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ORIGINAL ARTICLE

Versatile algorithmic midline approach to perineal urethrostomy for complex urethral strictures

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Abstract

Purpose To present results of an algorithmic approach to perineal urethrostomy (PU) based on a midline perineal incision among men with complex urethral strictures.

Methods A single surgeon retrospective review of consecutive patients who underwent PU between 2008 and 2017 was performed. Patient demographics and outcomes were collected via medical record review. After a midline perineal incision, the PU was matured either by (a) mobilization of the urethral plate (loop) alone in cases with distal strictures or low body mass index (BMI), or (b) with creation of a lateral perineal skin flap (7-flap) for those with longer urethra-to-skin distances. Success was defined as functional voiding without the need for further procedures. Patients were contacted by phone and administered validated questionnaires.

Results Of 62 PU patients, 20 (32.3%) underwent the loop technique, and 42 (67.7%) had the 7-flap procedure, 7 of which were reoperative for prior failed PU. Median age was 61.9 years (range 23–85) and the median stricture length was 8.0 cm (range 2.5–18 cm). Mean BMI was greater among 7-flap compared to loop patients (34.9 vs. 30.0 kg/m^2, $p = 0.01$). Success rates were 92.9% (39/42) in the 7-flap group and 100% (20/20) in the loop PU cohort during a median follow-up of 30.7 months. Among 62 PU patients, 19 (30.6%) responded to the survey—median PGI-I score was 1.0 (range 1–2) indicating that symptoms were "very much improved".

Conclusions The algorithmic midline approach to PU offers a standardized, versatile solution with excellent surgical outcomes and high patient satisfaction, even in obese or refractory stricture patients.

Keywords Urethral stricture · Urethroplasty · Perineal urethrostomy · Patient-reported outcomes

Introduction

Although urethral reconstruction can usually be accomplished in a single setting using various tissue transfer techniques, reconstructive options may be limited in patients with extensive stricture disease. Perineal urethrostomy (PU) has long been recognized as an effective "last resort" when standard orthotopic reconstructive efforts are deemed futile. In recent decades, PU has increasingly been recognized as a simple, reliable option for selected patients with complex urethral stricture disease [1, 2].

The classic PU technique popularized by Blandy in 1968 is based on an inverted "Y" or "U" perineal incision to create a broad perineal skin flap [3]. Although the Blandy technique has been widely adopted and performed for over 50 years, one limitation of the Blandy technique is that the skin flap is created prior to urethral dissection. In 2011, we reported an alternative "7-flap" PU technique using a lateral perineal skin flap, tailored after urethral dissection as an extension of the midline perineal incision [4, 5]. When the stricture extends to the proximal bulbar urethra or the patient is obese, the 7-flap is efficient since the lateral perineal skin flap can be extended according to the patient's anatomic requirements.

We have recently found that mobilization of the bulbar urethra from the corporal bodies alone (in conjunction with a perineal Z-plasty) often facilitates a tension-free urethrostomy ("loop PU") while preserving dorsal urethral blood flow and avoiding larger perineal skin flaps. Herein we present our updated PU experience based on a familiar midline perineal approach, with algorithmic combination of the loop

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PU technique, perineal Z-plasty, and 7-flap. We hypothesized that the PU produces excellent functional outcomes, even in cases with complex refractory strictures.

Materials and methods

After obtaining Institutional Review Board approval, a single surgeon retrospective review of consecutive patients who underwent a PU between 2008 and 2017 was performed. All patients had preoperative imaging with voiding cystourethrogram and/or retrograde urethrogram to delineate stricture characteristics and location. Strictures were extensive, often with palpable periurethral fibrosis throughout the penile spongiosum. Patient demographics and outcomes were collected via medical record review. Patients were contacted by telephone and administered validated questionnaires [Patient Global Impression of Improvement (PGI-I) [6], Regret questionnaire] to assess patient satisfaction postoperatively. Surgical success was defined as functional voiding without the need for further procedures.

Operative technique

Perioperative broad-spectrum antibiotics are administered in the operating room prior to incision. The patient is placed in the lithotomy position and the genital area and perineum are prepped and draped in the usual fashion. A midline perineal incision is made, and dissection proceeds through superficial tissue layers until the bulbospongiosis muscle is divided in the midline, exposing the bulbar urethra. A LoneStar™ self-retaining retractor system (CooperSurgical, Trumbull, CT) and Adson Beckman retractor are used to optimize visualization.

The urethra is circumferentially mobilized from proximal to distal bulbar urethra with additional traction from a vessel loop. If the distal urethra is not obliterated, a small bougie-a-boule is passed to the distal bulbar urethra, and 4-0 polyglactin (Vicryl™) urethral stay sutures are placed on either side of midline to stabilize the urethra. The urethra is sharply opened until healthy urethra proximal to the stricture disease is encountered accommodating a 28 French bougie-a-boule. The urethrotomy is opened widely to at least 5 cm in length to minimize the risk of stenosis (Fig. 1). Flexible cystoscopy is performed to ensure that there are no stones or lesions within the bladder. At this point, we determine if a 7-flap is necessary, or if tension-free maturation can be achieved via urethral mobilization and perineal Z-plasty alone (loop PU). For long skin-to-urethra distances, a 7-flap is measured, marked out, and created from the top of the incision as previously described [4, 5]. The skin flap must have adequate thickness to preserve its underlying cutaneous blood supply.

A change in practice since the initial description of the 7-flap technique [4] is that we no longer routinely amputate the urethra, but rather attempt to leave the urethral plate intact when possible, incising the ventral urethra only. Skin is matured to the urethrotomy in an interrupted fashion using 2-0 poliglecaprone (Monocryl™). A perineal Z-plasty is often performed at the inferior portion of the incision to reduce tension [7]. Oxidized regenerated cellulose (Surgicel® Fibrillar™; Ethicon US, Cincinnati, OH) is placed in the deep portions of the incision to promote hemostasis in lieu of drains. The incision is closed in multiple layers with absorbable suture and the incision is dressed with bacitracin ointment and gauze. A 16 French Foley catheter is placed and removed by the patient at home in 3 days, after which the patient voids spontaneously. Patients are seen in clinic at 4–6 weeks to assess their incision, voiding habits, post-void residual (PVR), and AUA Symptom Score (AUASS). Patients are then offered annual visits for evaluation of voiding symptoms, or on an as-needed basis per patient preference. Patients with known benign prostatic hyperplasia may be followed more closely with AUASS, uroflowmetry, and PVR to determine if an outlet procedure is necessary.

Statistical methods

Perioperative and survey data were compared between the 7-flap and loop groups using Chi-square, Mann–Whitney *U*, and independent sample *t* tests for categorical, ordinal, and continuous variables, respectively. Statistical significance was considered at $p < 0.05$ and reported p values are two sided. Analysis was performed using JMP version 12.2 (SAS Institute Inc., Cary, NC).

Results

Patient demographics and success rates

Of the 62 patients who underwent PU during the study period, 20 (32.3%) underwent the loop technique alone and 42 (67.7%) underwent the 7-flap approach, with either the amputating 7-flap procedure (35/42, 83.3%) or combined 7-flap/loop (7/42, 16.7%). Seven (11.3%) of the 7-flap cases were reoperative for prior failed PU performed elsewhere. Median age was 61.9 years (range 23–85). The most common urethral stricture etiologies were lichen sclerosus (LS) in 38.7% (24/62) and hypospadias in 21.0% (13/62) (Table 1).

Comparing 7-flap to loop PU patients, mean BMI was significantly higher in the 7-flap group (34.9 vs 30.0 kg/m^2, $p = 0.01$). Stricture length was similar between the two groups, with a median length of 8.5 cm (range 2–15 cm) in

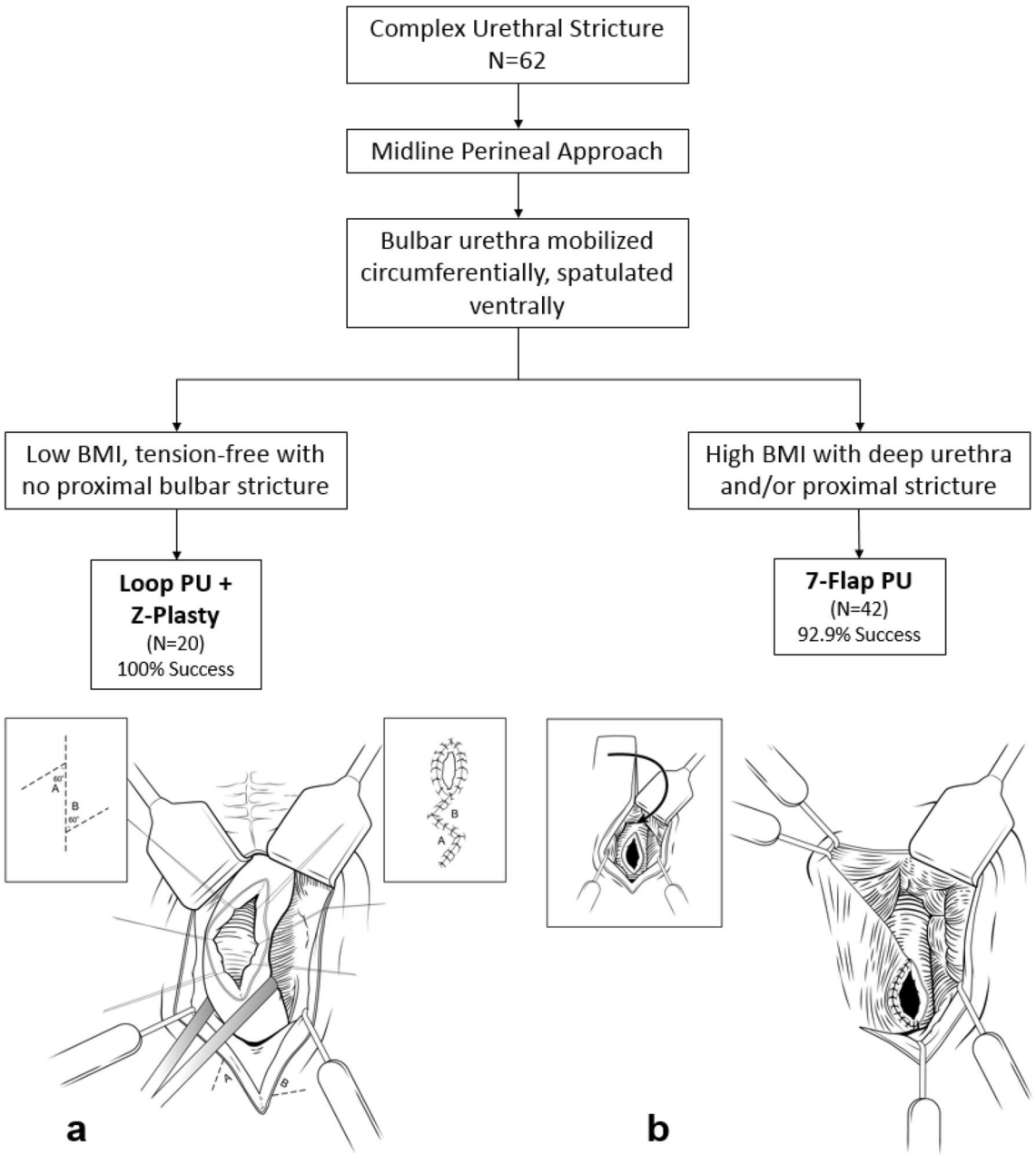

Fig. 1 Algorithm for midline approach to perineal urethrostomy, with illustrations depicting the loop perineal urethrostomy (**a**) and the 7-flap technique (**b**)

the loop group, and 8.0 cm (range 2.5–18 cm) in the 7-flap cohort. Patient comorbidities such as cardiovascular disease, diabetes mellitus, erectile dysfunction, and history of smoking were similar between the two groups, with slightly more patients in the 7-flap group presenting with hypertension (71.4% vs. 45.0%, $p = 0.05$).

Overall success rates were high, with 92.9% (39/42) primary success in the 7-flap group over a 53.6-month median follow-up and 100% (20/20) primary success in the loop PU cohort over a median follow-up of 13.0 months. Complications occurred in 11.3% of patients and were mild (urinary retention, cellulitis, perineal abscess). There was no difference in complication rates between the different surgical techniques (10.0% in loop group, 11.9% in 7-flap cohort, $p = 0.83$). All high grade complications (Clavian–Dindo III+) were reoperation due to recurrent stenosis ($n = 3$)—one was salvaged with a single PU revision, the second required two PU revisions, and the third underwent PU revision and subsequent balloon dilation. Among obese patients with a BMI > 35 kg/m^2 (range

Table 1 Perineal urethrostomy patient demographics, perioperative characteristics, and patient-reported outcomes ($n = 62$)

	Loop	7-Flap	Overall	*p* value
Patients	20	42	62	
Median age (years)	60.1	62.8	61.9	
BMI (mean)	30.0	34.9	33.3	*0.01*
Median stricture length (cm)	8.5	8.0	8.0	
Etiology				
BXO	30.0%	42.9%	38.7%	0.33
Idiopathic	30.0%	14.3%	19.4%	0.15
Hypospadias	20.0%	21.4%	21.0%	0.9
Iatrogenic	15.0%	9.5%	11.3%	0.52
Penile cancer	0.0%	4.8%	3.2%	0.32
Trauma	5.0%	7.1%	6.5%	0.75
Comorbidities				
CAD	30.0%	23.8%	25.8%	0.6
DM	20.0%	16.7%	17.7%	0.75
COPD	5.0%	21.4%	16.1%	0.1
HTN	45.0%	71.4%	62.9%	*0.05*
Tobacco	30.0%	33.3%	32.3%	0.8
Radiation	0.0%	4.8%	3.2%	0.32
Complications				
Minor (grade I/II)	10%	4.8%	6.5%	0.44
Major (grade III+)	0%	7.1%	4.8%	0.23
Total	10.0%	11.9%	11.3%	0.83
Median follow-up (months)	13.0	53.6	30.7	*< 0.01*
Surgical success (%)	100.0%	92.9%	95.2%	0.23
Patient-reported outcomes				
Mean PGI-I	1.5	1.2	1.3	
Regret (1 = yes)	0.0	0.0	0.0	1
Recommend (1 = yes)	1.0	1.0	1.0	1
Overall improvement	88.8%	92.7%	91.1%	0.61

All significant *p* values (< 0.05) in italics

35.1–59.4, $n = 23$), PU success rates remained high (22/23, 95.7%), with only one revision required during a median follow-up of 23.3 months.

Patient-reported outcomes

All patients were contacted by telephone for survey administration with a 30.6% (19/62) response rate. Patients reported a mean global percentage of improvement of 91.1% (range 65–100%) compared to their condition before surgery. Patient Global Improvement Index (PGI-I) scores were similarly high, with a median score of 1.0 (range 1–2), indicating that voiding symptoms were "very much improved". All patients reported that they had no regrets about undergoing the surgery and would recommend the surgery to others in a similar situation (Table 1).

Discussion

This study further verifies the 7-flap PU as a reliable alternative means of resolving complex (even long and proximal) urethral defects. We have refined the technique with incorporation of the loop PU in a versatile, algorithmic manner. Using a combination of the loop and 7-flap techniques, we have achieved a near uniform success rate (95.3%) over several years of follow-up, despite the long and recurrent nature of the strictures in this cohort. This approach has also proven to be successful in obese patients requiring long skin flaps for tension-free reconstruction.

Algorithmic approach to perineal urethrostomy

We believe that it is advantageous to conduct PU procedures through the same vertical midline perineal approach commonly used during conventional bulbar urethroplasty, which has been associated with fewer wound complications compared to the inverted lambda perineal incision [8]. Using a "common pathway" approach, the proximal extent of the stricture is defined and the necessity to forego orthotopic urethral reconstruction is confirmed. We have had cases wherein orthotopic reconstruction was deemed possible intraoperatively and plans for PU were then canceled. The algorithmic approach affords maximal flexibility, allowing all aspects of PU creation to be customized to a given patient's habitus and stricture characteristics, which reduces surgical time and trauma as much as possible.

In our early experience with the 7-flap technique [4, 5], we routinely performed urethral amputation at the distal portion of healthy urethra. While we have seen favorable outcomes using this technique, we now believe that urethral transection may often be unnecessary, especially when the distal bulb is spared. Our rationale for amputation was that it reduced tension during maturation because the proximal stump could be maximally mobilized and that a robust proximal vascular supply obviated the need for retrograde blood flow. However, with mobilization of the entire bulbar urethral plate from the corpora, we can often mature the adjacent skin to the PU with perineal Z-plasty alone, reserving a 7-flap for only the most proximal defects.

Maintaining the bidirectional urethral blood supply using the loop PU technique is sensible, as many of these patients have had multiple urethroplasties and urethral vascularity may be tenuous. Many reconstructive centers now advocate non-transecting approaches to anterior urethroplasty to maximally preserve urethral blood supply [9–12] and the loop PU approach follows this rationale. Although

the straightforward ventral urethrostomy has long been advocated for creation of the PU [1, 13], we have found that bulbar urethral mobilization minimizes tension at the site of urethrostomy and that proximal bulbar strictures may not reach the skin without tension.

Perineal Z-plasty provides skin lengthening in the axis of the midline incision proximally, further promoting tension-free closure during maturation of the loop PU. The Z-plasty is a versatile plastic surgical tissue transfer maneuver, often used throughout the body to release skin contractures via transposition of triangular skin flaps (Fig. 1a) [7]. In urology, the use of Z-plasty has been described for correction of bifid scrotum in severe hypospadias [14], and to release concealed penis or penile chordee secondary to overexuberant circumcision [15]. To our knowledge, this is the first report of Z-plasty use in creation of perineal urethrostomy, which we have found to be a useful adjunct.

Perineal urethrostomy outcomes and patient satisfaction

Although orthotopic urethral reconstruction is almost universally preferred, especially among younger men, most patients appear pleased by their decision to undergo PU given the chronic and disruptive nature of their voiding pathology. Barbagli et al. reported that 97.1% of PU patients were satisfied or very satisfied in their series of 173 patients who underwent PU over a median follow-up of 62 months [1]. Though performed with the intent for a second stage urethroplasty, the majority (73.4%) chose not to undergo the second stage. Success rate of primary PU was 70%, which increased to 88.4% after a single revision. Peterson et al. reported multicenter results among 63 patients who underwent PU, reporting similar outstanding patient satisfaction. On the whole, for chronic stricture patients accustomed to seated voiding, definitive PU appears to be an excellent surgical option [2].

The most common stricture etiology in our cohort was LS and these patients present a formidable challenge for the reconstructive urologist. Although multiple treatment modalities have long been suggested for LS patients, including staged reconstruction with extragenital tissue [16] and topical or intraurethral steroids [17, 18], success is highly variable [16, 19–21]. Our observation has been that LS strictures are distinctly recalcitrant, especially when the distal urethra is palpably indurated. We have been impressed that the perineal and lower scrotal tissues used to develop the 7-flap tend to be spared of dermatopathology even in the most severe LS cases. For patients with LS limited to the meatus and glans, we have found that aggressive topical steroids and extended meatotomy to relieve obstruction tend to stabilize the LS disease process with minimal risk of recurrence [22]. LS patients with extensive urethral involvement are prone to suffer repeated difficulties and poor quality of life with conventional treatments, thus we encourage PU more aggressively in this cohort. Although the non-transecting loop/7-flap PU approach maintains continuity of the urethral plate (thus enabling possible second stage reconstruction), further surgery is almost never requested.

After multiple failed attempts at orthotopic reconstruction, PU is among the most durable options for these highly recalcitrant strictures. While heroic attempts for orthotopic urethral reconstruction are often justified in younger (especially single) patients [19, 20, 23], many older patients prefer a simpler, more definitive resolution to their obstructive voiding. Our practice has evolved to offer PU to recurrent/extensive stricture patients earlier in their treatment process in lieu of skin flaps or other complex maneuvers [24]. Generally, if a patient is under age 50, we offer PU as an option, but if they are older and/or have limited life expectancy, we encourage PU preferentially. Reconstructive urologists should recognize patients with treatment fatigue relating to chronic, severe urethral stricture disease, for whom PU can be utilized at any time depending on patient goals.

Limitations

As with any retrospective clinical study, this study has inherent biases. The response rate to our telephone survey was modest (30.6%), which may have biased our results. Few patients who were contacted by phone declined to answer the survey questions; most non-responders were unable to be contacted by phone. Responders, therefore, likely constitute a representative sample. Our study is limited by lack of preoperative patient-reported quality of life metrics, which would have been helpful to delineate which aspects of their quality of life were most improved by the surgery. However, favorable scores on the PGI-I indicate strong global improvement on a validated metric.

Follow-up in the loop PU group (13.0 months) was significantly shorter than the 7-flap group (53.6 months), thus true surgical success rates in the loop group may be less than uniform. Additionally, sexual function was not discretely assessed pre- or postoperatively. Aside from ejaculation through the perineal neomeatus, no patients reported adverse effects on sexual function at clinic visits; however, no sexual domain questions were administered in the telephone survey. Finally, the surgical technique presented often results in mildly asymmetric incisions under the scrotum due to the unilateral nature of the 7-flap. Although cosmetic concerns were not assessed, no patient expressed dissatisfaction regarding the appearance of the PU or the surrounding incisions.

Conclusions

Perineal urethrostomy via an algorithmic midline approach allows for maximal surgical flexibility, while preserving the bidirectional urethral blood supply. These techniques can be applied in patients of any habitus or stricture location. Outcomes are excellent, with a long-term success rate of over 95%, and patient satisfaction is high.

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Compliance with ethical standards

Conflict of interest Dr. Allen Morey receives honoraria for being a guest lecturer/meeting participant for Boston Scientific. No other authors have disclosures to report.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Verbal informed consent was obtained from all individuals participating in the telephone survey portion of the study. For the retrospective outcomes review, formal consent is not required, as no identifying information was included in the study.

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