

Under general anesthesia, the patient was transversely positioned near the end of the operating table with the head turned rightward and toward the anesthetist. Additionally, the patient was placed in the lithotomy position for easy access to the abdomen and perineum. The surgeon stood near the patient's head, and a monitor was positioned beyond the patient's feet through the laparoscopic portion of the procedure (Fig. 1). Further, one 5 mm and two 3 mm trocars were inserted in the umbilical incision and middle abdomen, respectively. In the case of reduced-port surgery, a reversed Y-shaped incision (Benz incision) was constructed at the umbilicus, and a multichannel port was inserted through the incision with three retractor-attached 5 mm trocars. If necessary, a 3 mm port also was inserted in the lower right abdomen. Initially, a full-thickness bowel biopsy was performed to confirm the correct position of the ganglionic intestine. Further, laparoscopic dissection was extended to the peritoneal reflection of the rectum. For the long-type HD, the aganglionic bowel with mesentery and associated vessels was removed with exteriorization via the umbilical incision, as possible. The proximal ganglionated bowel was mobilized, and distal circumferential dissection was performed around the colon.

Fig.1

In the Soave procedure, the rectum was dissected around the peritoneal reflection. Further, after placing an anal retractor (The Lone Star Retractor System TM; Yufu, Tokyo, Japan), transanal circumferential submucosal dissection was performed from the Herrmann line, which exists 0.5–1 cm above the dentate line and is a line coinciding with the upper edge of the surgical anal canal to the peritoneal reflection. When this dissection was

successfully achieved, the aganglionic bowel was easily removed, and a muscular cuff was resected with exteriorization from the anal canal to achieve a 1–3 cm muscular cuff. Next, the ganglionic bowel was pulled through and anastomosed to the anal canal.

In the modified Swenson procedure, the rectum below the peritoneal reflection was circumferentially dissected up to the inferior border of the levator ani muscle. This dissection was performed meticulously along the precise lines of the rectum wall to precisely identify and preserve the pelvic structures. Digital examination confirmed whether the level of dissection had extended to the levator ani muscle (Fig. 2). Then, after placing an anal retractor, transanal circumferential full-thickness dissection was performed from the Herrmann line without leaving a muscular cuff (Figs. 3a, 3b). When a full-thickness circumferential dissection was achieved, the aganglionic bowel was easily removed (Fig. 3c), and the ganglionic bowel was pulled through and anastomosed to the anal canal (Fig. 3d). The schema of surgical procedures is shown in Fig. 4.

Fig.2

Fig.3

Fig.4

Results

Of the 43 patients, 16 (14 males and 2 females; 13 with short-segment HD and 3 with long-segment HD; reduced-port surgery in 13) underwent the single-stage modified Swenson procedure, whereas 27 (23 males and 4 females; 23 with short-segment HD and 4 with long-segment HD; reduced-port surgery in 8) underwent the single-stage Soave procedure. Median age at operation (range) was 3.5 (1–27) and 4 (0–79) months for the single-stage modified Swenson and single-stage Soave procedures, respectively, and median weight was 6.5 (2.8–12.1) and 6.3 (3.1–26.4) kg, respectively (Table 1). At Saitama Children's Medical Center, the Soave

Table 1

procedure was performed in all children. At Nagoya University Hospital, the modified Swenson procedure was performed after 2014, and the Soave procedure was performed before 2014. The Soave procedure was performed at both hospitals, but there was no difference in this procedure between the two hospitals. Postoperative management was similar at both hospitals. Specifically, oral intakes were started from postoperative day 3, the bougie was administered on postoperative day 10, and it was discharged if oral intakes and defecation were acceptable.

Median operative time and blood loss in the modified Swenson versus Soave groups were 213 (143–306) and 223 (134–300) min, respectively, and 7.5 (2–52) versus 10 (0–229) mL, respectively. Length of hospital stay and frequency of bowel movements on the day of discharge were 13 (11–65) versus 16 (12–59) days, respectively, and 9 (5–12) versus 8 (3–14) times, respectively. Follow-up duration was 29 (10–36) and 36 (10–36) months, respectively. There was no significant difference between the two groups in terms of patient background, operative time, bleeding volume, postoperative length of stay, frequency of bowel movements at discharge, and follow-up duration (Table 2).

Table 2

In the modified Swenson group, except for one case of temporary dysuria, there were no major surgical complications, including postoperative small-bowel obstruction, anastomotic leakage, anastomotic stenosis, or urinary retention. The case of dysuria was evaluated and followed by measuring intravesical pressure and conservatively relieved. Regarding postoperative complications, enterocolitis was noted in two patients with long-segment HD, severe perianal excoriation in one with long-segment HD and three with short-segment HD, and wound infection and dehiscence in one (Table 3). Almost all patients had frequent defecation, liquid stools,

Table 3

and perianal excoriation in the early postoperative period. These symptoms resolved with medications and ointment for skin treatment. All but one patient had good control of bowel movement and perianal excoriation during their discharge. One patient with short-segment HD, who was suspected to have Mowat–Wilson syndrome, had wound infection and dehiscence.

On the other hand, postoperatively, in the Soave group, one patient had small-bowel obstruction, one colonic stenosis, three obstructive symptoms, three enterocolitis, and three severe perianal excoriation. Only one patient with small-bowel obstruction required unexpected reoperation. There was no significant difference in the incidence of complications between the two groups (Table 3).

Discussion

For HD, many types of surgical procedures combined with major operations have also been reported [6,12]. However, to the best of our knowledge, no prospective study has clearly established the superiority of any technique over the others [1,2,4,5,12]. In Japan, Soave procedures have been commonly used with or without laparoscopic assistance. However, worldwide, the numbers of surgeons popularly preferring the Soave approach are waning because of ongoing problems with anorectal function [14]. Soave procedures leave an aganglionic muscular cuff. The residual aganglionic muscle cuff can lead to obstructive symptoms or subsequent enterocolitis. Indeed, in our Soave procedure group, three patients had obstructive symptoms requiring regular dilatation of the anal canal.

Recently, the transanal Soave pull-through procedure with a shorter muscular cuff has been widely

used because of the concerns about cuff stricture [5,9,10]. Notably, the difference in the cuff length between the Soave procedures with a short cuff and the modified Swenson procedures is minimal [4].

Recently, several studies have reported that the laparoscopic or transanal modified Swenson procedure does not increase the risk of injury to intrapelvic structures and produces favorable outcomes that are as good, if not better, than outcomes produced by other procedures [3–5,12,13,15,16]. Laparoscopic surgery with excellent lighting and magnification provides better visualization and facilitates precise intrapelvic dissection. Indeed in our experience, laparoscopy allowed us to see the intrapelvic structures better, so that the rectum below the peritoneal reflection was precisely dissected up to the inferior border of the levator ani muscle. In addition, data concerning restorative proctocolectomy in adults that, similar to the modified Swenson procedure, include super-low anterior resection are available. These data showed long-term postoperative functional results with excellent postoperative lifestyles in adults and the majority of children with HD [17]. Therefore, the laparoscopic modified Swenson surgery produces no injury to the pelvic nerves and vessels and preserves rectovesical and sexual functions in adults and children. In this study, except for one case of temporary dysuria, no major surgical complications were observed; additionally, no damage to intrapelvic structures was observed. However, dissection of the rectum surrounding the pelvic organs must be performed carefully.

Overall, in our study, there was no significant difference in terms of procedure and perioperative complications and the short-term outcomes between the groups undergoing the modified Swenson and Soave procedures with a short cuff. The laparoscopic modified Swenson procedure is comparable with the

laparoscopic Soave procedure with a short cuff.

In summary, laparoscopic surgery particularly facilitates removal of the complete original aganglionic bowel without leaving a muscular cuff or pouch. The laparoscopic single-stage modified Swenson procedure was safe, with acceptable continence and promising results, and was feasible on the basis of short-term follow-up outcomes comparable with those of the laparoscopic-assisted Soave procedure. However, in this study, median follow-up duration was 29 months. Therefore, longer follow-up durations are required to better characterize this procedure.

Compliance with Ethical Standards:

Conflict of interest: The authors declare that there is no conflict of interest regarding the publication of this paper.

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Figure Legends

Fig. 1. Operative position

The operator stands above the patient's head, and a monitor is positioned beyond the patient's feet. The surgical assistant and camera holder are positioned at the foot of the operating table or beyond the patient's feet. When the transanal procedure is initiated, the operator stands beyond the patient's feet.

Fig. 2. Intraoperative image of modified Swenson procedure

Laparoscopic dissection is performed meticulously along the precise lines of the wall of the rectum (R). Digital rectal examination is performed to confirm that the level of dissection has reached the internal anal sphincter.

*Levator ani muscle.

Fig. 3. Transanal circumferential full-thickness dissection in the modified Swenson procedure

(a) A mucosal incision was constructed from the Herrmann line to mark the planned incision line. (b) A full-thickness incision was constructed at the site indicated by the arrow and connected to the abdominal cavity dissected in the process of laparoscopic surgery. (c) A full-thickness circumferential dissection was achieved, and the aganglionic bowel was easily removed. (d) Full-thickness single layer suture at end-to-end anastomosis was completed.

Fig. 4. Schema of the modified Swenson procedures

The red arrows show the dissection line. Arrow (a) shows the laparoscopic dissection line, and arrow (b) shows the incision line by the transanal procedure.

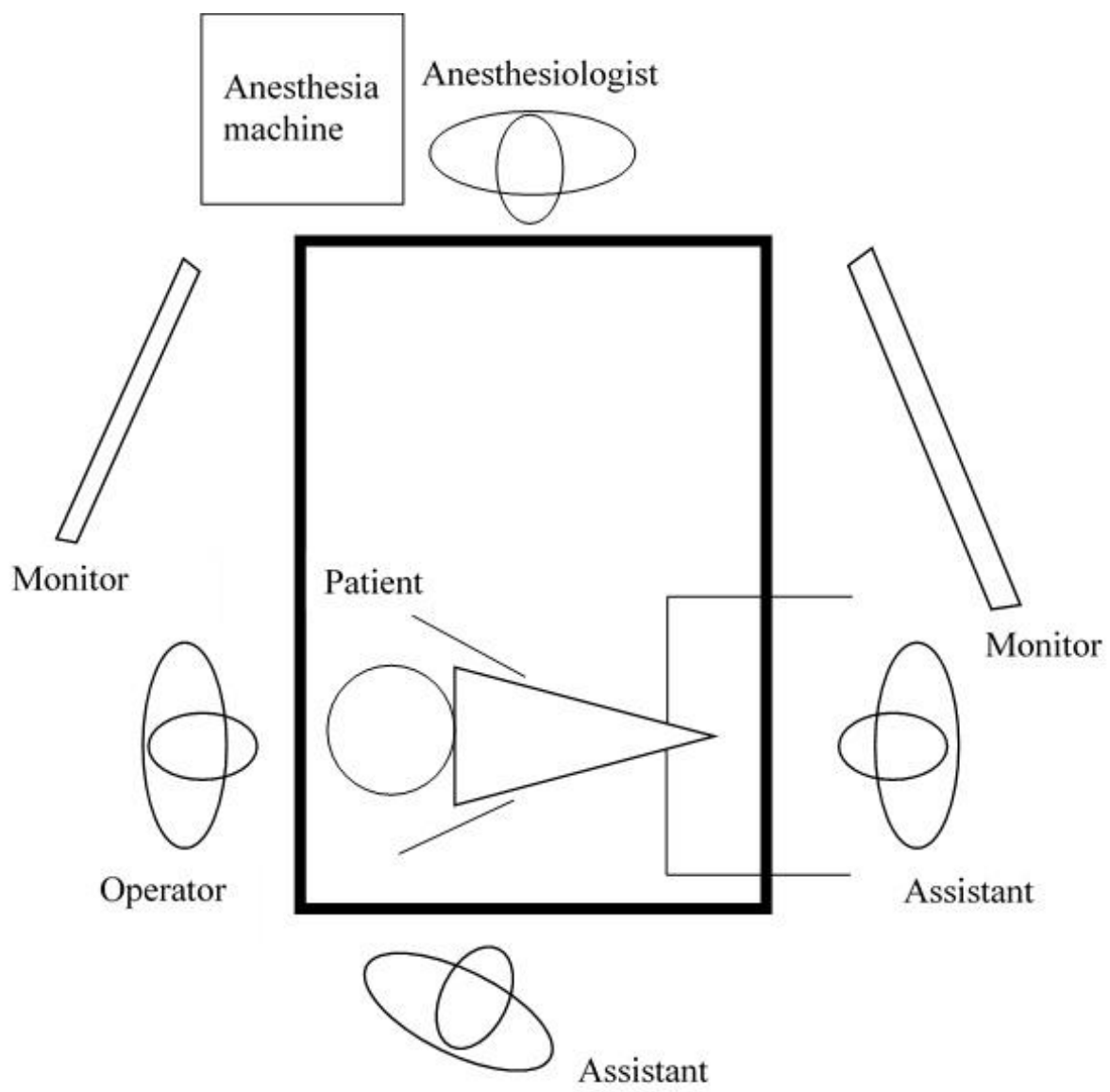


Figure 1

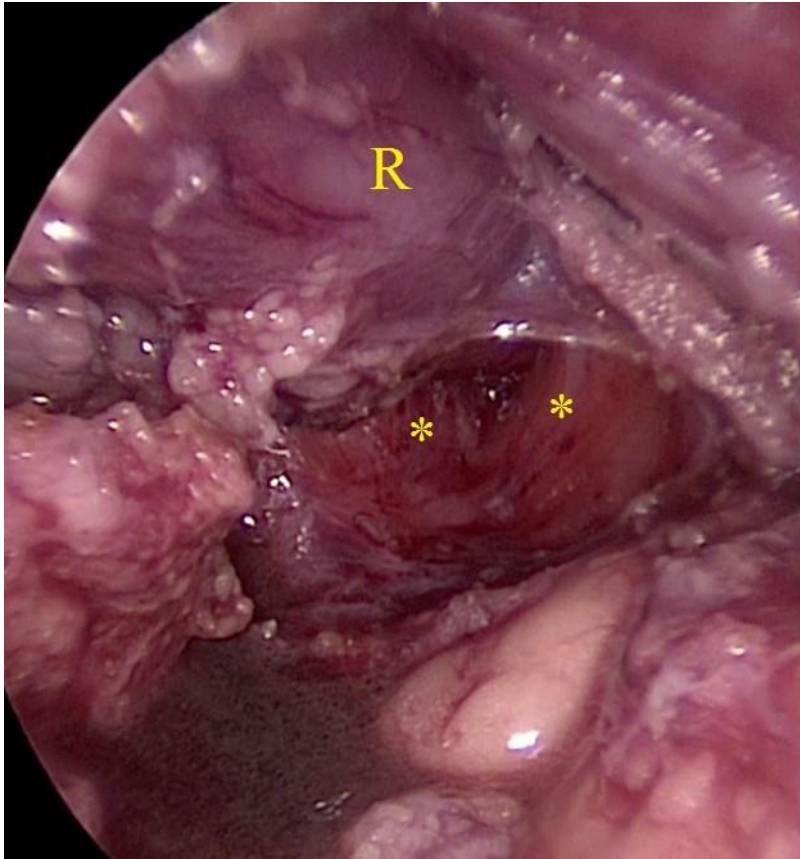


Figure 2

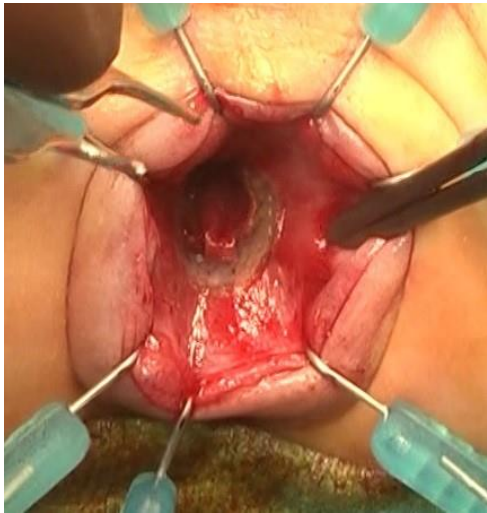


Figure 3a

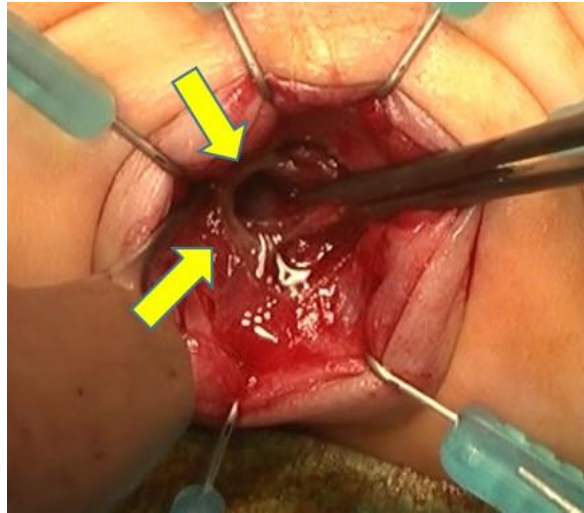


Figure 3b

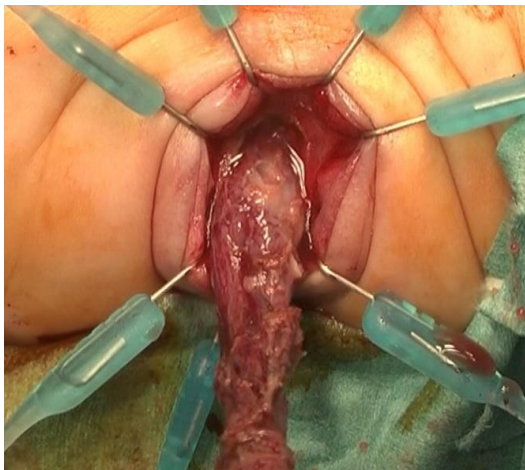


Figure 3c

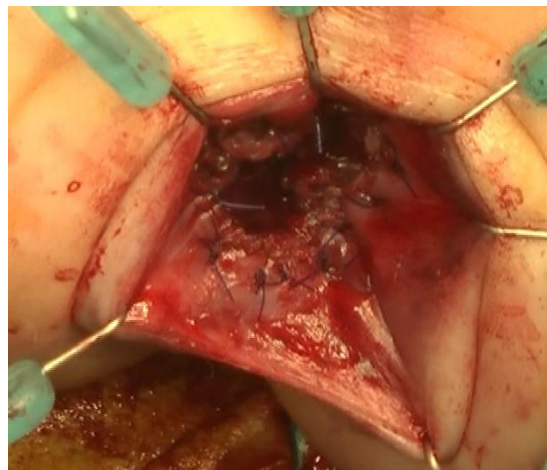


Figure3d

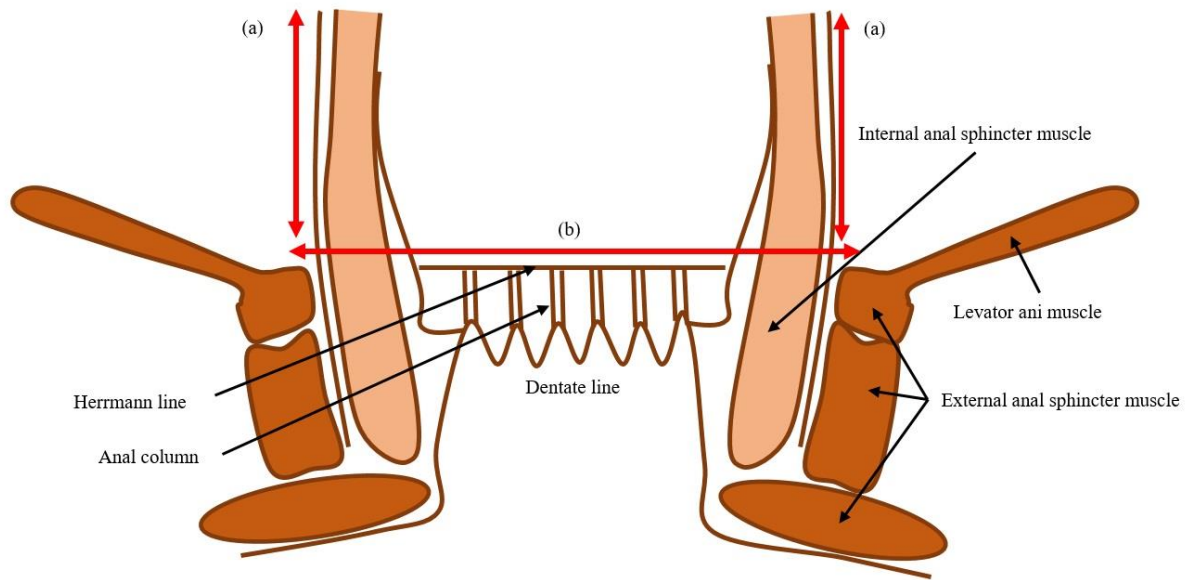


Figure 4

Table 1. Characteristics of the patients and details of operative procedure

	Modified Swenson Procedure (<i>n</i> = 16)			Soave Procedure (<i>n</i> = 27)		
Age at surgery (months), Median (range)	3.5 (1–27)			4 (0–79)		
Weight at surgery (kg), Median (range)	6.5 (2.8–12.1)			6.3 (3.1–26.4)		
Type of HD	Transitional Zone	Number	Reduced Port Surgery, (<i>n</i>)	Transitional Zone	Number	Reduced Port Surgery, (<i>n</i>)
Short	Rs	7	7	Rs	14	3
	S/C	6	3	S/C	9	2
Long	D/C	1	1	D/C	2	1
	T/C	2	2	T/C	2	2

HD, Hirschsprung disease; Rs, rectosigmoid colon; S/C, sigmoid colon;

D/C, descending colon; T/C, transverse colon

Table 2. Intraoperative and postoperative data (other than postoperative complications)

Variable	Modified Swenson Procedure	Soave Procedure	<i>P</i> -value
Operative time (min), Median (range)	213 (143–306)	223 (134–300)	0.43
Operative bleeding (mL), Median (range)	7.5 (2–52)	10 (0–229)	0.66
Length of hospital stay (days), Median (range)	13 (11–65)	16 (12–59)	0.35
Frequency of bowel movements per day at discharge (times), Median (range)	9 (5–12)	8 (3–14)	0.79
Follow-up duration (months), Median (range)	29 (10–36)	36 (10–36)	0.09

Table 3. Postoperative complications

Complications	Modified Swenson (n = 16)	Soave (n = 27)	<i>P</i> -value
Postoperative enterocolitis	2	3	1.00
Severe perianal excoriation	4	3	0.39
Wound infections/wound dehiscence	1	0	0.37
Postoperative small bowel obstruction	0	1	1.00
Colonic stenosis	0	1	1.00
Obstructive symptom	0	3	0.28
Urinary retention	1	0	0.37
Anastomotic leakage	0	0	1.00