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ORIGINAL ARTICLE

Repair of sphincter urethral strictures preserving urinary continence: surgical technique and outcomes

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Abstract

Introduction Repair of post-TURP sphincter urethral strictures represents challenging problem, due to the risk of urinary incontinence after the repair. We described a surgical technique we use to repair these strictures preserving urinary continence in patients with incompetent bladder neck.

Materials and methods An observational, retrospective, study was conducted to include patients with post-TURP urethral strictures in the area of distal sphincter. We included only patients with complete clinical data and follow-up who previously underwent TURP or HOLEP or TUIP, and subsequently developed proximal bulbar urethral strictures close to the membranous urethra and the related distal urethral sphincter. Patients were included, if they were fully continent after TURP or other procedures to treat BPH. The primary outcome of the study was treatment failure, defined as the need for any post-operative instrumentation. Secondary outcome was post-urethroplasty urinary continence. Patients showing stricture recurrence or post-operative incontinence were classified as failure.

Results Overall, 69 patients were included in the study. Median patient's age was 67 years; median stricture length was 4 cm. Thirty-tree patients (47.8%) underwent previous urethrotomy. Median follow-up was 52 months. Out of 69 patients, 55 (79.7%) were classified as success and 14 (20.3%) as failure. Out of the whole cohort, thus, 11/69 (16%) have a risk of recurrent strictures and 3/69 (4.3%) have incontinence.

Conclusions The use of modified ventral onlay graft urethroplasty, using particular non-aggressive steps, is a suitable surgical technique for repair of sphincter urethral stricture in patients who underwent BPH transurethral surgery, using different procedures (TURP, HOLEP, TUIP).

Keywords Urethral stricture · Urinary incontinence · Urethroplasty · TURP

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Introduction

The incidence of urethral stricture after TURP is reported to range between 2.2 and 9.8% [1, 2].

In 2004, Fenton et al. reported that out of 194 urethral strictures, 63 (32%) were classified as iatrogenic, and transurethral surgery accounted for most iatrogenic strictures (26/63, 41%) [3].

In 2009, Lumen et al. reported that transurethral surgery was the cause of strictures in 52 (19.4%) of the 268 patients [4]. These authors also suggested that transurethral surgery is the major cause of stricture in older patients and the second most common cause of bulbar urethral strictures [4]. In 2012, Heynes et al. reported an increase in incidence of iatrogenic strictures (mainly related to transurethral surgery) from 10% (in year 2001) to 36.8% (in year 2007) [5].

It is interesting to note that some authors using a bipolar transurethral resection of the prostate (TURis) reported a significantly higher urethral stricture rate compared to standard monopolar TURP (M-TURP), in patients with a prostate volume > 70 ml (20% in TURis vs 2.2% in M-TURP) [6].

The most common sites of post-TURP urethral strictures have been meatus, fossa navicularis, penile urethra, penobulbar site and proximal bulbar tract [2]. The etiology of post-TURP bulbar urethral strictures is probably due to a multitude of causes, including improper traumatic insertion of the resectoscope (26F/28F), exacerbated by the narrow urethral caliber, monopolar current leakage due to insufficient resectoscope isolation, prolonged resection time, ischemia, protracted catheterization and infection. However, the main cause of stricture after TURP remains undetermined to date [4].

Even though the anatomy suggests that the classification of the male urethra as penile, bulbar, membranous, prostatic may be very difficult, in the current clinical practice, to clearly identify the border between the proximal bulbar urethra and the membranous tract, mainly in patients with post-TURP stricture. We used the term sphincter strictures to define these proximal bulbar urethral strictures close to the membranous urethra and the related distal urethral sphincter. Because of the stricture proximity to the sphincter, and the bladder neck compromised by prior BPH surgery, there is an inherent risk of causing urinary incontinence by attempts to repair these strictures [2, 7]. In a limited series of patients with post-TURP sphincter strictures who underwent urethroplasty, Mundy reported a high incidence of postoperative incontinence [8].

The aim of this study was to investigate the clinical outcome of surgical repair of post-TURP sphincter urethral strictures and to report the rate of post-operative urinary continence.

Methods

Patient population and study design

We performed an observational, retrospective, descriptive study on a cohort of patients who underwent surgical repair of post-TURP proximal bulbar urethral strictures, close to the membranous urethra and the related distal urethral sphincter, at the Centers for Reconstructive Urethral Surgery in Arezzo, Italy and Pune, India from October 2002 to July 2017. The study was approved by the Institutional Review Board. Patients were requested to read and sign the informed consent explaining the surgical procedure and the complications. We included only patients with complete clinical data who previously underwent TURP or HOLEP or TUIP, and later developed sphincter urethral stricture. All patients included in the study were fully continent after TURP or other procedures. Patients with traumatic or penile strictures, or posterior urethral disruption, lichen sclerosus (LS), failed hypospadias repair (FHR), previous radiotherapy, or incomplete clinical records or inadequate follow-up (minimum follow-up 12 months) were excluded. Patients with history or clinical records reporting treatment of urethral stricture prior to the TURP were excluded as well. Furthermore, patients with pre-operative urgency or urgency incontinence, with neurological diseases impacting on micturition reflex were excluded from the study. The primary outcome of the study was treatment failure, defined as the need for any post-operative instrumentation. Secondary outcome was evaluation of post-surgery urinary continence. Patients showing stricture recurrence or post-operative incontinence were classified as failure. Urinary incontinence was defined as a subjective incontinence or use of pads reported by the patients. Clinically it was classified as stress urinary incontinence, mixed or urgency urinary incontinence.

Pre-operative investigations

The clinical history and charts of patient were reviewed to evaluate the etiology of stricture (TURP, HOLEP, TUIP), and the presence of urinary incontinence, and the previous treatment of the stricture (dilation, urethrotomy, urethroplasty). The genitalia were inspected to exclude the presence of LS or FHR. Preoperative tests included urine culture, post-void residual (PVR), retrograde urethrogram (RUG) and voiding cystourethrogram (VCUG), sonourethrography and urethroscopy.

Surgical technique

A 3F guide-wire is inserted with small instrument (7 F.) through the stricture (Fig. 1). Atraumatic plastic Nelaton 16 F. is gently inserted through the external urinary meatus into the urethra to the site of stricture where the catheter stops to progress, and the area is marked on perineum (Fig. 2a). A midline perineal incision is made, the bulbo-spongiousum muscles are separated at the midline and the bulbar urethra is fully exposed. The site of stricture is again marked (Fig. 2b). About 2 cm proximal to the stricture, a site is also marked were the bulbar urethra will be opened (Fig. 2b). The bulbar urethra is longitudinally opened and a previously placed 3F guide-wire is exposed as it traverses through the stricture (Fig. 2c). Under the guidance of the guide-wire, the stricture is gently progressively dilated from 8F to 16F using atraumatic plastic Nelaton catheters (Fig. 3a–c). After the final 16F catheter dilation, a nasal speculum is gently inserted across the stricture (Fig. 4a, b) and the mucosal ring is incised at the 6 o'clock position using a special ophthalmic scalpel

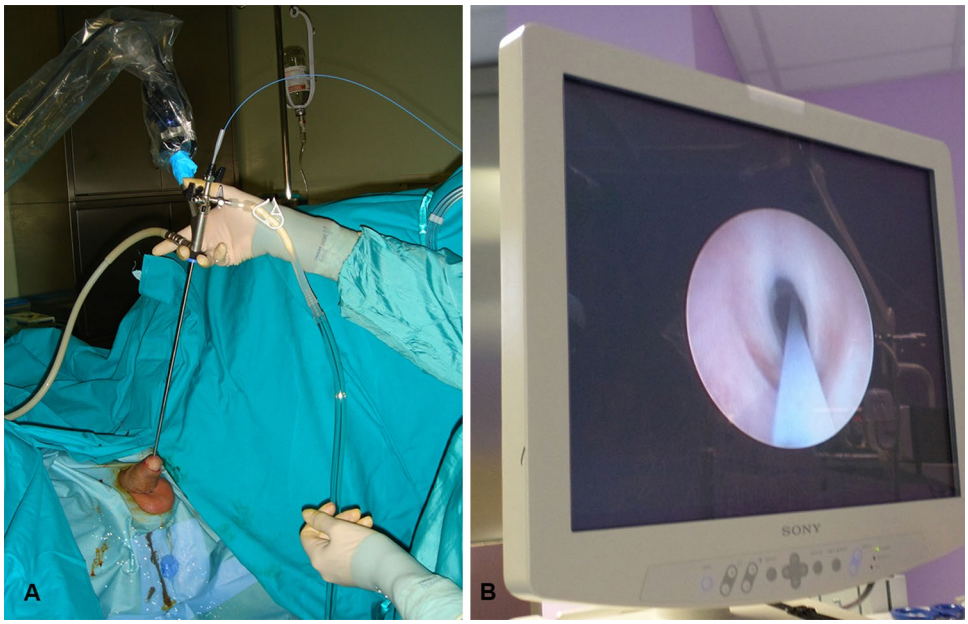

Fig. 1 **a, b** The 3F guide-wire is inserted by urethroscopy through the stricture

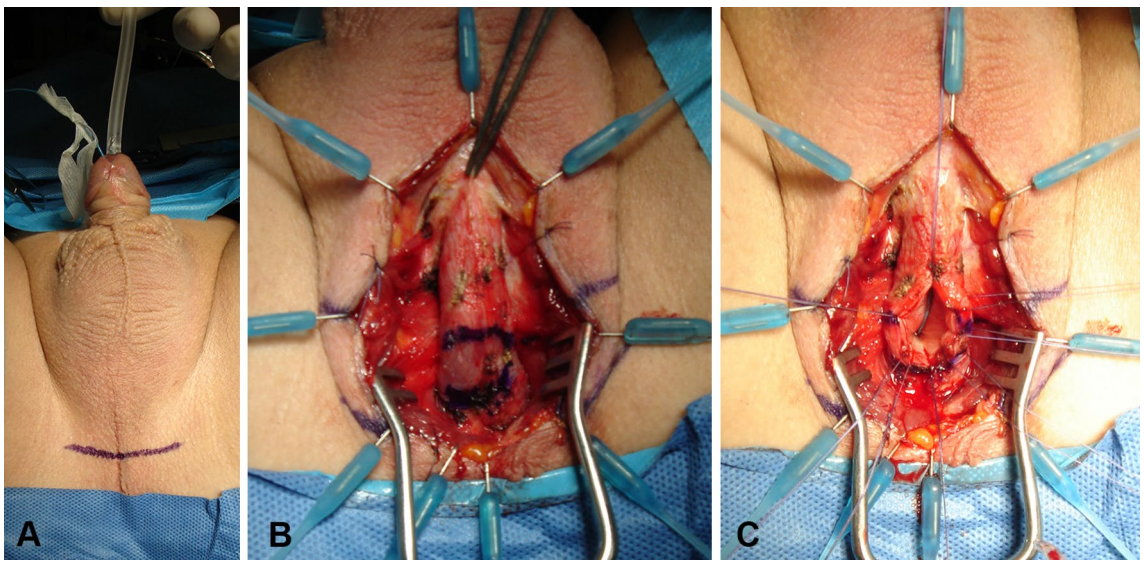

Fig. 2 **a** Nelaton 16 F is inserted and the site of stricture is marked into perineum. **b** The bulbar urethra is exposed, and the site of stricture is marked. Two cm before the stricture site is also marked the site were the bulbar urethra will be opened. **c** The bulbar urethra is opened and the 3F guide-wire is exposed inside the stricture

(Fig. 4c, d) until the nasal speculum could be fully opened without tension (Fig. 4e). A J-shaped needle (Fig. 5a) is inserted through the spongy tissue in front to the verumontanum, and the tip of the needle is delivered towards the bladder and then pulled back using a second needle driver (Fig. 5b–d). Using this technique, three stitches (Vicryl 4/0) are inserted at the 5–6–7 o'clock just distal to the verumontanum (Fig. 5e). Oral mucosal graft is then placed into the ventral urethrotomy according to the standard technique of ventral onlay urethroplasty. At the completion of the procedure, a grooved silicone Foley catheter 18F is left in place for 1 month.

Post-operative course and follow-up criteria

One month after the surgery, a voiding cysto-urethrography was performed and the catheter was removed. Follow-up visits were scheduled every 6 months and included uroflowmetry and post-micturition residual urine evaluation. Patients were queried in detail regarding their urinary continence

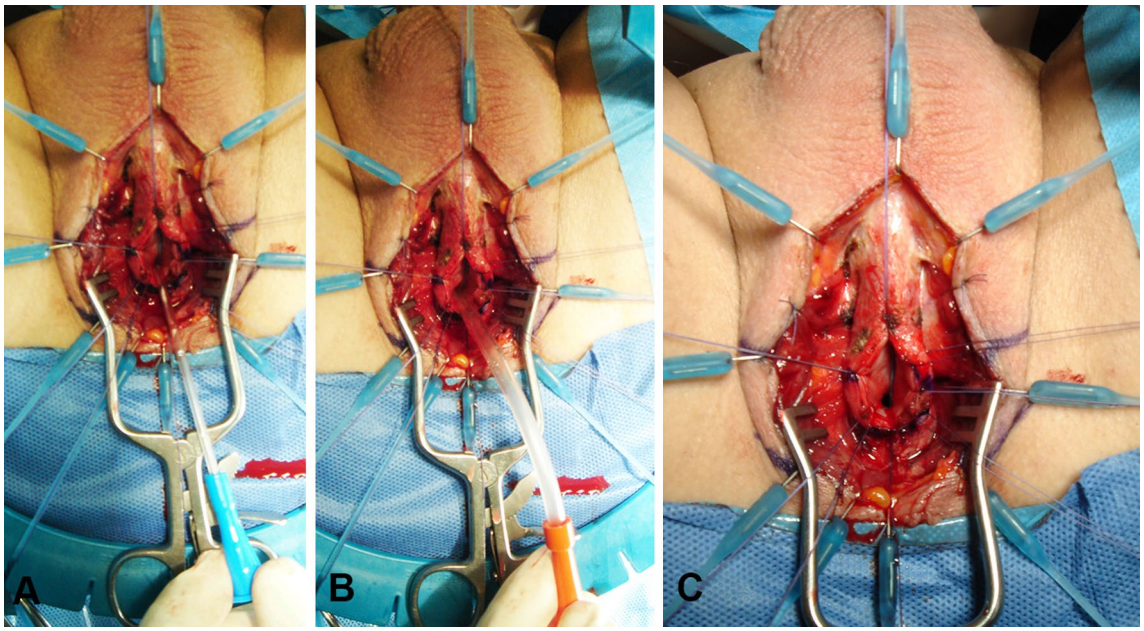

Fig. 3 **a** Under the guidance of the guide-wire, the stricture is gently progressively dilated by inserting Nelaton catheter 8F. **b** After progressive 10, 12, 14 F dilation, a 16F Nelaton catheter is inserted. **c** View of stricture after progressive dilation

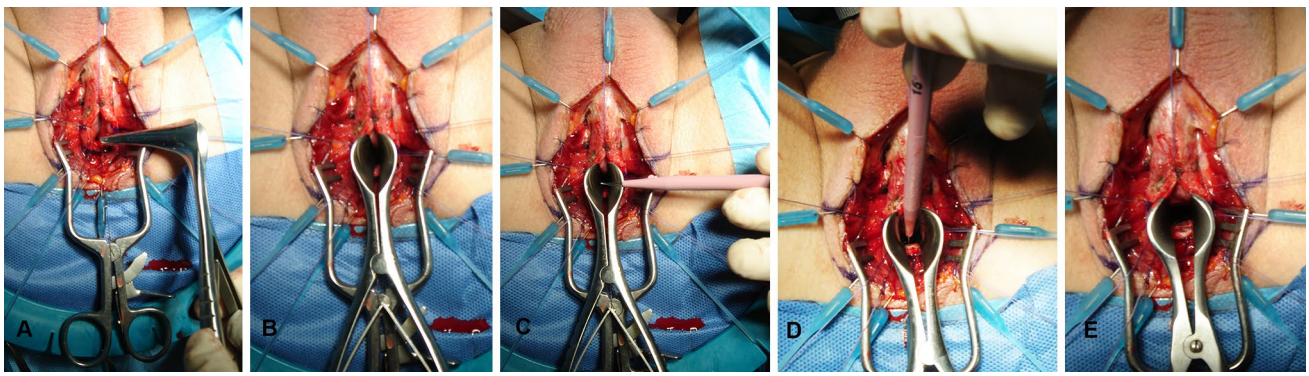

Fig. 4 **a** View of the nasal speculum with modified tip. **b** The nasal speculum is inserted in the stricture. **c**, **d** The white mucosal ring is incised at 6 o'clock using a special ophthalmic scalpel. **e** The nasal speculum is fully opened

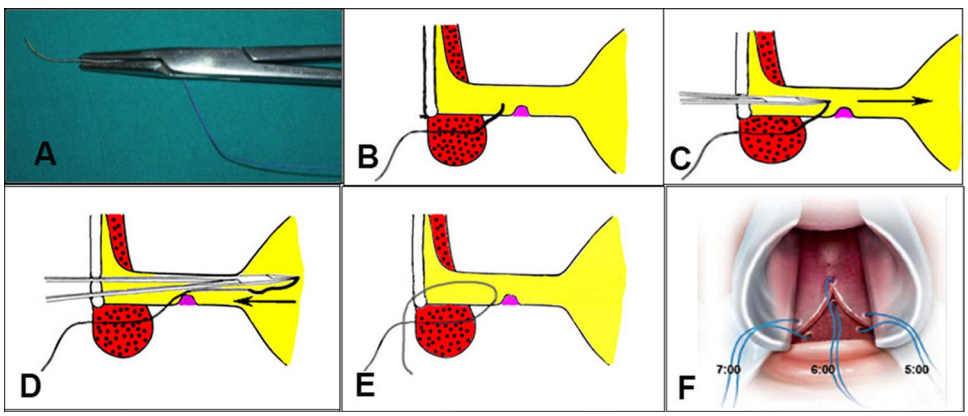

Fig. 5 **a** The J-shaped needle. **b–e** The J-shape needle is inserted through the spongy tissue in front to the veru montanu, the tip of the needle is pushed on the bladder and pulled back. **f** Using this maneuver, three stitches are inserted at 5, 6, 7 o'clock in front to the veru montanu

status in different body positions (supine, standing, under stress) and were asked to report on their use of pads (small, medium, large). For patients who have reported any degree of post-operative incontinence, urodynamic study was performed to rule our detrusor overactivity.

Data were described as number and percentage, or mean and standard deviation, or median and range, when appropriated. Differences between groups were not compared.

Results

Overall, 69 patients were included in the study of whom 63 (91.4%) previously underwent TURP, 3 (4.3%) HOLEP and 3 (4.3%) TUIP. Median patient's age was 67 years (range 31–81 years), and median stricture length was 4 cm (range 1–7 cm). Overall, 33 patients (47.8%) underwent previous urethrotomy, median 1 (range 1–10). Following urethroplasty a median follow-up was 52 months (range 14–191 months). Out of 69 patients, 55 (79.7%) were classified as a success and 14 (20.3%) as a failure. Among the 43 (62.3%) patients 31–69 years old, the success rate was 81.4%; while among the 26 patients older than 70 years, the success was 76.9%. Stratified by prior BPH treatment, for the patients with strictures after TURP, the urethroplasty success rate was 79.4%, after HOLEP 100% and after TUIP 66.7%. In patients with urethral strictures between 1 and 5 cm, the success rate was ranging from 76.2 to 100%. In comparison, in patients with strictures 5/6 cm the successful outcome was achieved in 66.7% (Table 1). The number of previous urethrotomies did not influence the outcomes of urethroplasty (Table 2). Overall, out of the 14 failures, 11 (78.6%) were due to recurrent strictures, and 3 (21.4%) were due to post-operative incontinence. Out of 11 failures, 4 (36.4%) were observed within first 12 months, 4 (36.4%) after 12–24 months, and 3 (27.2%) after more than 24 months.

One of the three patients developed urge incontinence due to overactive bladder, as it was showed by urodynamic assessment, and was successfully treated with medical therapy. The treatments of 11 patients with recurrent strictures were summarized in Table 3. In summary, out of 69 patients, 5 (7.2%) were included in periodic dilation program, and 1(1.4%) was suggested to leave a permanent urethral catheter.

Table 1 Success rate according to the stricture length

Stricture length	No patients	Success	Failure
1–2 cm	2 (2.9%)	2 (100%)	–
2–3 cm	11 (16%)	9 (81.8%)	2 (18.2%)
3–4 cm	21 (30.4%)	16 (76.2%)	5 (23.8%)
4–5 cm	25 (36.2%)	20 (80%)	5 (20%)
5–6 cm	6 (8.7%)	4 (66.7%)	2 (33.3%)
> 6 cm	4 (5.8%)	4 (100%)	–
Total	69	55 (79.7%)	14 (20.3%)

Discussion

The repair of post-TURP proximal bulbar urethral strictures close to the membranous urethra and the related distal urethral sphincter still represents a challenging problem, due to the risk of urinary incontinence after the repair. Indeed, due to incompetent bladder neck, the residual urinary continence is only guaranteed by the functioning distal urinary sphincter. To repair these difficult urethral strictures, we used the ventral onlay oral mucosa graft technique originally described by Morey and McAninch in 1996 [9–11]. This technique was greatly modified with important non-aggressive surgical steps to avoid the sphincter damage.

Despite numerous anatomical and radiological studies, the anatomy of the distal male urinary sphincter is still a controversial subject [8, 12–16]. In summary, the full male

Table 3 Treatment of 11 failures

Previous treatment	No patients	Success	Failure
1 urethrotomy	14 (20.3%)	12 (85.7%)	2 (14.3%)
2 urethrotomies	11 (16%)	10 (90.9%)	1 (9.1%)
3 urethrotomies	2 (2.9%	2 (100%)	–
4 urethrotomies	1 (1.4%)	1 (100%)	–
5 urethrotomies	1 (1.4%)	1 (100%)	–
6 urethrotomies	3 (4.3%)	3 (100%)	–
10 urethrotomies	1 (1.4%)	1 (100%)	–
None	9 (13%)	6 (66.7%)	3 (33.3%)
Dilations	8 (11.6%)	6 (75%)	2 (25%)
Associated treatment	19 (27.5%)	13 (68.4%)	6 (31.6%)
Total	69	55 (79.7%)	14 (20.3%)

Table 2 Success rate according to the previous treatments

Treatment of failures	No patients	Success	Failure
Periodic dilation	2 (18.2%)	–	–
Urethrotomy	7 (63.6%)	4 (57.1%)	3 (42.9%) periodic dilation
Oral mucosa urethroplasty	2 (18.2%)	1 (50%)	1 (50%) permanent catheter
Total	11	5	4

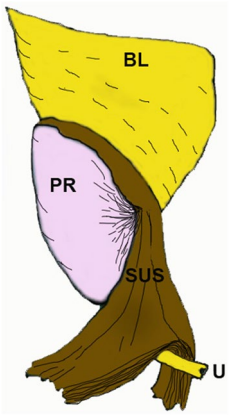

Fig. 6 Schematic drawing of the rhabdosphincter of the male urethra: *BL* urinary bladder, *PR* prostate, *U* urethra, *SUS* striated urinary sphincter = rhabdosphincter (Reprinted with permission [16])

urinary continence is guaranteed by two different sphincter components: 1. The proximal smooth muscle component composed of condensation of detrusor fibers (bladder neck); 2. The distal rhabdosphincter, a striated muscle that extends sleeve like from the base of the bladder to the urogenital diaphragm [8, 12, 13]. The distal rhabdosphincter is not a circumferential ring around the urethra, but is omega-shaped inserting dorsally at the perineal body via a tendinous rafe [6, 7, 13]. Innervation of the rhabdosphincter comes from pelvic (autonomic) and pudendal (somatic) nerve branches, which enter the rhabdosphincter postero-laterally. [15] In 1996, Strasser et al. fully described the anatomy and innervation of the rhabdosphincter of the male urethra, by means of anatomical dissections and serial anatomical as well as histological sections of 12 male pelves [16]. The authors have clearly shown that in an adult male, hardly any striated muscle fibers can be found dorsal to the urethra, forming an omega-shaped loop around the anterior and lateral aspects of the urethra [16] (Fig. 6). This pattern of muscle position leaves the ventral anterior and anterolateral surface of the membranous urethra relatively safe for dissection without sphincter damage.

Preserving urinary continence in patients with strictures in the area of the distal sphincter is fundamental to fully respect and preserve the true anatomy of this sphincter. Fully circumferential dissection or complete transection of the proximal bulbar/membranous urethra or aggressive dorsal dissection of the urethra may damage the sphincter fibers and potentially cause incontinence [6–8]. For these reasons, we greatly modified our surgical technique of ventral onlay graft urethroplasty. In our approach, the bulbar urethra is opened along its ventral surface, avoiding any circumferential dissection, the stricture is gently progressively dilated avoiding damage to the sphincter fibers and the incision of the stricture is made at 6 o'clock where the sphincter fibers are absent. Moreover, we make the urethrotomy incision only through the mucosal ring sparing the underlying spongiosum tissue. All these sphincter-sparing maneuvers have allowed us to avoid post-operative incontinence in 91.3% of the patients who underwent repair of strictures in the area of the distal sphincter. Only 4.3% of patients were incontinent after our surgery.

There are some weaknesses in this study. The sample size is relatively small, notwithstanding the multicenter international setting. No statistical comparative analysis was done. Additionally, other limitations include the definition of post-operative urinary incontinence, which remains a matter of debate, the absence of neurophysiological tests to investigate the status of micturition arch reflex before and after the surgical repair. Somatosensory evoked potentials of the pudendal nerves were not investigated and we could not detect the presence or absence of neurogenic sphincter deficiency. Finally, when we evaluated existing literature for articles on similar topics, we failed to find data to consider in a discussion.

Conclusion

The use of modified ventral onlay graft urethroplasty is a suitable surgical technique for repair of sphincter urethral stricture in patients who underwent BPH transurethral surgery. This technique provided 79.7% success rate in terms of urethral patency, and 95.6% of post-operative urinary continence.

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