



# Laparoscopic Surgery for Anorectal Malformations

Liem NT\*

Department of Pediatric Surgery, Vinmec International Hospital, Vietnam

## Abstract

The aim of this review article is to review the technique of laparoscopic assisted anorectoplasty (LAARP), its modifications, indications, contraindications and outcomes for anorectal malformations (ARM).

LAARP was first introduced by Willital in 1998 and developed by Georgeson in 2000. Many modifications have taken place to reduce complications and to provide better functional outcomes. Recto-bladder neck fistula, rectoprostatic fistula, high cloaca, high recto-vesical fistula, and rectal atresia are good indications for LAARP. Low cloaca, low recto-vesical fistula, recto bulbar fistula, and anal agenesis without fistula are relative indications. There is no indication of LAARP for other types of ARM. Outcomes of LAARP are at least similar to standard PSARP in many series and superior in some others. LAARP is a new development in the management of ARM.

**Keywords:** Anorectal malformation; Laparoscopic; Surgery

## Core Tip

Although laparoscopic surgery of anorectal malformation has been put into use 17 years, there are still many arguments regarding the application of this technique. In fact, it has not become a procedure in all surgical centers due to difficulties in conducting the technique, especially in managing the recto-urethral fistula. The paper mentions important modifications in laparoscopic surgery in the treatment of anorectal malformation, especially in the treatment of recto-urethral fistula and cloaca to achieve good function of defecation and reduce urethral complications.

## Introduction

In 1998, Willital presented the first report using LAARP in the management of anorectal malformation in 2 children [1]. This technique was more developed by Georgeson in 2000 [2]. More recently, LAARP has been applied in many centers [3-50], however there are still controversies regarding indications, surgical technique, and outcomes [32,40,53]. The aim of this review article is to review the technique of laparoscopic assisted anorectoplasty (LAARP), its modifications, indications, contraindications and outcomes for anorectal malformations (ARM).

## OPEN ACCESS

### \*Correspondence:

Liem NT, Pediatric Surgery, Vinmec International Hospital, Vietnam, Tel: +84-4-3974 3556; Fax: +84-4-3974 3557; E-mail: liemnhp@hotmail.com

Received Date: 10 May 2016

Accepted Date: 08 Jun 2016

Published Date: 13 Jun 2016

### Citation:

Liem NT. Laparoscopic Surgery for Anorectal Malformations. *Remed Open Access*. 2016; 1: 1007.

**Copyright** © 2016 Liem NT. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## Indications

LAARP has been indicated for different types of anorectal malformations: recto-vesical fistula, recto-urethral fistula, recto-vesical fistula, rectal atresia, cloaca, anal agenesis without fistula [6,7,10,16,18,23,26,27,31,39,42,44,48,51,52]. Most people agree with using LAARP for recto-vesical fistula and rectoprostatic fistula [6,7,9,20,28,31,35,38,40,42,49,51,52] but there is no consensus on indications for other types of ARM [32,51]. For rectal atresia, we introduced the combined LAARP and transanal approach for rectal atresia in 2007 [16]. This combined approach is easy to carry out and physiological because the external and internal sphincters are completely preserved. For cloaca, we introduced LAARP and delayed urethral and vaginal plasties via the perineal approach in 2012 [39]. Combined laparoscopic approach and perineal approach can be used for high cloaca and the combined laparoscopic and modified PSARP can be used for low cloaca. This approach can make complicated operations easier and much less invasive procedures. In 2003, Tei et al. [10] introduced assisted LAARP for 4 patients with recto-vesical fistula and in 2010, Bailez et al. [31] reported good outcomes using LAARP for recto-vesical fistula in 5 girls. Bailez et al. [31] concluded that laparoscopy allowed an optimal view of the pelvis, helped to achieve a low dissection of the fistula, and could be considered as an option for the treatment of the recto-vesical fistula. We also agree that high recto-vesical fistula is a good indication for LAARP. LAARP was used for recto bulbar fistula and anal agenesis without fistula in some reports [43,47,48,51]. The rectobulbar fistula is difficult to manage using a combined LA and perineal approach because the common wall between the rectal pouch and the urethra is long therefore injury to the urethra could happen

during separating the urethra from the rectal pouch. On the other hand, the rectobulbar fistula or anal agenesis without fistula can be also operated by a modified PSARP preserving the external sphincter intact [53] or standard PSARP [51]. Hence for those types of ARM, the approach should be the choice of the surgeon depending on their experience and preference. We agree with Bischoff et al. [51] that LAARP is not indicated for recto vestibular fistula because it could be better addressed by standard PSARP or modified PSARP preserving the external sphincter intact. We reported a series of 57 patients with recto vestibular fistula who were operated on using modified PSARP, preserving the sphincter intact with good outcome. The operation is easy to carry out. The operative time was short and the results were excellent [54].

### Technique

The first technique of endosurgical intrapuborectal reconstruction of high anorectal anomalies was introduced by Willital in 1998 [1], however the technique described by Georgeson in 2000 is widely accepted [2]. In Georgeson's technique, the patient is positioned transversely at the end of the operating table. The bladder is emptied by a urinary catheter. The surgeon and surgical assistant stand at the patient's head. The operation is performed with 3 incisions and 3 trocars: a 5mm trocar is inserted through the umbilicus for instrument, a 4 mm trocar is introduced in the anterior axillary line just below the inferior margin of the liver for the telescope, a second 4mm trocar is inserted in the anterior axillary line for instrument [2]. Some modifications of the trocar placement have been done. Lima et al. [7] used 4 trocars instead of 3 trocars; however the scope was still placed below the inferior margin of the liver. We placed the first trocar through the umbilicus for the scope. The second trocar was introduced in the right iliac fossa. The third trocar was placed in the left iliac fossa if the colostomy was located at the transverse colon. When the colostomy was located at the sigmoid colon, the third trocar was inserted just at the median edge of the colostomy after insufflating the abdomen and viewing the site of colostomy by laparoscopy. In 2007, we introduced the combined laparoscopic and transanal approach for rectal atresia [16]. The operation was started by laparoscopic approach to dissect and mobilize completely the rectal pouch then the transanal approach was combined. A circumferential incision was made around 0.5 cm proximal to the dentate line in the mucosa similar to the transanal technique for Hirsch sprung disease. The sub mucosal dissection was extended to the anal cul- de- sac which then was opened transversely. The rectal pouch was pulled through the anal canal and recto anal anastomosis was fashioned after removing around 0.5 cm of the distal rectal pouch. In 2012, we introduced the laparoscopic rectal pull through and delay vaginal and urethral plasties for cloaca. The laparoscopic step was carried out similar to the technique for recto-vesical fistula. The vaginal and urethral plasties were performed after closure of the colostomy via the perineal approach. The technique of vaginal and urethral plasties was similar to the technique in the management of adrenal hyperplasia [39].

### Combined approaches

**Perineal approach:** Combined perineal approach was well described by Georgeson et al. [2]. The anal area of the perineum was mapped using transcutaneous electro-stimulation. An 8mm vertical midline incision was made in the perineum at the site of the proposed anal orifice. A trocar was inserted through the external sphincter and then through the space between two pubococcygeus muscles to the pelvis. The rectal pouch was then grasped and pulled

onto the peritoneum for anoplasty. To expose maximally the external sphincter, we performed a crucial incision on anal dimple and dissected cutaneous and subcutaneous flaps from the external sphincter then created a tunnel through its center with support of a muscle stimulator. Some other modifications were also carried out to pull the rectal pouch between two pubococcygeus muscles and within the external sphincter. Yamataka et al. [4] introduced one muscle stimulator through one trocar into the abdomen to identify the center of contraction of the levator ani. Kubota used the ultrasonographic guide to create a tunnel through the levator ani and behind the urethra [11].

**Laparoscopic-assisted PSARP:** Laparoscopic-assisted was introduced in 2011 by Golebiewski et al. [41] and in 2013 by Bischoff et al. [40]. The laparoscopic approach was used to mobilize the rectal pouch, to divide and ligate the fistula. The posterior sagittal incision was added to pull the rectal pouch within the external sphincter and perform the anoplasty. Bischoff et al. [40] stated that the combination of laparoscopic and PSARP allows for a safe reconstruction in cases of recto-bladder neck and selective prostatic fistula. However with this combination, the sphincter was not preserved intact as seen in the combination of laparoscopic and modified PSARP [43].

**Modified PSAP preserving the sphincter intact:** In 2013, we introduced the combination of LAARP and modified PSARP, leaving the external sphincter intact for recto-urethral fistula. The operation was started by a laparoscopic approach to mobilize the rectal pouch and separate the upper rectal pouch from the urethra. The modified PSARP, preserving the sphincter, was added to completely separate the rectal pouch from the urethra and then to divide and to close the recto-urethral fistula. This combination can provide the advantages of both laparoscopic and modified PSARP. The fistula was easy to manage, so as to avoid the urethral diverticulum or recurrent recto-urethral fistula. The sphincter can be preserved intact to provide a better fecal continence [43].

**Management of recto-vesical fistula or recto-urethral fistula:** The recto-vesical fistula is easily divided then clipped, ligated or sutured by laparoscopic approach. We believe that closure of the fistula is the best way to manage the recto-vesical fistula. The management of recto-urethra fistula is more difficult. Urethral diverticulum or recurrent recto-urethral fistula have been reported in LAARP for ARM [13,24,34,43]. Different measures have been used to manage the recto-urethral fistula. In a multicenter study with 34 boys, the fistula was cut without closure in 11 cases, divided and closed with a suture in 15, clipped in five, cut with linear stapler in two [22]. Hay introduced the technique of transperineal recto-vesical fistula ligation. The fistula was mobilized laparoscopically. The ligature was inserted to the pelvis through a tract made on the anal dimple. This was then turned around the fistula forming a loop and regrasped outside and tied [21]. Srimurthy carried out a subseromuscular dissection starting about 1inch proximal to the termination of the rectum to create a mucosal tube of the distal rectum to the urethra which was then ligated and divided [18]. Yamataka et al. [5] used a technique of endoscopic-assisted laparoscopic excision of the recto-urethral fistula. A flexible endoscope was inserted into the rectum during laparoscopic dissection of the recto-urethral fistula allowing exact excision of the fistula. We introduced the combined laparoscopic and modified PSARP to manage the recto-urethral fistula [43].

**One stage, two stages or three stages:** Three stage LAARP has been used in many centers in the management of ARM [14,16-

20,22,27,28,36,37,39,42,43,49,50]. However, one stage LAARP was also used for ARM [2,15]. In 2014, Yang reported two-stage laparoscopic approaches for high ARM for 20 patients with good outcomes [51]. Recently we also carried out two stages LAARP for ARM without complications concerning closure of colostomy or wound dehiscence. We believe that this approach is worth to try.

**Single incision versus three incisions:** Most surgeons performed LAARP using three trocars through three incisions. Diao et al. [47] introduced single incision LAARP for recto-urethral or recto-vesical fistula in 2014. We have also performed LAARP using three trocars through a single incision for 20 patients. Laparoscopic and perineal approaches were used for recto-vesical fistula. Combined single incision laparoscopic approach and modified PSARP preserving the external sphincter intact were used for recto-urethral fistula.

### Outcomes of LAARP in the management of anorectal malformation

**Operative time:** Long operative time is one of concerns in using LAARP for ARM. However, the mean operative time among 8 reports was 139.1 minutes (ranged: 82minutes to 176.1minutes) [21,26,31,35,39,43,45,50]. In comparison with open surgery, in 2 reports, the operative time in LAARP was shorter than in standard PSARP [35,50].

**Intraoperative complications/accidents:** Intraoperative complications/accidents in LAARP are low. Among 622 patients collected by Bischoff et al. [51], urethral injury occurred in 2 patients, transection of ureter in 1, and vas deferens injury in 1. It showed that LAARP is a safe procedure.

**Conversion rate to open surgery:** Conversion to open surgery is rarely required in LAARP.

**Early and late postoperative complications:** All kind of complications that happen with PSARP can occur in LAARP including wound infections, recurrent recto-urethral fistula, posterior urethral diverticulum, rectal prolapse, anal stenosis. Among them, rectal prolapse seems to be more common in LAARP [51]. The rectal retraction due to too short of free rectal pouch and rectal prolapse due to too long of rectal pouch are two opposite complications in LAARP for ARM. How to balance two those extremes depending on the surgeon's assessment and experience. The rectal dissection should be commenced at the level of the peritoneal reflection. The over dissection of the upper rectal pouch should be avoided to reduce the rectal prolapse.

**Functional outcomes:** LAARP is being used with a hope of providing a better functional outcome in comparison with standard PSARP. In fact it is difficult to compare the outcomes between two techniques because different criteria were used in published papers. In addition, the duration of the follow-up was short in most papers. In a review article, Bischoff et al. [51] collected ten papers and attempted to compare outcomes between LAARP (161 patients) and PSARP (130 patients). Those papers revealed that the functional outcomes of LAARP were better or at least similar to PSARP.

### Advantages and disadvantages of LAARP

In comparison with PSARP, LAARP has following advantages: LAARP is a less invasive procedure. The external sphincter is preserved instead of severe damage in standard PSARP.

- Laparotomy is not required even in recto bladder neck fistula.
- Less pain and faster recovery.

- Detection of associated anomalies
- Fewer wound complications.

Besides many important advantages, LAARP has also some limitations:

- Management of rectobulbar fistula is challenging because of a long common wall between the rectal pouch and the urethra.
- A part of the procedure is carried out intra abdominally with a risk of intestinal adhesions.

### Conclusion

LAARPS is a new landmark and represents progress in management of ARM. The most important advances are that it is less invasive and a more physiological procedure. The complications can be reduced and outcomes improved with more experience.

### References

1. Willital GH. Endosurgical intrapuborectal reconstruction of high anorectal anomalies. *Pediatr Endosurg Innov Tech.* 1998; 2: 5-11.
2. Georgeson KE, Inge TH, Albanese CT. Laparoscopically assisted anorectal pull-through for high imperforate anus—a new technique. *J Pediatr Surg.* 2000; 35: 927-930.
3. Ettayebi E, Behamou M. Anorectal malformation: treatment by laparoscopy. *Pediatr Endosurg Innov Tech.* 2001; 5: 209-213.
4. Yamataka A, Segawa O, Yoshida R, Kobayashi H, Kameoka S, Miyano T. Laparoscopic muscle electrostimulation during laparoscopy-assisted anorectal pull-through for high imperforate anus. *J Pediatr Surg.* 2001; 36: 1659-1661.
5. Yamataka A, Yoshida R, Kobayashi H, Lane GJ, Kurosaki Y, Segawa O, et al. Intraoperative endosonography enhances laparoscopy-assisted colon pull-through for high imperforate anus. *J Pediatr Surg.* 2002; 37: 1657-1660.
6. Sydorak RM, Albanese CT. Laparoscopic repair of high imperforate anus. *Semin Pediatr Surg.* 2002; 11: 217-225.
7. Lima M, Tursini S, Ruggeri G, Aquino A, Gargano T, De Biagi L, et al. Laparoscopically assisted anorectal pull-through for high imperforate anus: three years' experience. *J Laparoendosc Adv Surg Tech A.* 2006; 16: 63-66.
8. Prabhakaran K, Mali V, Patankar J. Laparoscopy assisted anorectal pull-through for high imperforate anus—a new technique. *Singap Paediatr J.* 2002; 44: 60-61.
9. Iwanaka T, Arai M, Kawashima H, Kudou S, Fujishiro J, Matsui A, et al. Findings of pelvic musculature and efficacy of laparoscopic muscle stimulator in laparoscopy-assisted anorectal pull-through for high imperforate anus. *Surg Endosc.* 2003; 17: 278-281.
10. Tei E, Yamataka A, Segawa O, Kobayashi H, Lane GJ, Tobayama S, et al. Laparoscopically assisted anorectovaginoplasty for selected types of female anorectal malformations. *J Pediatr Surg.* 2003; 38: 1770-1774.
11. Kubota A, Kawahara H, Okuyama H, Oue T, Tazuke Y, Tanaka N, et al. Laparoscopically assisted anorectoplasty using perineal ultrasonographic guide: a preliminary report. *J Pediatr Surg.* 2005; 40: 1535-1538.
12. Kudou S, Iwanaka T, Kawashima H, Uchida H, Nishi A, Yotsumoto K, et al. Midterm follow-up study of high-type imperforate anus after laparoscopically assisted anorectoplasty. *J Pediatr Surg.* 2005; 40: 1923-1926.
13. Koga H, Okazaki T, Yamataka A, Kobayashi H, Yanai T, Lane GJ, 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.

14. Wong KK, Khong PL, Lin SC, Lam WW, Lan LC, Tam PK. Post-operative magnetic resonance evaluation of children after laparoscopic anorectoplasty for imperforate anus. *Int J Colorectal Dis.* 2005; 20: 33-37.
15. Vick LR, Gosche JR, Boulanger SC, Islam S. Primary laparoscopic repair of high imperforate anus in neonatal males. *J Pediatr Surg.* 2007; 42: 1877-1881.
16. Nguyen TL, Pham DH. Laparoscopic and transanal approach for rectal atresia: a novel alternative. *J Pediatr Surg.* 2007; 42: E25-27.
17. Ichijo C, Kaneyama K, Hayashi Y, Koga H, Okazaki T, Lane GJ, et al. Midterm post-operative 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: 158-162.
18. Srimurthy KR, Ramesh S, Shankar G, Narendra BM. Technical modifications of laparoscopically assisted anorectal pull-through for anorectal malformations. *J Laparoendosc Adv Surg Tech.* 2008; 18: 340-343.
19. Watayo H, Kaneyama K, Ichijo C, Hayashi Y, Lane GJ, Yamataka A. Is intraoperative anal endosonography necessary during laparoscopy-assisted anorectoplasty for high/intermediate type imperforate anus? *J Laparoendosc Adv Surg Tech A.* 2008; 18: 123-126.
20. El-Debeiky MS, Safan HA, Shafei IA, Kader AH, Hay SA. Long-term functional evaluation of fecal continence after laparoscopic-assisted pull-through for high anorectal malformations. *J La-paroendosc Adv Surg Tech A.* 2009; 19: S51-S54.
21. Hay SA. Transperineal rectovesical fistula ligation in laparoscopic-assisted abdominoperineal pull-through for high anorectal malformations. *J Laparoendosc Adv Surg Tech A.* 2009; 19: S77-79.
22. Podevin G, Petit T, Mure PY, Gelas T, Demarche M, Allal H, et al. Minimally invasive surgery for anorectal malformation in boys: a multicenter study. *J Laparoendosc Adv Surg Tech A.* 2009; 19: S233-235.
23. Uchida H, Iwanaka T, Kitano Y, Kudou S, Ishimaru T, Yotsumoto K, et al. Residual fistula after laparoscopically assisted anorectoplasty: is it a rare problem? *J Pediatr Surg.* 2009; 44: 278-281.
24. Rollins MD, Downey EC, Meyers RL, Scaife ER. Division of the fistula in laparoscopic-assisted repair of anorectal malformations-are clips or ties necessary? *J Pediatr Surg.* 2009; 44: 298-301.
25. Yamataka A, Kato Y, Lee KD, Lane G, Kusafuka J, Okazaki T. Endoscopy-assisted laparoscopic excision of rectourethral fistula in a male with imperforate anus. *J Laparoendosc Adv Surg Tech A.* 2009; 19: S241-243.
26. Yang J, Zhang W, Feng J, Guo X, Wang G, Weng Y, 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: 2380-2383.
27. Bailez MM, Cuenca ES, Di Benedetto V, Solana J. Laparoscopic treatment of rectovaginal fistulas. Feasibility, technical details, and functional results of a rare anorectal malformation. *J Pediatr Surg.* 2010; 45: 1837-1842.
28. Kimura O, Iwai N, Sasaki Y, Tsuda T, Deguchi E, Ono S, et al. Laparoscopic versus open abdominoperineal rectoplasty for infants with high-type anorectal malformation. *J Pediatr Surg.* 2010; 45: 2390-2393.
29. Koga H, Kato Y, Shimotakahara A, Miyano G, Lane GJ, Okazaki T, et al. Intraoperative measurement of rectourethral fistula: prevention of incomplete excision in male patients with high-/intermediate-type imperforate anus. *J Pediatr Surg.* 2010; 45: 397-400.
30. Koga H, Miyano G, Takahashi T, Shimotakahara A, Kato Y, Lane GJ, et al. Comparison of anorectal angle and continence after Georgeson and Peña procedures for high/intermediate imperforate anus. *J Pediatr Surg.* 2010; 45: 2394-2397.
31. Bailez MM, Cuenca ES, Mauri V, Solana J, Di Benedetto V. 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: 473-477.
32. Bischoff A, Levitt MA, Peña A. Laparoscopy and its use in the repair of anorectal malformations. *J Pediatr Surg.* 2011; 46: 1609-1617.
33. De Vos C, Arnold M, Sidler D, Moore SW. A comparison of laparoscopic-assisted (LAARP) and posterior sagittal (PSARP) anorectoplasty in the outcome of intermediate and high anorectal malformations. *S Afr J Surg.* 2011; 49: 39-43.
34. Krickhahn A, Petersen C, Ure B. Transvesical resection of a mucocele after laparoscopically assisted anorectal pull-through for imperforate anus with rectobulbar urethral fistula. *J Pediatr Surg.* 2011; 46: e29-e31.
35. Tong QS, Tang ST, Pu JR, Mao YZ, Wang Y, Li SW, et al. Laparoscopically assisted anorectal pull-through for high imperforate anus in infants: intermediate results. *J Pediatr Surg.* 2011; 46: 1578-1586.
36. Wong KK, Wu X, Chan IH, Tam PK. Evaluation of defecative function 5 years or longer after laparoscopic-assisted pull-through for imperforate anus. *J Pediatr Surg.* 2011; 46: 2313-2315.
37. England RJ, Warren SL, Bezuidenhout L, Numanoglu A, Millar AJ. Laparoscopic repair of anorectal malformations at the Red Cross War Memorial Children's Hospital: taking stock. *J Pediatr Surg.* 2012; 47: 565-570.
38. Takahashi Y, Shono T, Tatsuta K. Laparoscopically assisted sacroperitoneal pull-through for high imperforate anus: a new technique. *Eur J Pediatr Surg.* 2012; 22: 174-175.
39. Liem NT, Quynh TA. Laparoscopic rectal pull-through for persistent cloaca: an easier approach for a complex anomaly. *J Pediatr Surg.* 2012; 47: 815-818.
40. Bischoff A, Pena A, Levitt MA. Laparoscopic-assisted PSARP—the advantages of combining both techniques for the treatment of anorectal malformations with recto-bladderneck or high prostatic fistulas. *J Pediatr Surg.* 2013; 48: 367-371.
41. Golebiewski A, Murawski M, Losin M, Marek K, Piotr C. Laparoscopic surgical technique to facilitate management of high anorectal malformations - report of seven cases. *Wideochir Inne Tech Malo Inwazyjne.* 2011; 6: 150-154.
42. 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: 591-596.
43. Liem NT, Quynh TA. Combined laparoscopic and modified posterior sagittal approach saving the external sphincter for rectourethral fistula: an easier and more physiologic approach. *J Pediatr Surg.* 2013; 48: 1450-1453.
44. Japanese multicenter study group on male high imperforate anus. Multicenter retrospective comparative study of laparoscopically assisted and conventional anorectoplasty for male in-fants with rectoprostic urethral fistula. *J Pediatr Surg.* 2013; 48: 2383-2388.
45. van der Zee DC, Dik P, Beek FJ. Laparoscopy-assisted anorectal pull-through in anorectal malformations: a reappraisal. *World J Surg.* 2013; 37: 1934-1939.
46. Yamataka A, Lane GJ, Koga H. Laparoscopy-assisted surgery for male imperforate anus with rectourethral fistula. *Pediatr Surg Int.* 2013; 29: 1007-1011.
47. Diao M, Li L, Ye M, Cheng W. Single-incision laparoscopic-assisted anorectoplasty using conventional instruments for children with anorectal malformations and rectourethral or rectovesical fistula. *J Pediatr Surg.* 2014; 49: 1689-1694.

48. Koga H, Ochi T, Okawada M, Doi T, Lane GJ, Yamataka A, 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: 1815–1817.
49. Lopez M, Kalfa N, Allal H, Guibal MP, Forgues D, Sabatier-Laval E, et al. Anorectal malformation (ARM) with bladder fistula: advantages of a laparoscopic approach. *Eur J Pediatr Surg.* 2014; 24: e3-4.
50. Ming AX, Li L, Diao M, Wang HB, Liu Y, Ye M, et al. Long term outcomes of laparoscopic-assisted anorectoplasty: a comparison study with posterior sagittal anorectoplasty. *J Pediatr Surg.* 2014; 49: 560-563.
51. Bischoff A, Martinez-Leo B, Peña A. Laparoscopic approach in the management of anorectal malformations. *Pediatr Surg Int.* 2015; 31: 431-437.
52. Shawyer AC, Livingston MH, Cook DJ, Braga LH. 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.
53. Liem NT, Hau BD. Long-term follow-up results of the treatment of high and intermediate anorectal malformations using a modified technique of posterior sagittal anorectoplasty. *Eur J Pediatr Surg.* 2001; 11: 242-245.
54. Liem NT, Quynh TA. One stage operation through modified posterior sagittal approach preserving the sphincter intact for anal agenesis with rectovestibular fistula. *J Pediatr Surg.* 2015; 50: 634-637.
55. Yang L, Tang ST, Li S, Aubdoollah TH, Cao GQ, Lei HY, et al. Two-stage laparoscopic approaches for high anorectal malformation: transumbilical colostomy and anorectoplasty. *J Pediatr Surg.* 2014; 49: 1631–1634.