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Operative Technique

Minimal dissection of posterior wall of rectum reduces rectal prolapse in laparoscopic assisted anorectal pull-through

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ABSTRACT

Purpose: To determine if minimal dissection of the posterior wall of rectum can reduce rectal prolapse after laparoscopic assisted anorectal pull-through (LAARP) in male anorectal malformation (ARM) with rectourethral fistula.
Methods: Eighty-six male patients with ARM who underwent LAARP in our center between 2007 and 2018 were retrospectively analyzed. There were 45 cases of prostatic urethral fistula, 24 bulbar urethral fistulas, and 15 bladder neck fistulas. Two patients had no fistula. To prevent rectal prolapses, we markedly shortened the length of posterior rectal dissection from mid-2016. Dissection of posterior wall of rectum was performed minimally around the level of the fistula and the dissected portion of the posterior rectum was significantly shorter than the previous cases. For comparative analysis, patients were divided into two groups (before and after application of minimal dissection of posterior wall of rectum): Group A, from 2007 to mid-2016 and Group B, from mid-2016 to 2018.
Results: There were 60 patients in Group A and 26 patients in Group B. Demographic characteristics were not significantly different between the two groups. The median follow-up duration was 52.4 months for Group A and 26.9 months for Group B. Group B had lower incidence of rectal prolapse (11.5%) than Group A (68.3%) ($p < 0.001$). Upon our subgroup analysis based on types of fistula, patients with recto-prostatic urethral fistula and recto-bulbar urethral fistula showed significant reduction in the incidence of rectal prolapse (both $p < 0.001$). However, patients with recto-bladder neck fistula showed no statistical significance ($p = 0.264$).
Conclusion: Minimal dissection of the posterior wall of rectum can reduce rectal prolapse in LAARP.
Level of evidence: III. Retrospective Comparative Treatment Study

Laparoscopic assisted anorectal pull-through (LAARP) for surgical correction of anorectal malformation (ARM) was first introduced by Georgeson in 2000 [1]. Since then, this procedure has gained increasing acceptance among many pediatric surgeons. Many studies have described that LAARP is feasible and provides better clinical outcomes than posterior sagittal anorectoplasty (PSARP) [2–8]. However, a few studies have reported an increase in rectal prolapse in patients who have undergone LAARP [9,10]. It has been speculated that this specific complication is due to the maximal dissection of the rectum [11]. However, few studies have reported factors associated with rectal prolapse after LAARP. Under these circumstances, we have modified our dissection technique since mid-2016 to see the effect of minimal dissection of the posterior wall of rectum in preventing postoperative rectal prolapses. Results are reported herein.

1. Methods

After the institutional review board approval (IRB File No. 2020-02-060), we retrospectively reviewed patients who underwent LAARP performed by a single surgeon at Samsung Medical Center (Seoul, South Korea) between November 2007 and November 2018. Surgical technique of LAARP was the same as that described previously by Jung et al. [12]. All patients underwent a loop colostomy prior to LAARP. All patients underwent stoma closure and LAARP at the same time. Types of fistula were determined based on preoperative loopogram, intraoperative cystoscopic findings, and laparoscopic findings at the time of surgery. In our center, except for a few earlier cases, cystoscopic examination was routinely performed to locate the opening of the fistula. Using a cystoscope, we successfully located the fistula that was identical with the findings on the loopogram. However, few cases showed no evidence of fistula on cystoscopic exam. In that case, we inserted a ballooned Foley catheter in the distal loop of the colostomy and inserted a small amount of air to check if there was any concealed fistula.

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We used the umbilicus as a camera port (5 mm). Two or three additional working ports were inserted. Rectovesical or rectourethral fistula was ligated with ENDO LOOP (P.D.S.). Veress needle was placed at the center of the neo-anus identified with a transcutaneous electrostimulator. It was followed by 12 mm trocar insertion. Finally, the rectum was pulled through. Anastomosis between the rectum and the anus was then done.

Patients visited the outpatient clinic every one or two weeks for the first three months and every three months thereafter. Physical examination around the anus was performed at the outpatient clinic. Rectal prolapse was diagnosed when the protrusion of the rectal mucosa of any size was visible at the anal verge.

In few early cases, we placed an anchoring stitch between the rectum and the presacral fascia to prevent rectal prolapse. Despite the measure, rectal prolapse occurred; thus, we had stopped applying such technique. Instead, we decided to modify our dissection technique. Before mid-2016, we started posterior rectal dissection from the level of the fistula and went up over the line of the peritoneal reflection. After mid-2016, we have shortened the length of posterior rectal dissection by dissecting the posterior rectum only around the level of the fistula without going up over the line of the peritoneal reflection. Fig. 1 shows how we have modified our dissection plane since mid-2016.

Chi-Squared test was used to compare categorical variables and Mann-Whitney test was used for continuous variables. p-Values of less than 0.05 were considered statistically significant.

Table 1
Demographic characteristic of the patients.

	Overall ($n = 86$)	Group A ($n = 60$)	Group B ($n = 26$)	p-Value
Gestational age (weeks, mean ± SD)	37.8 ± 1.9	37.7 ± 2.0	37.9 ± 1.6	0.618
Birth weight (g, mean ± SD)	2902 ± 561	2867 ± 521	2978 ± 645	0.405
Age at operation (months, median)	3.6 (1.9-9.1)	3.4 (1.9-9.1)	3.6 (2.2-7.9)	0.849
Weight at operation (g, mean ± SD)	6772 ± 1156	6690 ± 1092	6960 ± 1293	0.323
Operation time (minutes, mean ± SD)	197 ± 50	198 ± 57	194 ± 31	0.734
Type of anorectal malformations				0.693
- Bladder neck (%)	15 (17.4)	10 (16.7)	5 (19.2)	
- Prostate (%)	45 (52.3)	30 (50.0)	15 (57.7)	
- Bulbous urethra (%)	24 (27.9)	18 (30.0)	6 (23.1)	
- No fistula (%)	2 (2.3)	2 (3.3)	0 (0)	
VACTERL syndrome (%)	28 (32.6)	18 (30.0)	10 (38.5)	0.442
Vertebral anomaly (%)	47 (54.7)	30 (50.0)	17 (65.4)	0.188
Cardiac anomaly (%)	32 (37.2)	21 (35.0)	11 (42.3)	0.520
Gastrointestinal comorbidities	10 (11.6)	7 (11.7)	3 (11.5)	0.986
Vesicoureteral reflux	28 (32.6)	20 (33.3)	8 (30.8)	0.816
Follow up duration (months, median)	38.4 (3.4-131.5)	52.4 (3.4-131.5)	26.9 (9.9-34.9)	<0.001

SD, standard deviation.

2. Results

During the study period, 86 male infants with ARM underwent LAARP performed by one surgeon at Samsung Medical Center. Patients who received surgery before mid-2016 were placed in Group A and patients who received minimal dissection of posterior wall of rectum after mid-2016 were placed in Group B. There were 60 patients in Group A and 26 in Group B. As shown in Table 1, demographic characteristics of patients were not statistically different between the two groups. Recto-prostatic urethral fistula (RPF) was the most common type in both group (50.0% in Group A and 57.7% in Group B), followed by recto-bulbar urethral fistula (RBF) (30.0% in Group A and 23.1% in Group B) and recto-bladder neck fistula (RBNF) (16.7% in Group A and 19.2% in Group B). The mean operation time was not statistically different between the two groups (198 ± 57 min vs 194 ± 31 min, $p = 0.734$). The median follow-up duration was 52.4 months for Group A and 26.9 months for Group B.

Postoperative outcomes for both groups are shown in Table 2. Forty-one (68.3%) patients in Group A showed rectal prolapses. On the other hand, only three (11.5%) patients in Group B showed rectal prolapses ($p < 0.001$). Median time to develop prolapse was 5.8 months (range, 0.6–37.0 months) after the surgery. Of 44 patients who developed rectal prolapses, 36 (81.8%) developed prolapses within 1 year after the surgery (Fig. 2). Forty-three patients underwent surgical correction of the prolapse and of those, 5 required an additional surgical correction. The incidence of rectal prolapse had no statistically significant association with height of anorectal defect or the presence of vertebral anomalies in our study. Subgroup analysis based on types of fistula showed that the difference in the incidence of rectal prolapse between Group A and Group B was not statistically significant in patients with RBNF ($p = 0.264$). Only patients with RPF and RBF showed significant reduction in the incidence of rectal prolapse (both $p < 0.001$).

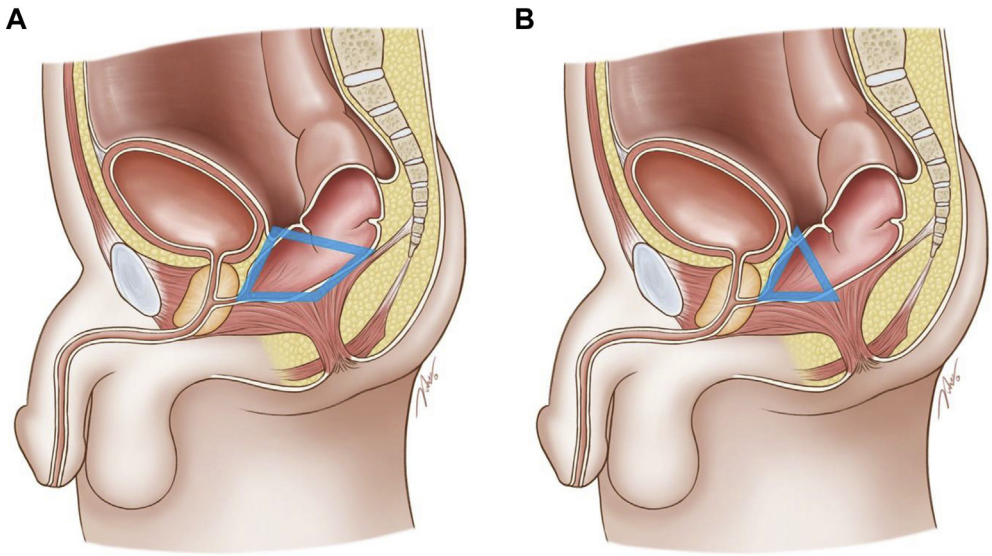

Fig. 1. (A) Dissection plane for Group A. (B) Modified dissection plane for Group B.

Table 2
Postoperative outcomes.

	Overall ($n = 86$)	Group A ($n = 60$)	Group B ($n = 26$)	p-Value
Rectal prolapse, n (%)	44 (51.2)	41 (68.3)	3 (11.5)	<0.001
Time to develop prolapse (months, median)	5.8 (0.6-37.0)	5.9 (0.6-37.0)	4.1 (1.3-6.43)	0.323
Rectal prolapse, n (%)				
Subgrouping by type of fistula				
- Bladder neck ($n = 15$)	6 (40.0%)	5 (50.0%)	1 (20.0%)	0.264
- Prostate ($n = 45$)	22 (48.8%)	20 (66.7%)	2 (13.3%)	<0.001
- Bulbous urethra ($n = 24$)	14 (58.3%)	14 (77.8%)	0 (0.0%)	<0.001
Correction surgery for prolapse, n (%)	43 (50.0)	41 (68.3)	2 (7.7)	<0.001
Anal stricture, n (%)	5 (5.8)	4 (6.7)	1 (3.8)	0.815

3. Discussion

LAARP has been a feasible surgical option for ARM with rectourethral fistula since its description by Georgeson in 2000 [1]. Previous studies have described that LAARP has benefits over PSARP such as excellent visualization of the fistula, better cosmetic outcomes, decreased wound infection and pain, and better functional outcomes [8,13–15]. On the other hand, a few authors have raised a concern that LAARP shows more postoperative complications such as posterior urethral diverticulum and rectal prolapses than PSARP [9,10,16–19]. The majority of the studies were single center trials with small sample sizes. As a result, the quality of evidence was low. Still there is no consensus on rates of complications for LAARP and PSARP [20].

In our single center analysis, we had no urethral diverticulum. Meanwhile, our results showed higher rates (51.2%) for rectal prolapses than those (9–46%) in other previous studies (Table 3). We assumed that different surgical skills of surgeons might be the reason for various incidences of rectal prolapse. Particularly, the length of rectal dissection at our center might have been long, resulting in a notably high incidence of rectal prolapse compared to other literatures. Another reason for higher rates of rectal prolapses in our study is that our study included all prolapses regardless of the size of prolapse (Fig. 3). We think that even a small prolapse can make the anal canal longer which makes defecation difficult. After then, we intentionally modified our dissection technique to make the length of pulled-through rectum shorter than the previous technique to prevent rectal prolapses.

To visualize the fistula, dissection of the anterior rectum is inevitable. Furthermore, in cases of RPF and RBF, surgeons have to go deeper beyond the line of peritoneal reflection. It is impossible to reduce the length of dissection for anterior rectal plane between the rectum and the prostate because dissection has to be proceeded until surgeons meet the fistula. As for the posterior side of the rectum, dissection is usually performed to mobilize the rectum. Thus, the length of dissection might be different among surgeons. Different length of posterior rectal wall dissection might have resulted in different incidence of rectal prolapses among centers. Before modifying the technique, we dissected the posterior rectum around the level of the fistula and extended dissection to proximal part of peritoneal reflection, making the mesorectum fully divided from the sacrum. In result, the rectum was easily pulled through to the anus. As we performed substantial numbers of LAARP, we noticed that most part of the rectum runs inferiorly towards the anal sphincter complex and only small part of the distal rectum turns anteriorly towards the urethra in patients with ARM. We assumed that dissection is not necessary for the proximal part of the rectum and posterior rectal dissection is required only around the distal portion of the rectum that is curved anteriorly. Considering these ideas, we have modified our technique by dissecting the posterior rectum only around the level of the fistula and trying not to go up over the line of peritoneal reflection. As a result, posterior part of the rectum was not divided from the presacral fascia and the dissected portion of the posterior rectum was shorter than the previous cases. Eventually, the anastomosed rectum was very stretched and tense at the time of surgery. The neo-anus was more

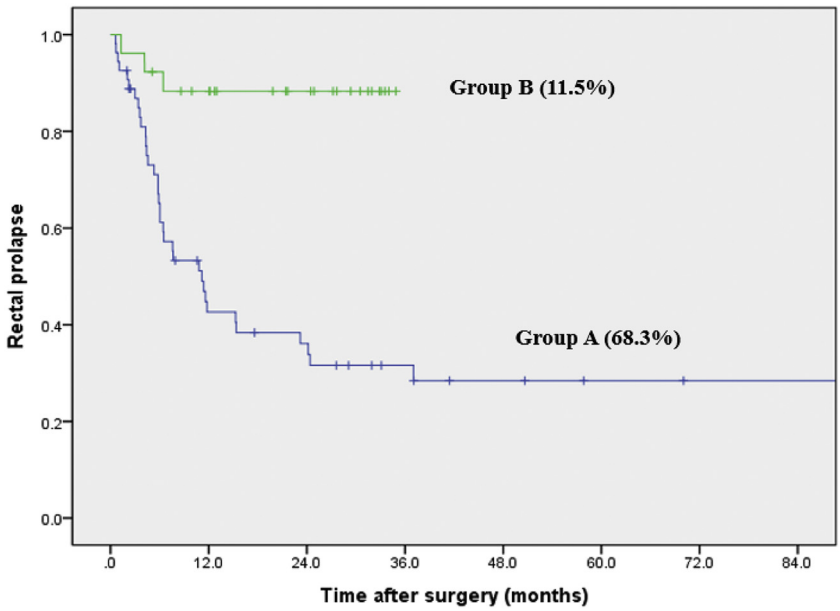

Fig. 2. Kaplan Meier curve for rectal prolapse ($p < 0.001$).

Table 3
Previous reports of rectal prolapse after LAARP.

Study, year	Country/number of center	Type of ARM	LAARP, (*n*)	Rectal prolapse, *n* (%)
Kudou et al. [2] 2005	Japan/Single	RVF, RUF, NF, RVAF, Cloaca	13	6 (46)
Vick et al. [13] 2007	USA/Single	RBNF, RPF	6	1 (17)
Yang et al. [4] 2009	China/Single	RVF, RPF, RUF, RVAF, NF	11	3 (27)
Podevin et al. [21] 2009	France/Multi (10)	RBNF, RPF, RBF	34	3 (9)
Bailez et al. [22] 2011	Argentina/Single	RVF, RPF	17	2 (12)
Tong et al. [5] 2011	China/Single	RVF, RPF, RBF, RVAF	33	3 (9)
Ming et al. [7] 2014	China/Single	RBNF, RPF	32	3 (9)
Leung et al. [15] 2016	Hongkong/Single	High, Intermediate	34	13 (38)
Yazaki et al. [10] 2016	Japan/Single	RPF, RBF	26	9 (35)
Ruggeri et al. [23] 2016	Italy/Single	RBNF, RPF, RBF	12	2 (17)

ARM, anorectal Malformation; RVF, rectovesical fistula; RBNF, recto-bladder neck fistula. RPF, recto-prostatic fistula; RUF, rectourethral fistula; RBF, recto-bulbar urethral fistula. RVAF, rectovaginal fistula; NF, no fistula.

concave than previous cases. We believe that this modification could reduce the risk of postoperative rectal prolapses by preserving the fixation of the rectum to neighbor structures, leaving no redundant rectum in the pelvic cavity.

A major concern of this technique is that it might produce strong tension around the suture line of the anus, and it may result in a dehiscence of the anal anastomosis or an anal stricture. However, no patient developed dehiscence in our study and the difference in the incidence of anal stricture between Group A (6.7%) and Group B (3.8%) was not statistically significant ($p = 0.815$) (Table 2).

In our center, RBF had the highest rate of rectal prolapse (58.3%), followed by RPF (48.8%) and RBNF (40.0%). Meanwhile, a few authors have mentioned that rectal prolapses are frequently seen in cases of RBNF [24,25]. When we reviewed our surgical technique, the length of posterior rectal wall dissection was longer for RBF than that for cases of RBNF. We assumed that our modification of surgical technique did not significantly change the length of rectal dissection for our patients with RBNF. This explains why our subgroup analysis showed that only RBF and RPF groups had significant reduction in the rate of rectal prolapse.

Minimal dissection of the posterior wall of the rectum may avoid unnecessary pelvic nerve and vessel injuries. Eventually, this might result in better functional outcomes of patients as well. We also think a concave anus makes anal canal shorter than a flat anus and it will have a positive effect on defecation. However, patients in Group B were operated after the year of 2016. Most of these patients were under three years old at the time of analysis, making it hard to review their status of voluntary bowel movement. If we follow up all our patients in Group B longer than three years and review their voluntary bowel control, we will be able to analyze the effect of minimal dissection of posterior wall of rectum on functional outcome of patients who underwent LAARP.

This study has several limitations. First, it was a retrospective study. Thus, results might be biased because our modification of surgical technique could be very subjective from a statistical point of view. Second, Group B had relatively shorter follow-up period than Group A. However, as we mentioned earlier, most patients developed rectal prolapses within a year (82%). All patients in Group B (except one patient) have been followed up over a year. Therefore, we assumed that even if additional rectal prolapses did occur, the number might be too small to affect results of our study. Another drawback of our study was that some institutions might have low incidence of rectal prolapses. Thus, our findings may not be useful to them. However, for institutions have high incidence of rectal prolapses, these results could be worth discussing. It might benefit from minimal dissection of the posterior rectum as shown in our study.

4. Conclusion

Minimal dissection of posterior wall of rectum reduces rectal prolapse in laparoscopic assisted anorectal pull-through. Additional studies concerning long-term functional outcomes should be discussed in the future.

Fig. 3. Various degrees of rectal prolapses.

References

[1] Georgeson KE, Inge TH, Albanese CT. Laparoscopically assisted anorectal pull-through for high imperforate anus – a new technique. J Pediatr Surg. 2000;35:927–30 discussion 30-1.

[2] Kudou S, Iwanaka T, Kawashima H, et al. Midterm follow-up study of high-type imperforate anus after laparoscopically assisted anorectoplasty. J Pediatr Surg. 2005;40:1923–6.

[3] Ichijo C, Kaneyama K, Hayashi Y, et al. Midterm postoperative clinicoradiologic analysis of surgery for high/intermediate-type imperforate anus: prospective comparative study between laparoscopy-assisted and posterior sagittal anorectoplasty. J Pediatr Surg. 2008;43:158–62 discussion 62-3.

[4] Yang J, Zhang W, Feng J, et al. Comparison of clinical outcomes and anorectal manometry in patients with congenital anorectal malformations treated with posterior sagittal anorectoplasty and laparoscopically assisted anorectal pull through. J Pediatr Surg. 2009;44:2380–3.

[5] Tong QS, Tang ST, Pu JR, et al. Laparoscopically assisted anorectal pull-through for high imperforate anus in infants: intermediate results. J Pediatr Surg. 2011;46:1578–86.

[6] Wong KK, Wu X, Chan IH, et al. Evaluation of defecative function 5 years or longer after laparoscopic-assisted pull-through for imperforate anus. J Pediatr Surg. 2011;46:2313–5.

[7] Ming AX, Li L, Diao M, et al. Long term outcomes of laparoscopic-assisted anorectoplasty: a comparison study with posterior sagittal anorectoplasty. J Pediatr Surg. 2014;49:560–3.

[8] Han Y, Xia Z, Guo S, et al. Laparoscopically assisted anorectal pull-through versus posterior sagittal anorectoplasty for high and intermediate anorectal malformations: a systematic review and meta-analysis. PLoS One. 2017;12:e0170421.

[9] Koga H, Ochi T, Okawada M, et al. Comparison of outcomes between laparoscopy-assisted and posterior sagittal anorectoplasties for male imperforate anus with recto-bulbar fistula. J Pediatr Surg. 2014;49:1815–7.

[10] Yazaki Y, Koga H, Ochi T, et al. Surgical management of recto-prostatic and recto-bulbar anorectal malformations. Pediatr Surg Int. 2016;32:939–44.

[11] Bischoff A, Martinez-Leo B, Pena A. Laparoscopic approach in the management of anorectal malformations. Pediatr Surg Int. 2015;31:431–7.

[12] Jung SM, Lee SK, Seo JM. Experience with laparoscopic-assisted anorectal pull-through in 25 males with anorectal malformation and rectourethral or rectovesical fistulae: postoperative complications and functional results. J Pediatr Surg. 2013;48:591–6.

[13] Vick LR, Gosche JR, Boulanger SC, et al. Primary laparoscopic repair of high imperforate anus in neonatal males. J Pediatr Surg. 2007;42:1877–81.

[14] Bischoff A, Levitt MA, Pena A. Laparoscopy and its use in the repair of anorectal malformations. J Pediatr Surg. 2011;46:1609–17.

[15] Leung JL, Chung PH, Tam PK, et al. Application of anchoring stitch prevents rectal prolapse in laparoscopic assisted anorectal pullthrough. J Pediatr Surg. 2016;51:2113–6.

[16] Koga H, Okazaki T, Yamataka A, et al. Posterior urethral diverticulum after laparoscopic-assisted repair of high-type anorectal malformation in a male patient: surgical treatment and prevention. Pediatr Surg Int. 2005;21:58–60.

[17] Japanese multicenter study group on male high imperforate a. Multicenter retrospective comparative study of laparoscopically assisted and conventional anorectoplasty for male infants with rectoprostatic urethral fistula. J Pediatr Surg. 2013;48:2383–8.

[18] van der Zee DC, Dik P, Beek FJ. Laparoscopy-assisted anorectal pull-through in anorectal malformations: a reappraisal. World J Surg. 2013;37:1934–9.

[19] Alam S, Lawal TA, Pena A, et al. Acquired posterior urethral diverticulum following surgery for anorectal malformations. J Pediatr Surg. 2011;46:1231–5.

[20] Shawyer AC, Livingston MH, Cook DJ, et al. Laparoscopic versus open repair of recto-bladderneck and recto-prostatic anorectal malformations: a systematic review and meta-analysis. Pediatr Surg Int. 2015;31:17–30.

[21] Podevin G, Petit T, Mure PY, et al. Minimally invasive surgery for anorectal malformation in boys: a multicenter study. J Laparoendosc Adv Surg Tech A. 2009;19(Suppl. 1):S233–5.

[22] Bailez MM, Cuenca ES, Mauri V, et al. Outcome of males with high anorectal malformations treated with laparoscopic-assisted anorectal pull-through: preliminary results of a comparative study with the open approach in a single institution. J Pediatr Surg. 2011;46:473–7.

[23] Ruggeri G, Destro F, Randi B, et al. Laparoscopic-assisted anorectal pull-through for high imperforate anus: 14 years experience in a single center. J Laparoendosc Adv Surg Tech A. 2016;26:404–8.

[24] Belizon A, Levitt M, Shoshany G, et al. Rectal prolapse following posterior sagittal anorectoplasty for anorectal malformations. J Pediatr Surg. 2005;40(1):192–6.

[25] Brisighelli G, Di Cesare A, Morandi A, et al. Classification and management of rectal prolapse after anorectoplasty for anorectal malformations. Pediatr Surg Int. 2014;30:783–9.