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Kulkarni Dorsolateral Graft Urethroplasty Using Penile Skin

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OBJECTIVES	To investigate the safety, efficacy, and versatility of dorsolateral graft urethroplasty using penile skin.
MATERIALS AND METHODS	Between 2010 and 2013, 37 men with anterior urethral strictures underwent dorsolateral graft urethroplasty using penile skin by a single surgeon (EP). Inclusion criterion was patients with anterior urethral strictures. Exclusion criteria were lichen sclerosus-related strictures, absence of available penile skin because of previous surgery, and obliterative urethral strictures. Clinical outcome was considered a failure when any postoperative instrumentation was needed, including dilatation.
RESULTS	Mean (\pm standard deviation) patients age was 51 (\pm 15.4) years. Stricture etiology was iatrogenic in 25 cases (67%), unknown in 10 (27%), trauma in 2 (6%). Stricture site was penile in 21 (57%) and peno-bulbar in 16 (43%). Median (range) stricture length was 5 cm (1-15). Of 37 patients, 30 (81%) had received previous treatments. Median (range) follow-up was 21 months (12-47). Of 37 patients, 34 (92%) had successful treatment and 3 (8%) had failed treatment. The 3 patients with failed treatment were treated with urethrostomy and are awaiting further reconstruction. Study limitations include the small sample size and the limited follow-up.
CONCLUSION	With a mid-term follow-up time, the dorsolateral graft urethroplasty using penile skin is shown to be a safe, efficient, and versatile technique for the repair of short-mid-long anterior urethral strictures. UROLOGY 90: 179–183, 2016. © 2016 Elsevier Inc.

Various reconstructive techniques are available to treat anterior urethral strictures.¹ Over time, patch grafting procedures have spread rapidly and the dorsal or ventral graft placement using dorsal or ventral urethrotomy approaches has become a contentious issue.²

Recently, Kulkarni et al³ proposed the one-sided dorsolateral graft urethroplasty which, avoiding the full circumferential mobilization of the urethra, represents a new minimally invasive alternative to traditional dorsal urethroplasty. Because most of the strictures reported in their first study were secondary to lichen sclerosus (LS), they described the technique with the use of oral mucosa grafts and as a valid alternative to a staged procedure.³

To date, except for the LS-related strictures, the literature data on urethral reconstruction show that penile skin

(PS) and oral mucosa (OM) have similar success rates.^{4,5} Thus, although OM seems to be the most used graft, the question on which type of graft is the best one remains open to debate.

With the aim to investigate the safety, efficacy, and versatility of the Kulkarni technique using grafts other than oral mucosa, we report our midterm experience with the treatment of anterior non-LS urethral strictures by using penile skin. To our knowledge, this is the first study on dorsolateral graft urethroplasty using penile skin.

MATERIALS AND METHODS

We retrospectively evaluated 37 men with anterior urethral strictures who underwent dorsolateral graft urethroplasty using penile skin between 2010 and 2013. All patients were treated by a single surgeon (EP).

Inclusion criterion was patients with anterior urethral strictures. Exclusion criteria were patients with LS-related strictures, absence of available penile skin because of previous surgery, and obliterative urethral strictures.

All patients provided written informed consent prior to their inclusion in the study. Hospital Ethics Committee approval was obtained and it conforms to the provisions of the Declaration of Helsinki.

Preoperative evaluation included a detailed clinical history, physical examination, urine culture, uroflowmetry, retrograde and voiding cystourethrography, and urethroscopy.

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Figure 1. Preoperative retrograde urethrogram showing a long peno-bulbar urethral stricture. (Color version available online.)

Table 1. Stricture characteristics

Variable	n (%)
Etiology	
iatrogenic (catheter, prostate surgery, hypospadias repair)	25 (67)
Unknown	10 (27)
Trauma	2 (5)
Location	
Penile	21 (57)
Peno-bulbar	16 (43)
Length (cm)	
<2	6 (16)
2- <4	8 (22)
4- <6	7 (19)
≥6	16 (43)
Prior treatments	
Dilatations	5 (13)
Urethrotomy	5 (13)
Urethroplasty	3 (8)
Multiple treatments	17 (47)
None	7 (19)

The stricture was located at the penile and peno-bulbar urethra in 21 (57%) and 16 (43%) cases (Fig. 1), respectively. Stricture characteristics are summarized in Table 1.

Surgical Technique

The patient was placed in a simple lithotomy position, with calves placed in the Allen stirrups. Urethroscopy was performed using a 7 F rigid ureteroscope, and a 3 F guidewire was inserted through the urethra into the bladder. Methylene blue was injected into the urethra to better define the mucosa at the moment of the urethral opening.

The strictured urethra was isolated by degloving the foreskin in 3 patients, by a midline penile incision in 15, by a midline peno-scrotal incision in 3, and by invaginating the penis into a midline perineal incision in 16, respectively. In contrast to the original Kulkarni technique,³ in case of strictures involving the mid or proximal bulbar segment, the bulbospongiosus muscle was split in the midline.

The urethra was dissected from the corpora cavernosa only along the left side, starting from the distal tract of the strictured urethra.

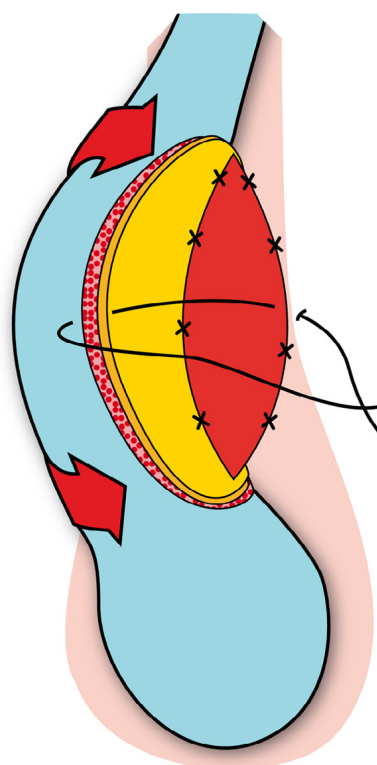


Figure 2. The urethra was dissected from the corpora cavernosa only along the left side. Along the right side, the urethra remained attached to the corpora over its full length. On the left side, the urethra was partially rotated. The strictured urethra was opened by an urethrotomy on its dorso-lateral surface. The penile skin graft was spread fixed over the tunica albuginea. The right margin of the graft was sutured to the left margin of the urethral mucosa plate with interrupted sutures. The urethra was rotated to its original position over the graft. (Color version available online.)

Along the right side, the urethra remained attached to the corpora cavernosa over its full length, thus preserving its lateral vascular blood supply. On the left side, the urethra was partially rotated and the lateral urethral surface was underlined. The distal extent of the stenosis was identified, the dorso-lateral urethral surface was incised along the midline, and the urethral lumen was exposed. The stricture was then incised along its entire length by extending the urethrotomy 1 cm both distally and proximally in the healthy urethra.

According to stricture length, the penile skin graft was obtained by a total or partial circumcision, or by a longitudinal harvesting from the ventral surface of the penis.

The skin graft was trimmed to an appropriate size according to the length and width of the urethrotomy, and it was spread fixed over the tunica albuginea with quilting 5/0 polyglactin sutures. The right margin of the graft was sutured to the left margin of the urethral mucosa plate with interrupted 5/0 sutures. An 18 F catheter was inserted. The urethra was rotated to its original position over the graft (Fig. 2). A double running fashion with 4/0 sutures was used to stabilize the left urethral margin to the corpora cavernosa. After 18 F catheter removal, a Foley 14 F grooved silicone catheter was inserted and left in situ for 3 weeks.

In 5 patients with strictures involving the peno-navicular tract, a wide meatotomy was performed, leaving open the distal tract of the urethral reconstruction.

During all the reconstructive time, the penis was stretched by means of a stitch clasp to a Mosquito and settled to a Scott retractor to reach the maximum stretched length of flaccid penis. This maneuver facilitated the spread and fixation of the graft with the aim to prevent graft shrinkage and subsequent penile chordee.

Postoperative Care and Follow-up

The patient ambulates on the second postoperative day and was discharged from the hospital 3 days after surgery. All patients received broad-spectrum antibiotics and were maintained on oral antibiotics until the catheter is removed. All patients receive desametasone for 9 days from the day of operation to reduce the edema of the genitalia.

We used desametasone postoperatively as we have observed it to be helpful, although no data supporting its use exist.

Voiding cystourethrography was performed upon catheter removal, 3 weeks after surgery.

Follow-up assessment included uroflowmetry and urine culture, together with clinic visit or telephone interview every 4 months in the first year and annually thereafter. Urethrography and urethroscopy were performed in patients presenting any new/residual obstructive symptoms or peak flow rate (Qmax) < 14 mL/s. Clinical outcome was considered a failure when any postoperative procedure was needed, including dilatation.⁵

Statistical Analysis

Categorical data are reported with proportions. Continuous data are evaluated by the Shapiro-Wilk test for normality. In case of normal distribution, data are reported by the mean and standard deviation (SD). In case of a non-normal distribution, the median with range is used. The improvement of Qmax was measured using the paired samples *t* test. To evaluate an eventual impact of stricture length on the surgical outcome, patients were categorized in stricture length ≤4 cm vs >4 cm. We decided that this stratification as strictures >4 cm showed a higher rate of failure in our previous study.⁶ Groups were compared with the Fisher's exact test. A *P* value <.05 was considered as statistically significant. Statistical analysis was performed using SPSS v.20.0 (IBM Corp., Armonk, NY).

RESULTS

Mean (±SD) patients age was 51 (±15.4) years. Median (range) stricture length was 5 cm (1-15). Median (range) graft length was 6 cm (3-16). In 31 (84%) patients, a total circumcision was done obtaining a long and wide skin graft useful to the urethral repair of any length. In 6 (16%) patients with short strictures (<2 cm), the graft was obtained by a partial circumcision or by a longitudinal harvesting from the ventral penile surface.

Mean (±SD) preoperative Qmax was 6.9 (±3.7) mL/s. Median (range) follow-up was 21 months (12-47). Mean

(±SD) postoperative Qmax was 19.4 (±6.8) mL/s. This improvement in Qmax was highly significant (*P* < .0001). Of 37 patients, 34 (91%) had successful treatment and 3 (8%) had failed treatment. Patient outcomes and complications are summarized in Table 2.

At voiding cystourethrography following catheter removal at 3 weeks, a mild leakage was observed at the graft anastomosis in 7 (19%) cases, particularly in 1 and 6 cases for a stricture length of ≤4 vs >4 cm (*P* = .052), respectively. However, this resolved spontaneously with a 12 F catheter for 3-4 additional weeks. No patients with contrast extravasation at first voiding cystourethrography developed resticture. Stricture recurrence was observed in 3 (8%) patients, particularly in 2 and 1 patients with stricture length of ≤4 vs >4 cm (*P* = .479), respectively. Because the stricture recurrences were >2 cm and with bad local urethral conditions, the 3 patients with failed treatment were treated with urethrostomy and are awaiting further reconstruction.

As a consequence of the harvesting, one patient developed a paraphimosis that required a revision of the circumcision.

COMMENT

Rationale of Kulkarni Technique

In 1996, Barbagli et al⁷ introduced the use of the dorsal grafting by the dorsal urethrotomy, suggesting two advantages: the corpora give good mechanical and vascular support for the graft; and this technique preserved the integrity of the spongiosum on its abundant ventral side. However, in the original dorsal graft technique, the urethra needs to be completely freed from the corpora. This step might be difficult in scarred urethras which are often firmly attached to the corpora as it occurs after repeated dilatations or in the presence of LS. Furthermore, even if the real vascular damage due to the interruption of the dorsal blood supply (circumferential arteries) is not well known, it has been hypothesized that an extensive urethral mobilization from the corpora, especially in long ischemic strictures, might contribute to further damage the vascularization of an already diseased urethra.³

In this regard, to avoid the excessive circumferential mobilization of the urethra and reduce the vascular damage preserving its contralateral vascular supply, Kulkarni et al³ proposed a less aggressive dorsolateral approach. This technique represents a development of the traditional Barbagli's dorsal grafting and is part of the new trend to reduce

Table 2. Patient outcomes and complications by stricture length

		Total	≤4 cm (n = 18)	>4 cm (n = 19)	<i>P</i> Value
Presence of contrast extravasation at first voiding cystourethrography	No	30 (81%)	17 (94%)	13 (68%)	.052
	Yes	7 (19%)	1 (6%)	6 (32%)	
Stricture recurrence	No	34 (92%)	16 (89%)	18 (95%)	.479
	Yes	3 (8%)	2 (11%)	1 (5%)	

the surgical trauma of a technique and subsequent complications.^{8,9}

Types of Grafts

Because most of the strictures reported in the study were secondary to LS, Kulkarni et al³ used OM as graft material. Then, other series of dorsolateral graft urethroplasty are described, but all of them report the use of OM.¹⁰⁻¹³

Nowadays, OM is considered the suitable material to treat LS strictures by most experts.^{14,15} In addition, OM appears to be the most popular graft also for the repair of strictures of different etiologies.^{2,5} However, among opinion leaders advocating the use of OM, the same Bracka claims that "it is good but not perfect."¹⁶ Furthermore, OM harvest may potentially cause some complications (pain, perioral numbness, tightness of the mouth, motor deficits, etc): this risk is higher in cases of wide and long harvests.¹⁷

To date, except for the treatment of LS strictures, the literature has shown that both PS and OM have a similar success rate.^{4,5} A systematic review and meta-analysis by Lumen et al on urethral reconstruction using PS or OM grafts reported a statistically significantly higher success rate with OM compared to PS (85.9% vs 81.8%, respectively), supporting the use of OM as graft of first choice.¹⁸ However, the results were biased by a significant longer follow-up duration and stricture length for PS compared to OM. Therefore, the authors stated that PS is a valuable alternative to OM and that the final answer on which graft is the best can only be provided by a prospective randomized trial in a homogenous population.¹⁸

Some authors proposed alternative nongenital graft sources but none of them has been so successful as to recommend its widespread use.¹⁹⁻²¹

The popularity of flaps vs grafts has varied over time, and lately, free grafts have been making a comeback, with fewer surgeons using genital flaps.²² However, penile flap procedures are technically complex, associated with higher morbidity (penile skin necrosis, scars, chordee, loss of penile sensation), and less preferred by patients.²³

With regard to the type of graft, in our daily practice, generally we use OM in bulbar strictures and in penile or peno-bulbar strictures with unavailable penile skin due to previous surgery or LS. In cases of penile or peno-bulbar strictures with available penile skin, often and after discussing with patients during counseling the risks and benefits of oral or penile skin harvest, we may decide to use PS grafts. The decision for PS graft selection is made using a combination of patient preference and physician recommendation: patients in whom buccal mucosa is not sufficient for the length of stricture, previous buccal harvest, oral mucosa harvest refused by the patient, cases in which the genito-urethral surgery suggests the circumcision anyway to avoid the risk of postoperative paraphimosis, etc.

Personal Experience Using Penile Skin Graft

With regard to the surgical technique, our trend is to perform one-stage ventral grafting in bulbar strictures, whereas in penile or peno-bulbar strictures we perform

one-stage grafting procedures (by Asopa or by Kulkarni) or staged procedures depending on the conditions of the urethral plate.

In this paper, we aimed to assess the safety, efficacy, and versatility of the Kulkarni technique but using PS instead of OM grafts for the repair of non-LS strictures and in the presence of available penile skin. Our study confirms that the dorsolateral grafting represents an efficient and less traumatic reconstructive approach for anterior urethral strictures. In our experience, the technique is shown to be useful, especially for the repair of long peno-bulbar strictures as a valid alternative to the staged procedures or to the Asopa technique in which the double dorsal plus ventral urethrotomy may lead to extensive damage to the urethral vascularization. As such, our report aimed to contribute to the debate about dorsal vs ventral urethral approach.

Compared to the series of Kulkarni et al using OM,³ our series with PS graft showed a similar success rate with a similar midterm follow-up time. The use of PS was particularly advantageous for the repair of long strictures because it avoids the need for a long and/or double oral harvestings, with associated oral morbidity.²⁴ Furthermore, the long skin graft obtained by circumcision allowed to repair urethral segment of any length, including those that are shown to be longer intraoperatively than at the radiological assessment. Therefore, we found that the dorsolateral grafting using PS is shown to be versatile in the treatment of short, medium, and long urethral strictures. After informing of all these aspects, none of the patients refused the penile skin harvesting.

In contrast to the original Kulkarni technique,³ the bulbospongiosus muscle was opened in the midline for strictures involving the mid-proximal bulbar segment. In our personal experience, this modification appears to be technically easier and without apparent complications, although ejaculatory function was not measured in this study and we acknowledge that incidence of these or other complications may have been higher.²⁵

The contrast leakage rate was somewhat high (19%), so patients need to be informed on the possibility of a prolonged catheterization. There was a trend toward higher leakage rate in the group of patients with a longer stricture length (>4 cm). However, these complications resolved spontaneously and did not result in an increase of recurrences.

Limitations

Limitations of our study are the retrospective design, the limited sample size, and the limited follow-up. To determine the hypothesized benefits of the new unilateral mobilization, large comparative studies with the traditional dorsal approach are warranted. Prospective, randomized trials with large population are necessary to better determine comparative outcomes between different graft types (PS vs OM). Another important limitation is the lack of measures for sexual complications that should be investigated about this new technique in the future.

CONCLUSION

With a midterm follow-up time, the dorsolateral graft urethroplasty using penile skin is shown to be a safe, efficient, and versatile technique for the repair of anterior urethral strictures of any length.

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