

Transanal surgery for obstructed defecation syndrome: Literature review and a single-center experience

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Abstract

Obstructed defecation syndrome (ODS) is a functional disorder commonly encountered by colorectal surgeons and gastroenterologists, and greatly affects the quality of life of patients from both societal and psychological aspects. The underlying anatomical and pathophysiological changes of ODS are complex. However, intra-rectal intussusception and rectocele are frequently found in patients with ODS and both are thought to play an important role in the pathogenesis of ODS. With the development of evaluation methods in anorectal physiology laboratories and radiology studies, a great variety of new operative procedures, especially transanal procedures, have been invented to treat ODS. However, no procedure has been proved to be superior to others at present. Each operation has its own merits and defects. Thus, choosing appropriate transanal surgical procedures for the treatment of

ODS remains a challenge for all surgeons. This review provides an introduction of the current problems and options for treatment of ODS and a detailed summary of the essential assessments needed for patient evaluation before carrying out transanal surgery. Besides, an overview of the benefits and problems of current transanal surgical procedures for treatment of ODS is summarized in this review. A report of clinical experience of some transanal surgical techniques used in the authors' center is also presented.

Key words: Obstructive defecation syndrome; Transanal surgery; Transanal manual technique; Transanal stapling procedure; Medical assessment; Clinical outcome; Clinical experience

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Core tip: Transanal surgery for obstructed defecation syndrome (ODS) remains a challenge for colorectal surgeons. Possible reasons are that reported clinical outcomes of current transanal surgical procedures are controversial and the patient selection criteria for different procedures are usually deficiently described in the current literature. This article reviews the literature regarding transanal surgery, introduces current problems and options for treatment of ODS and summarizes essential assessments needed for patient evaluation and the benefits and problems of each procedure. The aim of this article is to improve the understanding of selective strategies of transanal operations and increase patient satisfaction.

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INTRODUCTION

Obstructed defecation syndrome (ODS) is defined as paradoxical contraction or inappropriate relaxation of the pelvic floor muscles during attempted defecation with symptoms such as excessive straining, incomplete or fragmented evacuation, and/or inappropriate propulsive forces during attempted defecation with symptoms such as need for perineal or digital facilitation of defecation, tenesmus, urgency and pelvic heaviness with the normal desire to defecate^[1-3].

Rectocele and internal rectal intussusception are anatomic disorders that have frequently been associated with ODS^[4-8]. To date, there have been various surgical methods used for the treatment of

symptomatic ODS through transanal approaches^[9-13]. However, these transanal surgeries for ODS are challenges for all colorectal surgeons. One reason may be that ODS should be described as an "iceberg syndrome" characterized by "emerging rocks", such as internal rectal intussusception and rectocele that may benefit from operation, and also by "underwater rocks" or occult diseases such as rectal hyposensation that may affect the postoperative result of transanal operation^[14,15]. Another reason is that few standards of selection criteria for transanal surgical procedures for treatment of ODS have been made yet^[4,5,7,8]. Besides, anatomical and physiological disturbances underlying ODS are complex and remain incompletely understood.

These reasons may also explain why reported clinical outcomes of different transanal surgical procedures for treatment of ODS are controversial and remain debatable. None of these procedures has shown superior advantages and each technique has its benefits and disadvantages^[16-20]. This article will review the literature regarding current transanal operative procedures for ODS to summarize the problems and alternatives for treatment of ODS and to conclude essential assessments needed for patient evaluation before carrying out transanal surgery for ODS patients. The benefits and disadvantages of each transanal surgical procedure and some experiences of transanal surgery for ODS in a single clinical center will also be presented.

CURRENT OPTIONS FOR ODS

TREATMENT

Medical treatments

The basic medical treatments for patients with ODS may be a change of lifestyle, such as drinking plenty of water and eating a fiber diet every day^[16,21]. A short period of using retrograde rectal irrigation or large bowel irrigation with warm normal saline can also be an alternative basic medical treatment for patients with ODS^[22-24].

For patients with ODS induced by anismus, they may firstly be given 50 units of botulinum toxin A through transanal injection into the puborectalis muscle^[25]. Such patients may also benefit from yoga exercises. Patients are trained to relax themselves and control the pelvic floor muscles, which may change the activity of the pelvic floor muscles during incompleting defecation^[26,27]. For patients with ODS induced by anismus and rectal hyposensation, biofeedback therapy should be advised^[16,28]. If symptoms of the patient are related to pudendal neuropathy and rectal hyposensation, an alternative therapy might be transanal electrostimulation, which is carried out by inserting a small probe connected with a portable electrostimulator into the anus^[7].

Psychological counselling plays an important role in the treatment of patients with severe psychological pressure, such as depression and anxiety^[29]. Besides, simple relaxation exercises of abdominal and pelvic floor muscles may also be helpful for these patients^[30]. Furthermore, the latest psycho-echo-biofeedback therapy combined ultrasound-guided biofeedback with guided imagery and relaxation techniques. It might be a good option for ODS patients with both anismus and severe psychological pressure^[31]. Another new technology called biofeedback therapy plus transanal electrostimulation might also be an alternative for medical treatment of ODS^[32,33].

Alternative transanal surgical methods

The clinical outcomes of non-surgical treatments for anismus induced ODS were conflicting, and the effects are not significant. That may be the reason why partial division of the puborectalis procedure was proposed^[34]. This transanal manual procedure was thought to be effective in treating anismus induced ODS by partially dividing the puborectalis to relax the tension of hypertrophic puborectalis muscle^[34-38].

As a most commonly used transanal manual procedure, internal Delorme's transanal excision was supposed to be a relatively cheap and pathophysiologically appropriate procedure for many patients with ODS^[39].

Based on the stapled hemorrhoidopexy procedure, Corman *et al.*^[40] introduced an alternative minimally invasive transanal stapling procedure for patients with rectocele and internal intussusception induced ODS. This novel technique could restore the anatomical abnormality (rectocele and rectal intussusception) in the rectum through stapled transanal rectal resection (STARR) by sequentially using double circular stapling devices for the procedure for prolapse and hemorrhoids (PPH). That is why it was named PPH-STARR procedure. By resecting a full-thickness part of the rectum and subsequently strengthening the recto-vaginal septum and resecting redundant rectum, this procedure may provide promising results for ODS treatment.

PPH-STARR technique was confined to patients with large internal rectal intussusception and/or rectocele due to its limitation of resection of a large volume of prolapsed tissue and difficulty in visualizing the procedure. Patients with large internal rectal intussusception and/or rectocele may be treated by using a curved headed stapler device called the Contour-Transtar procedure^[41]. For patients with larger prolapses (> 5.0 cm), PPH-STARR has the disadvantage of resecting bands of rectal mucosal prolapses with a maximal width of approximately 4.5 cm, and a better choice might be the "transanal repair of rectocele and rectal mucosectomy with a single circular stapler (TRREMS)" or tissue selecting

therapy-stapled transanal rectal resection (TST-STARR) procedure^[11,42-44]. When treating patients with ODS induced by rectocele and rectocele with relatively minor rectal intussusception (depth of rectocele more than 4.5 cm), the Bresler procedure or improved linear stapling procedure combined with a Bioabsorbable Seamguard (BSG) should be a smart choice^[9,45]. For patients with ODS induced by symptomatic very high take-off internal rectal intussusception which is limited to reach the apex of the prolapse by above procedures, a transanal procedure called the TransAnal Endoscopic (internal) Rectal Prolapse" (TERP) may be advised^[46].

ESSENTIAL ASSESSMENTS NEEDED BEFORE TRANSANAL SURGERY FOR ODS

Clinical questionnaires

After hospitalization, all patients should be evaluated with a standardized questionnaire - the Cleveland Clinic Florida constipation score (Wexner score) for the assessment of constipation. The fecal incontinence score questionnaires including St. Marks incontinence score and Cleveland Clinic incontinence score should also be carried out. Moreover, quality of life should be assessed for all patients through the use of the gastrointestinal quality of life index and the Italian version of the Short-Form 12^[11,12,34,37,39].

Clinical examinations

All candidates should have prior screening with diagnostic examinations before the transanal operation as follows: (1) gastrointestinal transit time (GITT) assay with 20 radiopaque markers, and repeated abdominal X-ray tests on days 1, 3 and 5; (2) defecography or simultaneous pelvicography and colpocystodefecography (PCCD), including defecography, voiding cystography, vaginal opacification and pelvicography; (3) colonoscopy; (4) endorectal and endoanal ultraasonography; (5) anorectal manometry test; and (6) measurement of pudendal nerve terminal motor latency, anal surface electromyography and balloon expulsion^[9,46-49].

Clinical tests

Before surgery, all routine inspections should be completed, including a routine blood test, liver and kidney function tests, chest radiography, and electrocardiography^[10,36,47-49].

INCLUSION CRITERIA AND EXCLUSION CRITERIA FOR TRANSANAL SURGERY

Inclusion criteria (ODS induced by rectocele and/or rectal intussusception)

Symptoms of patients: Patients^[3,9,11,50,51] should fulfill at least two of the following symptoms in the

Table 1 Overview and summary of pros of each transanal operative procedure

Procedure	Pros	Ref.
Partial division of puborectalis	Good short-term follow-up outcome More effective compared with common non-surgical procedures	[35-37] [35]
Internal Delorme's procedure	Good long-term follow-up outcome with advantages as low recurrence rate and without complications such as postoperative constipation	[50,53,58,59]
	Suitable for patients with ODS and postoperative risk of fecal incontinence	[50,53]
PPH-STARR procedure	Overall satisfaction during postoperative long-term follow-up Without damage to the anal sphincters	[52,56,62-65,83-86] [47]
Contour-Transtar procedure	High percent of patient satisfaction during long-term follow-up with advantages such as visualizing the procedure and being suitable for resection of a large volume of prolapsed tissue and without severe complications such as recto-vaginal fistula and fecal incontinence	[41,87,88,91-96]
	With superiority over PPH-STARR procedure	[91]
Bresler procedure and liner stapler and bioabsorbable stapler line reinforcement material	High percent of patient satisfaction during long-term follow-up with advantages such as being suitable for resection of a large rectocele with a depth more than 4.5 cm, simple procedure and without severe complications such as recto-vaginal fistula and peritoneal perforation	[9,45,48,99,100]
TRREMS procedure	High percent of patient satisfaction during long-term follow-up with advantages such as being suitable for large prolapses of more than 5.0 cm, a short learning curve and without severe complications	[42-44,101]
TST-STARR procedure	High percent of patient satisfaction during long-term follow-up with advantages such as being suitable for large prolapses of more than 5.0 cm, a short learning curve, direct visualization during surgery and without severe complications	[11]
TERP procedure	Good short-term follow-up outcome	[46]

TRREMS: Transanal repair of rectocele and rectal mucosectomy with a single circular stapler; TST: Tissue selecting therapy; PPH: Procedure for prolapse and hemorrhoids; STARR: Stapled transanal rectal resection.

past 3 mo, with these symptoms appearing at least 6 mo prior to diagnosis: (1) A feeling of attempted defecation during $\geq 25\%$ of defecations; (2) Frequent feeling to defecate with failed attempts and a feeling of anorectal obstruction-blockage with long periods of time during $\geq 25\%$ of defecations; (3) Hard or lumpy stools during $\geq 25\%$ of defecations; (4) Facilitating $\geq 25\%$ of defecations by using at least one method as

follows: digital assistance, perineal support, enema and odd posture; (5) Excessive straining and prolonged painful effort during $\geq 25\%$ of defecations; and (6) Defecation ≤ 3 times per week. What's more, patients should satisfy conditions including: (1) Seldom having loose stools without using of laxatives and deficient standards for diagnosis of irritable bowel syndrome; and (2) Impaired defecation proved by using balloon expulsion test or anorectal manometry test.

Clinical history of patients: (1) Unresponsiveness to current intensive and appropriate medical treatment for at least 6 mo, such as basic medical therapy (drinking ≥ 1.5 L water and taking 10 g lactulose per day and eating high-fiber diet), stimulants, osmotic laxatives and enemas; and (2) the absence of severe psychiatric diseases^[45,46,52-54].

Radiological findings and Cleveland Clinic Florida constipation score: (1) The depth of rectocele ≥ 3 cm and/or rectal intussusception into the anal canal ≥ 1 cm on straining or defecography after defecation; and (2) a Cleveland Clinic Florida constipation score (Wexner score) ≥ 12 ^[11,39,41,55,56].

Inclusion criteria (ODS induced by anismus)

The inclusion criteria^[3,34,37,38,57] were: (1) Patients with the following symptoms in the past 3 mo, with these symptoms appearing at least 6 mo before diagnosis; (2) Proof of appropriate propulsive forces during defecation (rectal pressure > 45 mmHg); (3) Evidence for loss to rest the pelvic floor muscles or improper contraction through medical examination of the pelvic floor muscles during evacuation combined with defecography, anorectal manometry test, electromyography and balloon expulsion; and (4) A permanent need of digital assistance, enema and laxatives to facilitate evacuation.

Exclusion criteria (ODS induced by rectocele and/or rectal intussusception)

(1) Patients with cystocele or genital prolapse needing transvaginal surgery; (2) Patients with fecal incontinence or ODS induced by anismus or pelvic floor dyssynergia; (3) Patients with anastomotic stoma or foreign material or chronic inflammatory lesions in the rectum or the anal canal; (4) Patients with colonic inertia, neoplasia or anorectal stenosis; and (5) Patients with mental disorders or patients refusing to accept surgery^[3,9,11,50,51].

Exclusion criteria (ODS induced by anismus)

(1) Patients with colonic inertia or sphincter defect; (2) Patients with not only anismus but also other defecographic abnormalities; and (3) Patients with former pelvic operation^[3,34,37,38,57].

Table 2 Overview and summary of cons of each transanal operative procedure

Procedure	Cons	Ref.
Partial division of puborectalis	Disappointing short-term follow-up outcome Increased risk of postoperative fecal incontinence	[34,38,57] [34,38,57]
Internal Delorme's procedure	Unsatisfactory long-term follow-up outcome with disadvantages such as high recurrence rate, long operative time and complications such as constipation, fissure-in-ano, and transient incontinence Unsuitable for patients with ODS and diarrhea Requiring additional sphincteroplasty for patients with ODS and severe fecal incontinence Without superiority to stapling procedures in treatment of rectocele induced ODS	[39,53,55,60,61] [53] [60] [39,55]
PPH-STARR procedure	Disappointing long-term follow-up outcome with disadvantages such as a long learning curve and complications such as bleeding, puborectalis dyssynergia, urinary retention, granuloma of anastomotic stoma and recurrent ODS With some severe postoperative complications such as severe proctalgia, fecal incontinence and rectovaginal fistula With rare complications such as rectal diverticulum and sigmoid volvulus Unsuitable for patients with previous pelvic floor surgery or sphincter weakness Limitation of resection of a large volume of prolapsed tissue and difficulty in visualizing the procedure	[41,63,67-70,79,80] [75-78] [81,82] [66,68-70,76-80] [41]
Contour-Transtar procedure	Disappointing long-term follow-up outcome with disadvantages such as a long learning curve, relatively complicated procedure, high cost and complications such as bleeding, puborectalis dyssynergia, urinary retention, granuloma of anastomotic stoma and recurrent ODS With some severe complications such as recto-vaginal fistula, fecal urgency, fecal incontinence and anorectal pain Unsuitable for patients with previous pelvic floor surgery or sphincter weakness Without superiority over PPH-STARR procedure	[65,87,89,90,97] [87,89,90] [65,87,89,90,97] [65,97]
Bresler procedure and liner stapler and bioabsorbable stapler line reinforcement material	Limited effect on rectal intussusception and unsuitable for patients with sphincter weakness	[45,48,99,100]

TRREMS procedure	Limited effect on severe rectocele Unsuitable for patients with sphincter weakness	[44] [42-44,101]
TST-STARR procedure	Unsuitable for patients with sphincter weakness	[11]

TRREMS: Transanal repair of rectocele and rectal mucosectomy with a single circular stapler; TST: Tissue selecting therapy; PPH: Procedure for prolapse and hemorrhoids; STARR: Stapled transanal rectal resection.

ALTERNATIVE TRANSANAL SURGICAL PROCEDURES FOR ODS

There have been a great variety of transanal surgical techniques to treat patients with ODS and each technique has its benefits and problems. The tabular format of the diverse transanal operative procedures highlighting the pros and cons of each technique is summarized in Table 1 (pros) and Table 2 (cons).

Partial division of puborectalis

As Wallace *et al.*^[35] and Wasserman^[36] reported, patients had good responses after partial division of the puborectalis muscle. Moreover, a comparative study investigated by Faried *et al.*^[37] showed that partial division of puborectalis was more effective than non-surgical treatment such as biofeedback retraining with a BTX-A injection. However, some studies reported that the outcome of treatment for patients with anismus through lateral or posterior midline division of the puborectalis muscle was disappointing^[34,38,57]. Division of the puborectalis muscle failed to improve the ODS symptoms among the majority of patients, but might increase the risk of subsequent incontinence after surgery^[34,38,57].

Internal Delorme's procedure

Berman *et al.*^[50] demonstrated that 21 patients who had undergone this procedure obtained a satisfaction rate of 71% at the 3-year follow-up without any major complications. Ganio *et al.*^[53] found that 45.7% of the incontinent patients had normal fecal continence after undergoing the internal Delorme's procedure. Tsunoda *et al.*^[58] and Liberman *et al.*^[59] also proved that internal Delorme's procedure had a reasonably low recurrence rate and a low morbidity. And this procedure did not lead to constipation post operation. However, this procedure also has limitations such as not being suitable for patients with diarrhea. Additionally, postoperative complications, including fissure-in-ano, suture-line dehiscence and anastomotic stoma stenosis, were observed^[53]. As Ohazuruike *et al.*^[39] reported, 8.6% of patients in their study had felt transient incontinence to gas and fluids, respectively. For ODS patient with severe fecal incontinence, this procedure should be combined with sphincteroplasty to improve postoperative anal continence^[60]. However, Ohazuruike *et al.*^[39] thought that there were no

statistically significant differences between internal Delorme's procedure and PPH-STARR procedure in treatment of ODS induced by rectocele and rectal intussusceptions. Roman *et al*^[61] also reported that the long-term outcome of internal Delorme's procedure was less encouraging with a high recurrence rate. Besides, Mahmoud *et al*^[55] demonstrated that this manual procedure had disadvantages of longer operative time and hospital stay and more complications, including constipation and fecal incontinence compared with stapling procedures, especially in the treatment of rectocele in ODS.

PPH-STARR procedure

As described by Boccasanta *et al*^[62], there was an overall satisfaction rate of nearly 88% for a period of 20 mo of postoperative follow-up after transanal surgery performed with PPH-STARR procedure. Similarly, in another study by Gagliardi *et al*^[63], a 65% satisfaction rate was achieved in patients suffering from rectocele and rectal intussusception. Another study also reported that the frequency of defecatory urgency decreased dramatically from 10% at the 3rd mo to 2% by the end of 12 mo of postoperative follow-up^[56]. Additionally, radiological and clinical modifications of intussusception and rectocele were observed in 94.6% of patients during the follow-up investigated by Arroyo *et al*^[52]. Similar results were also reported by Ding *et al*^[64] and Naldini *et al*^[65]. Because a circular anal dilator (CAD) was introduced into the anus to provide a better view for surgeons, possible damage to anal sphincters due to the introduction of the CAD was considered by some investigators. For this reason, Boccasanta *et al*^[47] suggested in their study that if the stapler was correctly used, there would not be any direct damage to the anal sphincters.

However, the procedure has the advantages of being simple, easy and fast. It requires extensive experience to avoid further postoperative complications and to carefully resect the rectocele and prolapsed tissue. Besides, it may not be suitable for patients with previous pelvic floor surgery^[66]. And there were some controversial points of view regarding the complication and poor postoperative outcome of this procedure^[67,68]. For instance, the primary and most common perioperative and postoperative complication is "bleeding", which should be repaired intraoperatively by a few anastomotic sutures with absorbable thread^[41,63]. Another complication found in several studies was puborectalis dyssynergia^[41,69,70]. However, van Dam *et al*^[71] demonstrated that the clinical outcome of transanal surgery for ODS was not influenced by the presence of puborectalis dyssynergia. Persistent pain in the anus was another complication appearing frequently after transanal surgery with PPH-STARR. This symptom might result from the staple line rupturing induced by postoperative

sphincter spasm in the anus, extreme tension on the anoderm and excessive resection of smooth muscle^[72-74]. Postoperative fecal urgency and fecal incontinence were also reported as postoperative complications of PPH-STARR procedure, which may be improved by sacral nerve stimulation or other medical treatments after surgery^[75,76]. Besides, Pescatori *et al*^[77] and Pescatori *et al*^[78] summarized complications of PPH-STARR, including recurrent ODS, severe proctalgia, fecal incontinence and rectovaginal fistula. Furthermore, Asteria *et al*^[79] stated that they had observed transient fecal urgency in 18% of cases and urinary retention in 12% of patients. And in a long-term follow-up investigated by Zhang *et al*^[80], 14.7% of patients were reported to have similar complications related to granuloma of anastomotic stoma. Early postoperative urgency might result from traumatic inflammation at the staple line, but it could not explain why it lasts so long after surgery. In addition, rare complications such as rectal diverticulum and sigmoid volvulus were also reported^[81,82]. However, minor postoperative complications have been mentioned in several studies, while neither major morbidity nor threatening mortality has been observed with PPH-STARR procedure^[83-86].

Contour-Transtar procedure

As demonstrated by Renzi *et al*^[87], 87% of cases with a prolonged history of constipation had symptom-free defecation after operation. This surgical procedure with a curved head was shown to be good and have a great effect on the development of symptoms in patients suffering from ODS. However, a percentage of patients may develop anal stenosis and may have a risk of spiraling due to the longitudinal and circumferential resection of the prolapsed tissue. On account of these complications, Brescia *et al*^[88] modified the technique using an electric scalpel instead of a linear endoscopic stapler for initial longitudinal resection and stated that it could reduce the risk of spiraling. However, with resection of a large circumferential volume of the rectal wall, this new technique was considered to cause potentially severe complications such as recto-vaginal fistula, recto-enteric fistula, fecal urgency and fecal incontinence, which affected the quality of life of patients after surgery^[89,90]. Nonetheless, further investigation indicated that clinical outcome using this technique was good if the surgeons carefully resected the anterior rectal wall prolapse without the posterior vaginal wall and corrected the defect using a recto-vaginal flap between the recto-vaginal septum^[91,92]. As showed by Martellucci *et al*^[91], only 1.5% of patients who underwent Contour-Transtar procedure required further surgery because of anal pain caused by retained staples, and only one patient had rectal perforation rectified by colostomy and closed after 6 mo. They demonstrated that the early

complication rate of this procedure was low and this new procedure had superiority over PPH-STARR procedure. What's more, some following studies reported similar results^[93-96]. However, there were also some opposing views. Wadhawan *et al.*^[97] and Naldini *et al.*^[65] indicated that there were no statistically significant differences in postoperative clinical outcome, early complications, postoperative pain or hospital stay between PPH-STARR procedure and Contour-Transtar procedure. Similarly, Boccasanta *et al.*^[98] demonstrated that no improvements in symptoms and defecographic parameters were observed postoperatively in patients who underwent operation using Contour-Transtar procedure compared with PPH-STARR procedure. In addition, the cost of the stapler device used in Contour-Transtar procedure was higher.

Bresler procedure

As showed by Ayav *et al.*^[45], at least 90% of patients were satisfied and had no symptoms postoperatively in the 3 years of follow-up. And 76% of symptom-free cases were observed after a median-term follow-up. Another study investigated by Jiang *et al.*^[99] found that the mean constipation score improved significantly from 13.56 preoperatively to 5.07 postoperatively without severe complications as recto-vaginal fistula and peritoneal perforation. Moreover, Zhang *et al.*^[100] proved that the efficacy of this procedure can be highly appreciable with 72% of patients cured clinically. In addition, a study conducted by D'Avolio *et al.*^[48] indicated that defecography post operation proved complete correction of the anterior rectal wall defect in all 15 cases, and only a few cases had minor bleeding after surgery.

TRREMS procedure

As described by Regadas *et al.*^[42], all eight patients with ODS caused by rectocele had a good clinical outcome after TRREMS procedure. Additionally, a complete correction of the rectocele was demonstrated by anal-vaginal digitation and postoperative defecography. Cruz *et al.*^[43] investigated the outcomes of 75 patients with anorectocele related to rectal intussusception or mucosal prolapse in a prospective multicenter study. Mean Cleveland Clinic Florida constipation score (Wexner score) of these patients decreased meaningfully after the TRREMS procedure, which indicated that this operation is effective and safe. Besides, Leal *et al.*^[101] showed that TRREMS procedure could significantly reduce the mean constipation and obstructed defecation scores with lowered costs, even in treatment of grades II and III rectocele. What's more, as reported by Regadas *et al.*^[44], all 45 patients who underwent a modified TRREMS procedure had complete disappearance of rectal intussusception observed by imaging examination after surgery. Only 13.3% of the cases had a small residual mucosal prolapse.

TST-STARR procedure

Naldini *et al.*^[11] reported that only three patients had anastomotic bleeding with only one patient needing surgical intervention in the 76 patients who underwent TST-STARR Plus procedure. And only 7.6% of patients with fecal urgency were observed in the 14.5-mo follow-up.

Transanal rectocele repair using liner stapler and bioabsorbable stapler line reinforcement material

As described by de la Portilla *et al.*^[9], a remarkable reduction in rectocele size on defecography and a significant improvement of symptoms as vaginal prolapse during evacuation, rectorrhagia, vaginal prolapse or digitation with bulge/mass, pruritus ani, pain and tenesmus were observed after surgery. No patient exhibited severe complications during the follow-up period and only two cases exhibited fecal urgency.

TERP procedure

As described by Bloemendaal *et al.*^[46], two of three patients had a significant improvement of ODS symptoms after surgery. Whereas another patient had a left hemicolectomy 1 year after the operation due to an anterior recurrence of internal rectal prolapse with a redundant loop of transverse colon near anastomotic stoma and an ulcer on the anterior wall of the rectum.

OUR EXPERIENCE

Forty-three female patients with ODS induced by rectocele and/or minor rectal intussusception underwent transanal operation through Bresler procedure in three Chinese hospitals led by our center from November 2008 to December 2010. The surgical procedure (Figure 1 and Video 1) is similar to Ayav *et al.*^[45]'s procedure. There were not any severe postoperative complications. Moreover, the mean constipation score improved significantly post operation. In addition, postoperative defecography also showed a great improvement with complete disappearance of the rectocele in 15 of 28 patients^[99].

Our center registered a retrospective study in the Chinese Clinical Trial Registry (No. ChiCTR-ORN-16007696) to compare the clinical outcome between PPH-STARR and Bresler procedures in the treatment of ODS induced by rectocele and rectocele (depth of rectocele < 4.5 cm) with relatively minor rectal intussusception. Our PPH-STARR procedure (Figure 2 and Video 2) is similar to the traditional PPH-STARR procedure^[40]. We investigated 30 female ODS patients who underwent Bresler surgery and 30 female ODS patients who underwent STARR surgery at our center from October 2011 to November 2012. However, there were no statistically significant differences ($P > 0.05$) between the two surgical procedures in mean operative time, blood loss or mean postoperative hospital stay (Table 3). Additionally,

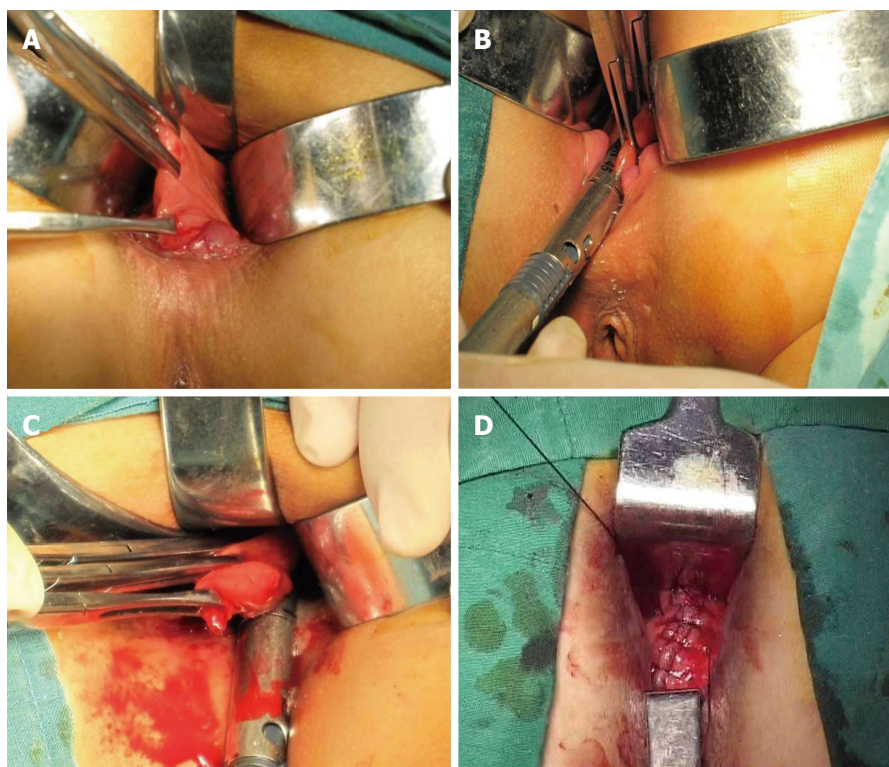


Figure 1 Surgical technique of Bresler procedure. A: The anterior wall of the defect in the rectum should be raised with two or three Allis clamps, and it should be ensured every time that it does not involve the posterior wall of the vagina to avoid further complications; B, C: A single use, reloadable endoscopic linear cutter is introduced, and one or two firings might be necessary depending on the extent of prolapse seen in the rectocele; D: A longitudinal locked running suture, including rectal mucosa, submucosa, and muscle, was made with 2-0 absorbable Vicryl suture along the staple line for the plication of the repaired anterior rectal wall to strengthen the stapled region.

Table 3 Comparison of mean operative time, blood loss and mean postoperative hospital stay between the procedure for prolapse and hemorrhoids-stapled transanal rectal resection and Bresler procedures

	STARR procedure	Bresler procedure	<i>P</i> value
Mean operative time (min)	21.5 ± 4.5	21.0 ± 4.0	0.26
Blood loss (mL)	10.0 ± 2.5	9.0 ± 2.0	0.35
Mean postoperative hospital stay (d)	5	5	0.19

STARR: Stapled transanal rectal resection.

there were no statistically significant differences ($P > 0.05$) between the two surgical procedures in the incidence of postoperative complications (STARR procedure group vs Bresler procedure group = 26.7% vs 30%, Table 4). Moreover, evaluation of patient satisfaction in the STARR procedure group was excellent (50%), good (16.7%), fair (10%) and poor (23.3%). The same assessment was excellent (46.7%), good (20%), fair (6.7%) and poor (26.6%) in Bresler procedure group. Moreover, in the short-term follow-up period, postoperative satisfaction rate (patients who felt excellent or good after surgery) of the two surgical procedures was same with 66.7% (Figure 3).

Table 4 Comparison of the incidence of postoperative complications between the procedure for prolapse and hemorrhoids-stapled transanal rectal resection and Bresler procedures

	Pain	Fecal incontinence	Bleeding	Total number	Incidence	<i>P</i> value
STARR procedure	2	5	1	30	26.7%	0.774
Bresler procedure	3	4	2	30	30.0%	

STARR: Stapled transanal rectal resection.

From April 2013 to September 2014, 50 patients (43 females and 7 males) with ODS were treated with TST-STARR procedure at our center. Our surgical procedure (Figure 4 and Video 3) was the same as Naldini *et al*^[11]'s procedure. The average time of surgery was 21 ± 4 min (range: 12-35 min), blood loss was 12 ± 2 mL (range: 6-16 mL) and the average hospital stay was 5 d (range: 4-8 d). What's more, there were a few postoperative complications with only one patient with transient fecal urgency and only one patient suffering anastomotic bleeding. Besides, there was only one patient with fecal incontinence and one patient with rectal anastomotic stenosis. What's more, the postoperative Wexner constipation score improved

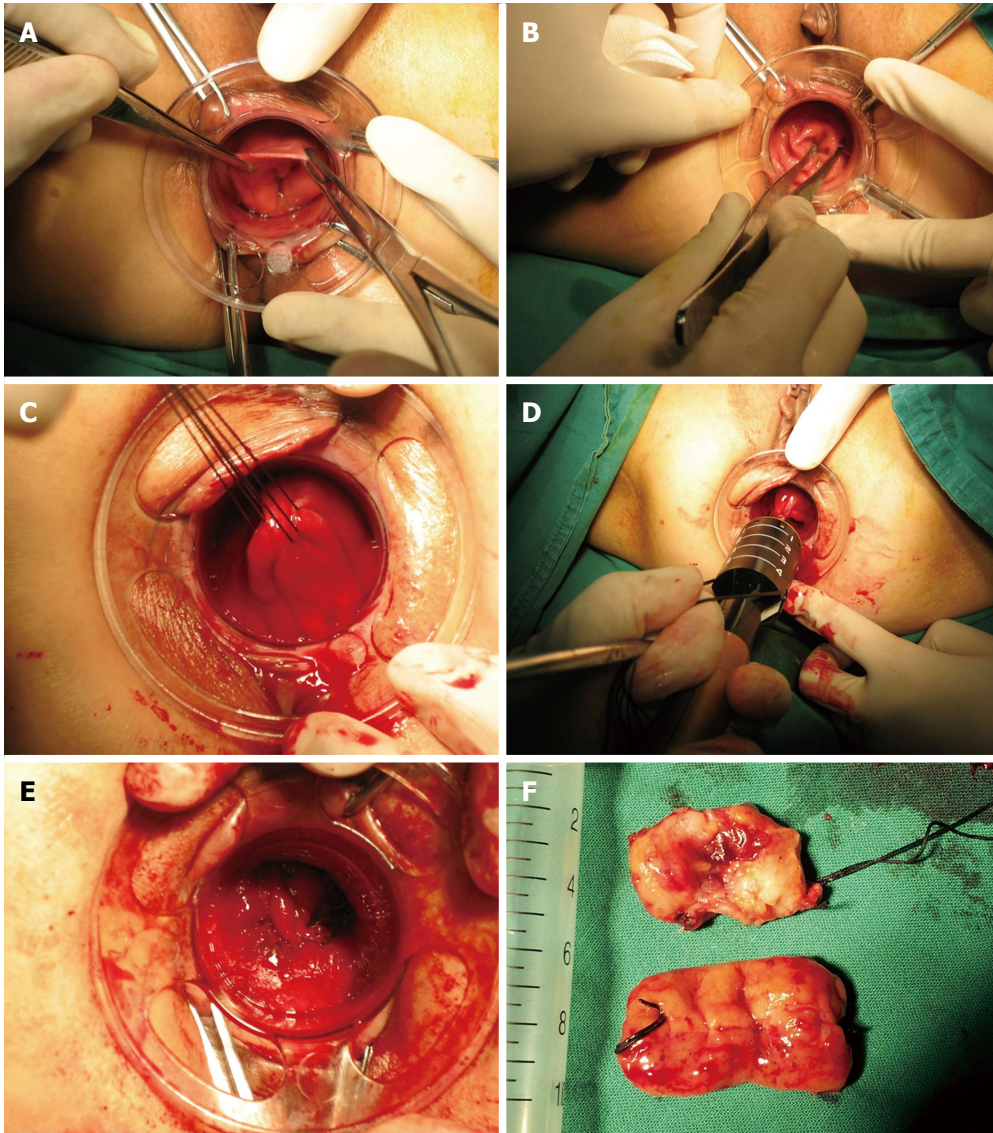


Figure 2 Surgical technique of prolapse and hemorrhoids-stapled transanal rectal resection procedure. A, B: A CAD was introduced into the anal canal, and a sterile betadine gauze hold with a pincer should be used to draw the prolapsed tissue inside the dilator; C: Three purse-string sutures in all of the layers of the rectum were made at 1 cm intervals using Prolene 2-0 in the anterior area of the rectum at 4 cm above the dentate line and from the 9 o'clock direction to the 3 o'clock direction including the apex of the anterior rectocele; D: A PPH device was inserted into the anal canal and closed and fired to perform the rectal anastomosis, and the staple line was reinforced using a 3-0 absorbable Vicryl suture; E: The same procedure was repeated on the posterior rectal wall; F: The resected sample. PPH: Procedure for prolapse and hemorrhoids; STARR: Stapled transanal rectal resection; CAD: Circular anal dilator.

significantly, and the overall satisfaction rates were approximately 84%, 84% and 82% at 3, 6, and 12 mo, respectively.

From January 2015 to December 2015, 45 patients (16 females and 29 males) with anismus induced ODS underwent transanal partial excision of puborectalis at our center. The surgical procedure is shown in Figure 5. And a retrospective study of postoperative outcome through transanal partial excision of puborectalis for treatment of anismus induced ODS had been registered in the Chinese Clinical Trial Registry with No. ChiCTR-ORB- 16007695. Part of the short-time follow-up showed a satisfactory outcome, and the full collection of clinical data and long-term follow-up are in progress. To date, none of these patients had

complications such as fecal incontinence after surgery, and only 20% of patients had the recurrent ODS symptom.

DISCUSSION

Although a plenty of studies about the transanal surgical management of ODS have been published, treatment strategies for ODS remain poorly understood. This may be because of a lack of strict patient selection criteria for ODS operation, which is essential for surgeons to define and evaluate the roles of each operative procedure. Additionally, randomized controlled trials and controlled clinical trials with long-term follow-up and review articles based upon these investigations are not enough

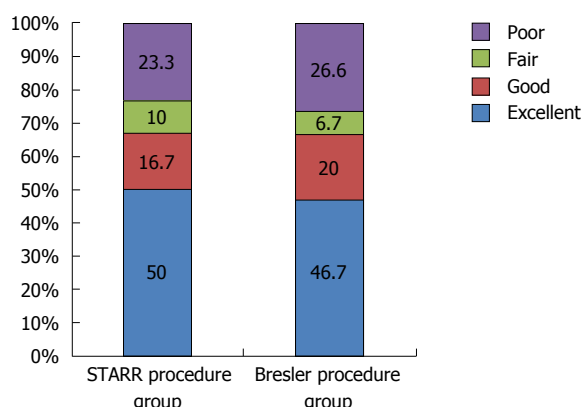


Figure 3 Short-term follow-up of postoperative satisfaction grade of both prolapse and hemorrhoids-stapled transanal rectal resection procedure and Bresler procedure. In 30 patients who underwent PPH-STARR procedure, there were 15 (50%) persons who felt excellent and five (16.7%) persons who felt good post operation. And there were three (10%) persons who just said fair and seven (23.3%) persons complaining about poor outcome after operation. In 30 patients who underwent Bresler procedure, there were 14 (46.7%) persons who felt excellent and six (20%) persons who felt good post operation. And there were two (6.7%) persons who just said fair and eight (26.6%) persons complaining about poor outcome after operation. PPH: Procedure for prolapse and hemorrhoids; STARR: Stapled transanal rectal resection.

for surgeons to evaluate and compare the clinical applications and outcomes of these transanal surgical procedures for the treatment of ODS.

Internal Delorme's procedure was supposed to be an appropriate operation for patients with ODS and internal prolapse with severe symptoms. However, this manual procedure has disadvantages of longer operative time and hospital stay. It also has more complications such as higher postoperative recurrence rate, constipation and recto-vaginal fistula compared with transanal stapling procedures, especially in the treatment of ODS induced by rectocele. Thus, the internal Delorme's procedure should be considered an alternative for patients with ODS induced by intra-rectal intussusception or internal rectal prolapse with relatively minor rectocele, and with supposed postoperative risk of fecal incontinence due to sphincter weakness. A partial division of puborectalis and partial excision of the puborectalis might be alternative to treat patients with anismus induced ODS. However, more long-term clinical controlled trials should be carried out to further investigate the effect of these manual procedures for the treatment of ODS.

PPH-STARR procedure contributed tremendously to treat patients with intra-rectal intussusception and rectocele induced ODS. However, it also has some postoperative complications, including bleeding, recurrence of ODS, fecal incontinence and so on. In addition, surgeons have a long learning curve to master this technique compared with other stapling procedures. What's more, it remains limited to patients with large intra-rectal intussusception with a length more than 4.5 cm and rectocele with a depth more

than 4.5 cm. Therefore, it should be advised to apply by surgeons with extensive maintenance experience for the treatment of patients with ODS induced by internal rectal prolapse (length of prolapse < 4.5 cm) and/or rectocele (depth of rectocele < 4.5 cm). The Contour Transtar procedure is technically demanding for treatment of ODS induced by large internal rectal prolapse and/or rectocele and its functional results may be as good as those of the PPH-STARR. However, its cost is relatively high and it may cause severe complications such as recto-vaginal fistula, fecal urgency, fecal incontinence and anorectal pain after surgery. Furthermore, the surgical procedure is relatively complicated. So, it also needs a long learning curve and should be advised to be carried out by surgeons with abundant experience for the treatment of patients with ODS induced by large intra-rectal intussusception and/or rectocele. When treating patients with ODS induced by large rectocele (depth of rectocele more than > 4.5 cm) and large rectocele with relatively minor rectal intussusception, the Bresler technique and a combination of the Bresler technique with bioabsorbable seamguard may be simple and effective choices. Both procedures remove the rectocele completely, but they should be selectively applied to rectocele and rectocele with relatively minor rectal intussusception on account of their limited effect on rectal intussusception. Moreover, all the above transanal stapling procedure should not be advised to be carried out in treatment of patients with ODS and supposed postoperative risk of fecal incontinence due to sphincter weakness.

For patients with large internal rectal intussusception (more than 5.0 cm) and/or rectocele induced ODS, a better choice might be the TRREMS or TST-STARR procedure. Both techniques have advantages such as a shorter learning curve, fewer complications, more space to accommodate the resected tissue and a large volume of tissue resected. Moreover, TST-STARR procedure also provides surgeons with direct visualization during surgery. These two techniques are also suitable for treatment of ODS induced by internal rectal intussusception (less than 5.0 cm) and/or rectocele. Nonetheless, the TRREMS procedure should not be used in rectocele with a depth of more than > 4.5 cm due to its limited effect on severe rectocele. Furthermore, both the TRREMS and TST-STARR procedures should not be considered an alternative for treatment of patients with ODS and sphincter weakness. For patients with ODS induced by symptomatic very high take-off internal rectal prolapse, which is limited to reach the apex by other transanal procedures, TERP procedure should be an alternative choice. However, as a result of the small scale of patients who underwent the above three latest techniques, their clinical outcomes need further investigation and multicenter and randomized controlled trials with large-scale patient and long-term

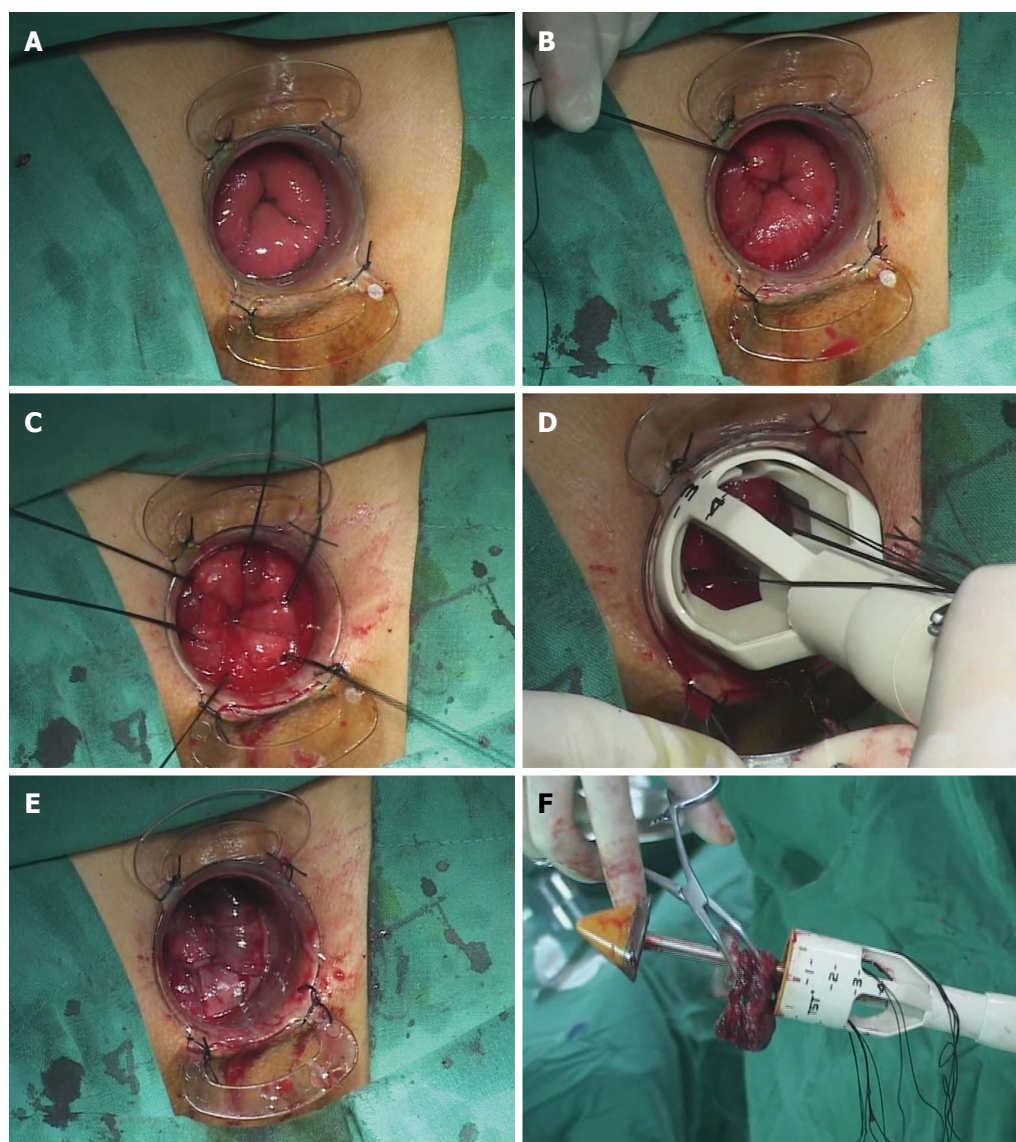


Figure 4 Surgical technique of tissue selecting therapy-stapled transanal rectal resection procedure. A: A CAD was gently introduced and fixed to the perianal skin after digital anal dilatation to assess the scope and degree of prolapse and rectocele; B, C: The parachute technique with six figure-eight sutures was used to pull out the rectocele and prolapsed tissues, and the depth of each suture should reach the rectal muscular layer; D: A 36-mm TST stapler was placed through the CAD, and all traction lines were pulled out through the mega windows; E: The stapler was closed and fired to perform the rectal anastomosis, and the staple line was reinforced using a 3-0 absorbable Vicryl suture; F: The resected sample. TST: Tissue selecting therapy; STARR: Stapled transanal rectal resection; CAD: Circular anal dilator.

follow-up should be carried out.

CONCLUSION

Although transanal surgery for ODS has been presented as a relatively simple, effective and safe treatment in short-term follow-up, the clinical outcomes in long-term follow-up are controversial and remain debatable. Possible reasons are still in need of further investigation. First of all, essential assessments before transanal surgery for ODS, especially the inclusion criteria and exclusion criteria and objective validated measurements for selection of patients, were deficiently described and summarized in most published articles. Additionally, there are few well designed randomized controlled trials comparing outcomes among different

transanal surgical procedures for the treatment of ODS. Third, patients may not be strictly selected adhering to the current inclusion and exclusion criteria of these transanal procedures. What's more, the "underwater rocks" or occult diseases such as the psychosomatic component of ODS might be neglected by some colorectal surgeons. Last but not the least, supplementary therapies such as a high-fiber diet, conservative treatment with drugs and even a movement promoting defecation may be considered unnecessary to introduce to patients after surgery by some surgeons. From our experience, to get better clinical outcomes and patient satisfaction, the priority is to strictly select of proper transanal surgical procedure for each patient according to the inclusion and exclusion criteria for each transanal

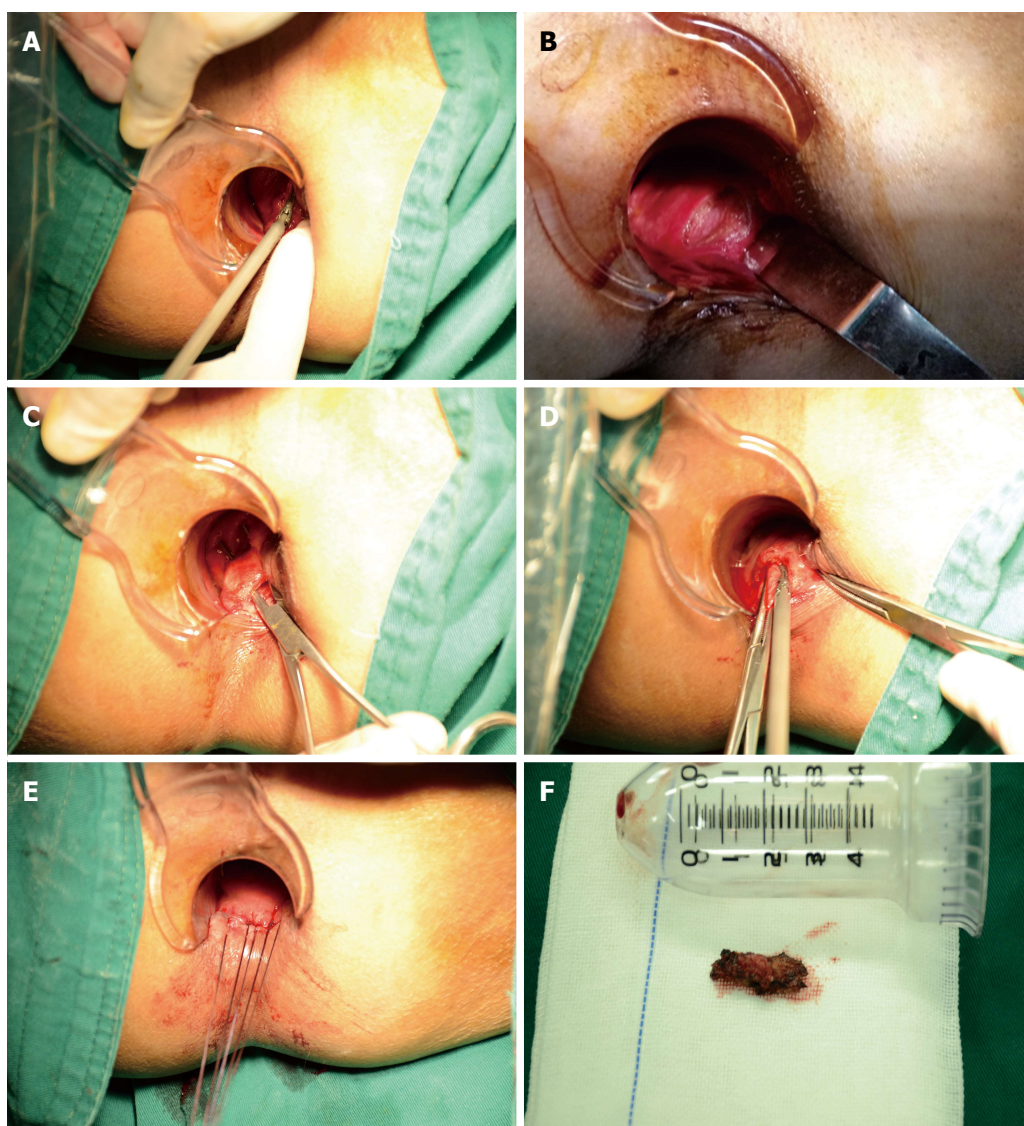


Figure 5 Technique of transanal partial excision of the puborectalis. A: Making a lateral incision of approximately 3 cm located 1 cm up on the dentate line on the rectal mucosa from the 3 o'clock direction to the 5 o'clock direction using an ultrasound knife; B: The rectal postero-lateral wall was dissected to the puborectalis; C, D: The puborectalis muscle was lifted up and approximately 2 cm was removed with an ultrasound knife; E: A full-thickness suture of the rectal wall was carried out; F: The resected sample.

procedure and the actual situation of the patient. In addition, surgeons should not only pay attention to surgery itself but also conservative treatments such as a change of lifestyle, psychotherapy, pelvic floor and abdominal muscle relaxation exercises and so on in order to improve patient satisfaction. Unquestionably, more large-scale, long-term prospective, multicentric and randomized controlled trials are needed to validate these preliminary findings and provide us with a better understanding of transanal surgery and stricter selection criteria for choosing proper transanal surgical procedure for each ODS patient in the future.

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