SCANDINAVIAN JOURNAL OF UROLOGY
2023, VOL. 57, NOS. 1–6, 97–101
https://doi.org/10.1080/21681805.2022.2147993

ARTICLE

Non-transecting urethroplasty in patients with bulbar urethral strictures shorter than three centimeters

Muhammet Şahin Yılmaz[a], Alihan Kokurcan[b], Fahrettin Şamil Uysal[b], Görkem Özenç[b] and Fatih Yalçınkaya[b]

[a]Department of Urology, Health Sciences University Samsun Training and Research Hospital, Samsun, Turkey; [b]Department of Urology, Health Sciences University Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey

ABSTRACT

Purpose: This study aimed to compare the success and postoperative complication rates of the novel non-transecting urethroplasty (NTU) technique and conventional excision-primary anastomosis (EPA) in the surgical treatment of short bulbar urethral strictures.

Material and methods: Data of the patients who underwent excision-primary anastomosis or NTU procedures at our center for the surgical treatment of bulbar urethral strictures shorter than 3 cm between January 2010 and December 2018 were retrospectively reviewed.

Results: Forty-seven patients fulfilled the eligibility criteria for this study. Among these patients, 22 underwent NTU procedure while 25 underwent EPA. There was no difference between the two groups regarding age, stricture length, etiology, past surgical history, and duration of follow-up. The surgical success rates were 88% and 87,2% in the NTU and EPA groups, respectively ($p = 0{,}603$). The complication rates were 12% and 13,6% in NTU and EPA groups, respectively. Two groups were similar concerning complication rates ($p = 0{,}603$).

Conclusion: The novel NTU and conventional EPA techniques are similar regarding surgical success and complication rates in the surgical treatment of bulbar urethral strictures shorter than three centimeters.

ARTICLE HISTORY
Received 6 May 2022
Revised 26 September 2022
Accepted 25 October 2022

KEYWORDS
Bulber urethral strictures; non-transecting; urethroplasty; strictures

Introduction

Management of urethral stricture is based on its length, severity, localization, etiology, and past surgical history of the patient [1,2]. Although patients with short annular strictures can benefit from optical internal urethrotomy (IU), this procedure is associated with a high recurrence rate [1].

Traditionally, short (typically 1–2 cm) bulbar urethral strictures are surgically treated by the excision and primary anastomosis (EPA) technique which involves excision of the strictured urethral segment (i.e. spongiofibrosis and surrounding corpus spongiosum) and subsequent tension-free anastomosis of the healthy spatulated edges [3–5]. This technique provided excellent long-term functional results [6,7].

Some authors stated that transection of the spongiosum and interruption of the blood flow to the spongiosum might lead to adverse outcomes such as impairment of retrograde urethral blood flow, tension at the anastomosis site in long bulbar urethral strictures, penile shortening, and curvature [7,8]. Therefore, they defined a novel surgical technique for treating short idiopathic bulbar strictures [8]. These authors stated that this non-transecting urethroplasty (NTU) technique did not impair the retrograde urethral blood flow, and it was applicable in patients with non-traumatic strictures [8]. Since there is a high risk of recurrence due to tension at the anastomosis site, the EPA technique is unsuitable for patients with long bulbar urethral strictures [9]. There is also a significant risk of chordee in these patients. Thus, augmentation procedures using oral grafts are preferred for relatively long strictures [10]. The strictured segment is not excised in this approach. On the other hand, in cases of longer traumatic bulbar strictures which require excision, an augmented anastomotic approach is usually preferred [6]. In this approach, EPA is performed at the ventral aspect of the urethra after excision of the strictured segment, and an oral mucosal graft is placed dorsally for augmentation.

Substitution urethroplasty is ideal for treating long anterior urethral strictures [11]. Genital skin flaps, genital and extragenital tissue grafts are used for urethral substitution. Buccal mucosa became popular after 1990 in complex urethra surgeries. Buccal mucosa provides advantages since it is well-vascularized and includes a thin lamina propria and a thick epithelium layer [10]. Besides, it is readily available, hairless, and is associated with a relatively low risk of graft contracture and pseudodiverticulum formation [11].

The NTU procedure is at least as effective as EPA [8]. Furthermore, since the urethral blood flow is not disrupted, this technique is associated with better healing and a lower risk of sexual dysfunction than EPA [8]. Therefore, this study aimed to compare the procedural success and complication

CONTACT Alihan Kokurcan alihankokurcan@gmail.com Department of Urology, Health Sciences University, Dışkapı Yıldırım Beyazıt Training and Research Hospital, Şehit Ömer Halisdemir St. Nu: 20, Ankara, Turkey

rates of the traditional method EPA and the novel NTU method in patients with short bulbar urethral strictures.

Materials and methods

Adult (age $\geq$ 18) patients who underwent EPA or NTU for non-traumatic bulbar urethral strictures shorter than 3 cm in Health Sciences University Diskapi Training and Research Hospital Department of Urology between January 2010 and December 2018 constituted the target population of this study. A search was performed in the institutional electronic folder system using the ICD code n.35 which corresponds to the patients admitted with the diagnosis of urethral stricture. Data of these patients were retrospectively reviewed following approval of this study by the Ethical Review Committee of the same institution (14.05.2018/50-01). Patients with a history of urethral trauma, lichen sclerosis, radiotherapy, or penile surgery were excluded.

All patients had consented to both the surgical procedure and the use of their data for research purposes. They all underwent routine preoperative assessment, uroflowmetry, retrograde urethrogram and flexible cystoscopy.

Patients underwent either EPA or NTU. Those who underwent NTU were categorized as stricturoplasty, non-transecting anastomosis, augmented non-transecting urethroplasty. Of note, NTU was not performed in subjects with preoperative findings of severe spongiofibrosis.

Regardless of the type of surgery, the surgical procedure was considered successful in the case that the following criteria were fulfilled after the sixth postoperative month or afterward:

1. There was no need for additional urethral surgery
2. Maximum flow rate was 15 ml/s or higher in uroflowmetry
3. A normal urethral caliber was detected in retrograde urethrogram
4. No urethral stricture was detected during flexible cystourethroscopy

Patients who underwent EPA were compared with those who underwent NTU regarding procedural success and surgical complication rates. Erectile dysfunction, penile chordee, wound infection, scrotal hematoma, and macroscopic hematuria were considered as potential postoperative complications. Data regarding complications were retrieved from electronic patient folders filled during inpatient stay and outpatient clinic encounters.

Surgical techniques

Excision and primary anastomosis urethroplasty (EPA)

All patients were given preoperative prophylactic antibiotic therapy by intravenous injection of a third-generation cephalosporin. This prophylactic therapy continued during the postoperative inpatient stay until discharge. Subsequently, the patients were switched to oral ciprofloxacin 500 mg twice a day after discharge and remained on this treatment until urethral catheter removal. They were all placed in social lithotomy positions and operated under general anesthesia. The perineal region was prepped with 2% chlorhexidine gluconate and 70% isopropyl alcohol solutions. The bulbospongiosus muscle was exposed after making a vertical perineal incision. The plane between the bulbospongiosus muscle and urethra was exposed by incision of the Gallaudet fascia. The bulbar urethra was freed by dissection, and a 20 F Foley urethral catheter was advanced to determine the distal end of the stricture. A dorsal stricturotomy incision was made starting from the distal end of the stricture and extending along the length of the stricture until reaching the normal urethra (Figure 1). The stenotic segments of the urethra and corpus spongiosum were excised (Figure 2). The proximal and distal ends were spatulated. The 20 F Foley urethral catheter was advanced towards the urinary bladder. The

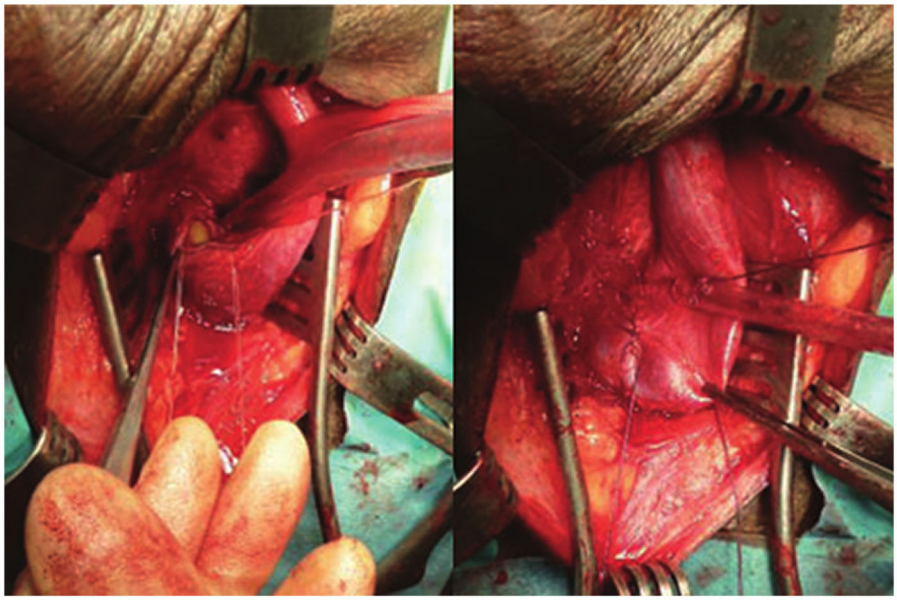

Figure 1. Dorsal stricturotomy.

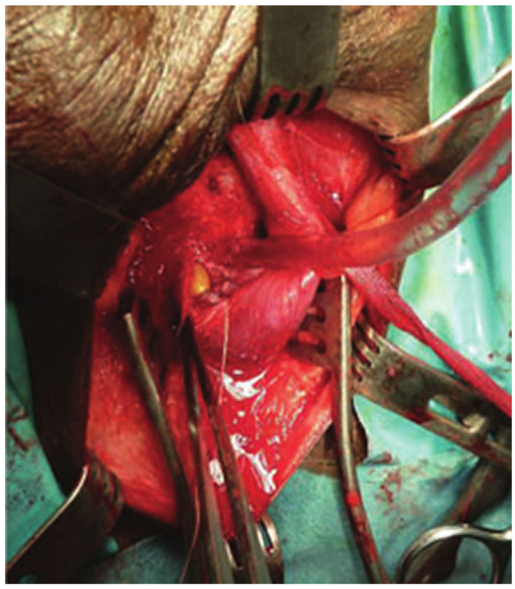

Figure 2. Excision of the strictured segment.

anastomosis was performed both on the urethral mucosa and corpus spongiosum. A bomb drain was placed. All anatomical layers were closed separately. The drain was removed once there was no more drainage postoperatively. Patients were discharged after drain removal. A pericathater retrograde urethrogram was performed two weeks after surgery, and the Foley catheter was removed in case there was no extravasation.

Non-Transecting urethroplasty (NTU)

Presurgical and surgical procedures up to determination of distal end of the stricture was applied to all patient like in EPA. Difference between undergoing EPA and NTU is intubation. Patients undergoing NTU were nasally intubated for easier buccal mucosal graft harvesting. Subsequently, a dorsal stricturotomy incision was made starting from the distal end of the stricture and extending along the length of the stricture until reaching the normal urethra. After this step, the decision regarding the type of urethroplasty was given as per the length and location of the stricture.

Stricturoplasty. Heineke–Mikulicz stricturoplasty was performed in cases with short (i.e. 1–2mm) membrane-like strictures located between the middle and proximal one-third of the bulbar urethra. The bulbar urethra was mobilized for ease of a tension-free anastomosis. The stricture was not excised. The dorsal stricturotomy incision was closed at the transverse edges after a 20 F Foley urethral catheter insertion.

Non-transecting anastomotic urethroplasty. Non-transecting anastomotic urethroplasty (NTAU) was performed in cases with relatively longer bulbar urethral strictures shorter than 2 cm. In this procedure, superficial spongiofibrosis was carefully excised along the entire length of the stricture while the underlying well-vascularized ventral spongiosum was left intact with the urethral arteries. Subsequently, the healthy mucosal edges were anastomosed end-to-end using 5/0 Vicryl® sutures. Finally, a tension-free anastomosis was performed after mobilization of the bulbar urethra and advancement of a 20 F Foley urethral catheter.

Augmented non-transecting urethroplasty (ANTU). This procedure was performed in cases with relatively longer bulbar strictures. The entire length of the stricturotomy was augmented by an oral mucosal graft. After measuring the stricture length, the Stenon duct and the buccal mucosa graft site were marked by a surgical pen. Subsequently, lidocaine hydrochloride 1% and epinephrine (1/100000) solution were injected submucosally to the graft site. The graft was harvested with the sharp dissection technique. The graft site was closed by suturing the mucosal edges. Next, defatting of the graft was done. After defatting, the graft was placed in gentamicin solution. The graft was dorsally placed along the length of the strictured segment and fixated to the corpora. A 20 F Foley urethral catheter was inserted. The urethral wings were continuously sutured and fixated to the graft and corpora cavernosa.

A bomb drain was placed at the end of each procedure. All layers were closed separately. The patients were discharged after drain removal. A pericatheter retrograde urethrogram was performed two weeks after surgery. The Foley catheter was removed if there was no extravasation.

Statistical analysis

The Statistical Package for Social Sciences (SPSS for Windows 16.0, Chicago, IL, USA) software was used for statistical analysis. The chi-square and Fisher's exact tests were performed to compare the success and complication rates. The Student's *t*-test was used to compare other variables, including age, duration of follow-up, and stricture length. The differences between the two groups concerning etiology of stricture and past urethral surgery history were analyzed by Pearson's chi-square test. The p value was considered significant when it was lower than 0,05.

Results

After applying the inclusion and exclusion criteria, 47 patients were included in this study. Our retrospective review revealed that 22 (46.8%) of these patients underwent EPA while 25 (53.2%) underwent NTU. Among those who underwent NTU, stricturoplasty was performed in 8, NTAU was performed in 7, and ANTU was performed in 10 cases.

Results of the comparison between EPA and NTU groups regarding mean age, stricture length, etiological factors, past urethral surgery history, and mean duration of follow-up are displayed (Table 1). These data were normally distributed. The mean follow-up periods were 19 ± 2,8 and 38,5 ± 5,6 months for NTU and EPA patients, respectively.

Comparison of overall success and complication rates revealed no significant difference between the two groups ($p = 0{,}603$) (Table 2). It was calculated that 87,5% (7 of 8 patients) of the patients who underwent stricturoplasty, 6 of

Table 1. Comparative analysis of the NTU and EPA groups regarding clinical parameters.

	NTU ($n = 25$)	EPA ($n = 22$)	
Age	53,2 ± 13,9	54,6 ± 17,5	0,769[a]
Stricture length (cm)	1,6 ± 0,9	1,8 ± 0,6	0,472[a]
Etiology	15	15	0,560[b]
Iatrogenic	10	7	
Idiopathic			
Past surgical history			
None	9	13	0,124[b]
Internal urethrotomy	11	9	
EPA procedure	5	–	
Duration of follow-up, months	19 ± 2,8	38,5 ± 5,6	0,003[a]

[a]Independent student-t test. [b]Pearson Chi-Square NTU: Non-transecting urethroplasty EPA: Excision and primary anastomosis.

Table 2. Results of the comparative analysis regarding success and complications rates.

	NTU ($n = 25$)	EPA ($n = 22$)	p value
Success rate	22 (88%)	19 (87,2%)	0,603[a]
Complication rate	3 (12%)	3 (13,6%)	0,603[a]

[a]Fisher's exact test. NTU: Non-transecting urethroplasty EPA: Excision and primary anastomosis.

7 (85,7%) patients who underwent NTAU, and 9 of 10 (90%) patients who went through ANTU had favorable outcomes.

Three of the 25 (12%) patients in the NTU group had postoperative complications. One of these patients developed a scrotal hematoma, while one developed erectile dysfunction, and one had a wound site infection. The patient with scrotal hematoma was treated conservatively. Daily wound care and antibiotherapy were given to the patient with wound infection, and oral tadalafil treatment was given to the patient with erectile dysfunction. All patients responded well to these treatments.

Three of 22 (13.6%) patients in the EPA group had complications. While one patient developed erectile dysfunction, one experienced a scrotal hematoma and one developed chordee. The patient with erectile dysfunction was treated with oral tadalafil treatment. Conservative treatment was given for the scrotal hematoma. These patients responded well to these treatments. The chordee was not treated since it was not associated with erectile dysfunction or an inability to have sexual intercourse.

Discussion

The idea of avoiding urethral transection in proximal bulbar urethroplasty was first suggested by G.H. Jordan, who described his NTU technique [12–14]. In this technique, the dorsal aspect of the corpus spongiosum is dissected free from the perineal body, and the bulbar arteries are identified and retracted. Thus, there is a risk of inadvertent bulbar artery injury in this approach [15].

The NTU technique is based on the fact that the proximal bulbar urethra is dorsally surrounded by corpus spongiosum. Anatomically, this segment of the membranous urethra is under the perineal membrane; thus, a dorsal stricturotomy made in this segment does not impair the blood supply of the corpus cavernosum.

Although EPA technique gives satisfactory results in patients with an appropriate stricture length, it is currently not preferred unless there is open necrosis or transmural fibrosis due to trauma or infection. Since most bulbar urethral strictures are associated with a relatively mild spongiofibrosis, they can be treated by intraurethral excision and mucosal anastomosis or only by stricturoplasty.

It was reported that NTAU was as effective as traditional anastomotic urethroplasty with minor surgical trauma [16]. It is arguably accepted that EPA is the optimal urethroplasty technique for patients with relatively short urethral strictures [6,17,18].

In 2017, Ivaz et al. followed 101 patients who underwent NTU due to bulbar urethral strictures for at least 18 months [16]. Therefore, these authors noted a success rate of 99%.

In 2012, Barbagli et al. reviewed data regarding 404 patients who underwent transecting bulbar urethroplasty (end-to-end anastomosis and augmented anastomotic repair), and they concluded that the success rates ranged between 90 and 98% [19]. In this review, 522 patients who underwent non-transecting bulbar urethroplasty were also included, and the authors reported success rates between 81,8 and 100% in this group. Thus, transecting and non-transecting bulbar urethroplasty techniques had similar success rates as per this review.

In line with the literature, our success rates were 88% and 87,2% in the NTU and EPA groups, respectively. There was no statistically significant difference between the two groups regarding procedural success.

It is known that transection of the urethra may facilitate complete excision of the scar; however, it can also lead to neurogenic urinary dysfunction and sexual dysfunction due to vascular and neural injuries [20]. On the other hand, non-transecting approaches preserve the neurovascular structures, but they may not achieve complete excision of the scar tissue [20]. It is known that complete transection of the urethra is mandatory for the excision of the traumatic scar tissue. However, it is questionable whether it is mandatory to transect the urethra to excise the scar tissue in cases with 1-2 cm, thick and narrow bulbar urethral strictures. To our knowledge, no studies showed that stricture should be excised for avoiding recurrence in patients with non-traumatic bulbar urethral strictures.

In addition, shortening of the urethra after EPA is performed in cases with long urethral strictures may lead to penile curvature or chordee. Mobilization of the spongiosum during primary anastomosis and transection may impair the caudal blood flow and lead to weak tumescence or cold glans during erection at the postoperative period [21,22]. It is also known that injury of the perineal nerves responsible for the sensory innervation of the perineum, scrotum, and ventral surface of the penile shaft may cause genital sensitivity disorders [23].

In the study published by Lumen et al. in 2016, the authors reported the data of 75 patients who underwent NTU [24]. Among these patients, 61 (81.3%) did not have any complications. However, three (4%) patients developed severe scrotal hematomas which required surgical drainage. Eleven (14.7%) patients had low-grade complications, which

were all treated conservatively. In addition, one patient developed erectile dysfunction.

In another study published in 2007, Barbagli et al. investigated the sexual dysfunction rates in patients who underwent EPA for traumatic or non-traumatic bulbar strictures [25]. Among these 153 patients, 14 (23.3%) had ejaculatory dysfunction, 1 (1.6%) had cold glans during erection, 7 (11,6%) complained about a glans that was not full during erection, 11 (18.3%) experienced reduced glans sensitivity [25]. However, none of their patients developed penile chordee and erectile dysfunction.

In 2017, Le et al. worked on 23 patients with traumatic posterior urethral strictures [26]. Authors noted a significant difference between the two patient groups, and the severity of erectile dysfunction was significantly lower in the NTU group than in the end-to-end anastomosis group [26]. In line with the literature, the comparison regarding postoperative complications did not reveal a significant difference between NTU and EPA methods in our study.

Our study has some weaknesses that must be considered while evaluating its findings. First, it is a retrospective study. Second, the number of patients included is relatively low. Third, the follow-up duration of the patients who underwent NTU was shorter than the conventional EPA procedure.

Conclusions

Despite the weaknesses mentioned above, we conclude that NTU is a relatively novel surgical technique, and there is no difference between NTU and EPA techniques concerning procedural success and postoperative complication rates.

However, these findings need to be confirmed by further studies with relatively more extended follow-up periods. Since NTU does not compromise the spongiosal blood flow and potentially endanger the neural elements, we suggest that NTU can be preferred in patients with bulbar urethral strictures. This approach seems especially appropriate for those who did not have extensive underlying spongiofibrosis after traumatic injury. Further studies with relatively more homogeneous patient groups and subjective assessments of urinary and sexual functions are needed to determine the gold standard treatment method in patients with non-traumatic proximal bulbar urethral strictures.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

No financial support was reported by the authors.

ORCID

Muhammet Şahin Yılmaz http://orcid.org/0000-0001-8713-8675
Alihan Kokurcan http://orcid.org/0000-0003-3486-108X
Fahrettin Şamil Uysal http://orcid.org/0000-0002-2635-6668
Görkem Özenç http://orcid.org/0000-0001-8853-5250
Fatih Yalçınkaya http://orcid.org/0000-0002-3443-1963

References

[1] Heyns CF, Steenkamp JW, De Kock ML, et al. Treatment of male urethral strictures: is repeated dilation or internal urethrotomy useful? J Urol. 1998;160(2):356–358.
[2] Mundy AR. Management of urethral strictures. Postgrad Med J. 2006;82(970):489–493.
[3] Mundy AR, Andrich DE. Urethral strictures. BJU Int. 2011;107(1):6–26.
[4] Morey AF, Watkin N, Shenfeld O, et al. SIU/ICUD consultation on urethral strictures: anterior urethra–primary anastomosis. Urology. 2014;83(3 Suppl):S23–S26.
[5] Mundy AR. Anastomotic urethroplasty. BJU Int. 2005;96(6):921–944.
[6] Eltahawy EA, Virasoro R, Schlossberg SM, et al. Long-term followup for excision and primary anastomosis for anterior urethral strictures. J Urol. 2007;177(5):1803–1806.
[7] Santucci RA, Mario LA, McAninch JW. Anastomotic urethroplasty for bulbar urethral stricture: analysis of 168 patients. J Urol. 2002;167(4):1715–1719.
[8] Andrich DE, Mundy AR. Non-transecting anastomotic bulbar urethroplasty: a preliminary report. BJU Int. 2012;109(7):1090–1094.
[9] Guralnick ML, Webster GD. The augmented anastomotic urethroplasty: indications and outcome in 29 patients. J Urol. 2001;165(5):1496–1501.
[10] Barbagli G, Guazzoni G, Lazzeri M. One-stage bulbar urethroplasty: retrospective analysis of the results in 375 patients. Eur Urol. 2008;53(4):828–833.
[11] Bhargava S, Chapple CR. Buccal mucosal urethroplasty: is it the new gold standard? BJU Int. 2004;93(9):1191–1193.
[12] Bugeja S, Ivaz S, Frost AV, et al. Non-transecting bulbar urethroplasty using buccal mucosa. AfrJUrol. 2016;22(1):47–53.
[13] Jordan GH, Eltahawy EA, Virasoro R. The technique of vessel sparing excision and primary anastomosis for proximal bulbous urethral reconstruction. J Urol. 2007;177(5):1799–1802.
[14] Gur U, Jordan GH. Vessel-sparing excision and primary anastomosis (for proximal bulbar urethral strictures). BJU Int. 2008;101(9):1183–1195.
[15] Juskiewenski S, Vaysse PH, Moscovici J, et al. A study of the arterial blood supply to the penis. Anat. Clin. 1982;4(2):101–107.
[16] Ivaz S, Bugeja S, Frost A, et al. The nontransecting approach to bulbar urethroplasty. Urol Clin North Am. 2017;44(1):57–66.
[17] Andrich DE, Dunglison N, Greenwell TJ, et al. The long-term results of urethroplasty. J Urol. 2003;170(1):90–92.
[18] Meeks JJ, Erickson BA, Granieri MA, et al. Stricture recurrence after urethroplasty: a systematic review. J Urol. 2009;182(4):1266–1270.
[19] Barbagli G, Sansalone S, Romano G, et al. Bulbar urethroplasty: transecting vs. nontransecting techniques. Curr Opin Urol. 2012;22(6):474–477.
[20] Barbagli G, Lazzeri M. Reconstructive urethral surgery to be addressed at 2009 GURS meeting. AUANews. 2009;14:14.
[21] Palminteri E, Berdondini E, De Nunzio C, et al. The impact of ventral oral graft bulbar urethroplasty on sexual life. Urology. 2013;81(4):891–898.
[22] Beysens M, Palminteri E, Oosterlinck W, et al. Anastomotic repair versus free graft urethroplasty for bulbar strictures: a focus on the impact on sexual function. Adv Urol. 2015;2015:912438.
[23] Barbagli G, De Stefani S, Annino F, et al. Muscle-and nerve-sparing bulbar urethroplasty: a new technique. Eur Urol. 2008;54(2):335–343.
[24] Lumen N, Poelaert F, Oosterlinck W, et al. Nontransecting anastomotic repair in urethral reconstruction: surgical and functional outcomes. J Urol. 2016;196(6):1679–1684.
[25] Barbagli G, De Angelis M, Romano G, et al. Long-term followup of bulbar end-to-end anastomosis: a retrospective analysis of 153 patients in a single center experience. J Urol. 2007;178(6):2470–2473.
[26] Le W, Li C, Zhang J, et al. Preliminary clinical study on non-transecting anastomotic bulbomembranous urethroplasty. Front Med. 2017;11(2):277–283.