



# Reconstruction of the urethra with an anterior vaginal mucosal flap in female urethral stricture

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## Abstract

**Introduction and hypothesis** We present our single institution experience with urethral reconstruction by using anterior U-shaped vaginal flap in female patients with urethral stricture.

**Methods** Retrospective analysis was performed from March 2014 to April 2018. Fourteen patients with retention or severe voiding dysfunction and failed conservative management were enrolled. The demographic characteristics, vaginal examination, urodynamic parameters, and post-void residual urine (PVR) were reviewed. Patient Global Impression of Improvement (PGI-I) and American Urological Association (AUA) symptom index were completed pre- and post-operatively. In the dorsal lithotomy position, the Foley catheter was inserted and two parallel anterior vaginal walls incised around the urethral meatus. After dissection and the vaginal flaps were flipped up, the dorsal part of the urethra was incised vertically to pass the stricture and the distal end of the vaginal flap sutured to the proximal end of the urethra and inner part of the flap was tabularized over the larger size of Foley's catheter. The second layer of the folded vaginal flap was sutured to native vagina.

**Results** In all the patients, voiding LUTS improved or was cured. Average postoperative maximum urinary flow rate (Q<sub>max</sub>) was 15.82 ± 3.27 ml/s and PVR was 27.35 ± 18.76 ml. During the follow-up, new onset of urgency and worsening urge incontinence were reported. Two patients suffered from stress urinary incontinence (SUI) after surgery, but in 1 patient it improved after 6 months and in the other due to the persistent SUI, trans-obturator tape (TOT) was applied after 12 months.

**Conclusions** Most patients had a high level of satisfaction and improvement of lower urinary tract symptoms (LUTS). Hence, anterior vaginal flap urethroplasty is a safe and effective technique and may be utilized in the management of the initial phases of female urethral stricture after a multicenter prospective trial.

**Keywords** Urethral stricture · Reconstruction · Vaginal flaps

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## Introduction

Female urethral stricture is an uncommon condition [1] with an idiopathic etiology [2]. Its true incidence is unclear. In a review article in 2008, only 59 cases of true urethral stricture disease were reported [3]. Its incidence in female bladder outlet obstruction (BOO) patients, has been estimated at between 4 and 18% [4]. Obstetric complications, predominantly due to prolonged labor, particularly cephalopelvic disproportion, are one of the leading causes of urethral stricture in addition to trauma, iatrogenic injury, malignancy, radiation, urethral or/and vaginal atrophy, recurrent infections, and skin disease such as lichen planus [2]. Urinary frequency, urgency, dysuria, hesitancy, incontinence, a low stream of urine, and recurrent urinary tract infection (UTI) are the common symptoms [5].

The exact diagnostic criteria for stricture in women remain undefined and its diagnosis is usually based on both irritative

or obstructive voiding symptoms and investigations such as the measurement of post-void residual urine volumes (PVR), cysto-urethroscopy and urethrography, uroflowmetry, urodynamic evaluation, and imaging techniques such as magnetic resonance imaging (MRI) [1].

Surgical management includes urethral dilation [6–8], reconstruction [9–11], or open surgical repair using flaps [3, 12–16] and grafts [17–20]. The evidence for the efficacy of medical management, pelvic floor muscle training, urethral dilation, neuro-stimulation, and acupuncture is poor. Dilation and internal urethrotomy are accompanied by several complications, including scar formation, fibrosis, and, usually, unsuccessful outcomes. In these patients, surgical treatment using vaginal flaps may be helpful [3]. Vestibular flap urethroplasty [14], pedicle flap from the labia minora urethroplasty [13], dorsal graft urethroplasty with a dorsal vaginal or buccal mucosal graft [17], and ventral graft of buccal mucosa [21] are some other urethroplasty techniques that are accompanied by some complications, such as the requirement for extensive dissection and the need to close with suture, low tolerance, distortion of the vaginal and perivaginal tissue, and the need to harvest the graft. Therefore, another technique is required to decrease female urethral stricture relapse.

In the current study, we extend our previous report [22] and present our single institution experience with urethral reconstruction by using an anterior U-shaped vaginal flap in 14 patients.

## Materials and methods

### Patients

The target population was women who presented with urethral stricture from March 2014 to April 2018. The inclusion criteria were age over 18 years, diagnosis of urethral stricture based on severe lower urinary tract symptoms (LUTS; in the storage or the micturition phase) according to the American Urological Association (AUA) symptom index, imaging, urodynamics or endoscopic evaluation, and a minimum PVR of 100 ml, failure of initial conservative and minimally invasive interventions such as urethral dilatation or internal urethrotomy. If catheter placement was possible in women with a history of incontinence, urodynamics was performed before the procedure.

Exclusion criteria included dermatological disorders such as lichen planus owing to mucosal change to the vaginal wall, immunosuppressive disorders leading to inappropriate anastomosis and fistula formation, those women for whom maintenance of the hymen was very important, and diagnosis of neurogenic bladder (detrusor sphincter dyssynergia) in the

urodynamics study due to overlapping symptoms with urethral stricture.

Of a total of 14 patients, 12 had middle and distal urethral stricture, and 2 patients had a proximal type with bilateral hydronephrosis. Etiology of strictures in patients was not clear, but some of them had a history of trauma, infection, and atrophic urethritis. Most patients had a history of urethral dilatation every 3–6 months for 1–15 years.

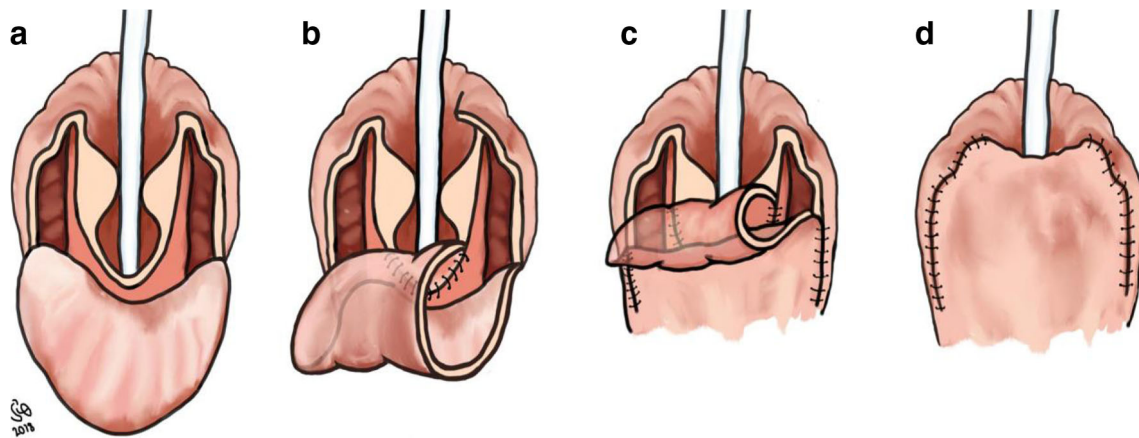
The medical records of all women, including demographic characteristics, vaginal examination, urodynamic parameters such as urinary flow rate and PVR, history of UTIs, and any related upper urinary tract imaging were reviewed. A series of standardized questions about voiding symptoms (reducing flow forces or caliber, hesitancy in urination, intermittency, failure to empty), repeated urethral dilatation or medication for urethral stricture disease in the postoperative period, symptoms of stress urinary incontinence (SUI) or new onset of urgency were taken. Patient global impression of improvement (PGI-I) questionnaire with scores of 1–5—1 (very much better), 2 (much better), 3 (a little better), 4 (no change), 5 (worse)—were completed after the procedure to assess their satisfaction.

The AUA symptom index was used in each case pre- and postoperatively and before the urodynamics study (UDS) to assess the severity of LUTS. Its range varies from 0 (no symptoms) to 35 (maximum symptoms). A score of 0–7 shows mild symptoms, 8–19 for moderate, and 20–35 represents severe symptoms [23].

After approval of the proposal by the Ethics Committee of Research and the vice-chancellor of Tabriz University of Medical Sciences (code: 58480), and also after registering the study in the Iranian registry of clinical trials (IRCT20130306012728N5), the written informed consent form was signed by all the participants.

### Surgery

First a small Foley catheter was inserted via the urethra, and its balloon inflated with normal saline to hold it at the bladder neck in the dorsal lithotomy position. Then, the two parallel anterior vaginal walls were incised around the urethral meatus for at least 4 cm (based on the site of the stricture). Vaginal flaps were dissected and flipped up. The dorsal part of the urethra was incised vertically to pass the stricture and the distal end of the vaginal flap was sutured to the proximal end of the urethra and the inner part of the flap was tabularized over the larger Foley catheter (20 Fr) using absorbable 3–0 Vicryl. The second layer of the folded vaginal flap was sutured to native vagina with continuous 3–0 Vicryl stitches. A vaginal pack was kept in place for 24 h. Intravenous antibiotics were given for 7 days. The urethral catheter was removed after 2 weeks. The surgical procedure is illustrated in Fig. 1.



**Fig. 1** Illustration of the surgical procedure as described in the text. **a** Insertion of a small Foley catheter and incision of the two parallel anterior vaginal walls around the urethral meatus. Dissection of the vaginal flaps, flipping up, and incision of the dorsal part of the urethra vertically to pass the stricture. **b** The distal end of the vaginal flap was sutured to the proximal

end of the urethra. **c** The inner part of the flap was tabularized over the larger Foley catheter (20 Fr) using absorbable 3–0 Vicryl. **d** The second layer of folded vaginal flap was sutured to native vagina with continuous 3–0 Vicryl stitches

## Results

Pre-operatively, all women had urgency and frequency and at least half had a high PVR. Pre-operative PVRs were 177, 102, 163, 107, 200, 200, 162, 150, 151, and 130 ml in 10 patients and in the other 4 patients, who were under clean intermittent catheterization (CIC), urinary retention was present (more than 300 ml). The mean  $\pm$  SD of PVR was  $195.8 \pm 73.9$  ml. In 5 patients, full UDS was performed pre-operatively and the others were measured using ultrasound. Four patients were in retention and could not void in free flowmetry. The mean maximum urinary flow rate (Q<sub>max</sub>) was  $4.58 \pm 1.70$  cmH<sub>2</sub>O and maximum detrusor pressure at peak flow was  $123.0 \pm 30.35$  cmH<sub>2</sub>O. Most patients were undergoing regular urethral dilatation every 3–6 months. Table 1 shows the characteristics of patients pre-operatively. Before the treatment, 3 women had overflow urinary incontinence. The average age of the patients was  $54.35 \pm 13.36$  years. The mean duration of the operation was  $62.50 \pm 10.14$  min, the intraoperative blood loss was  $175 \pm 28.48$  ml, and duration of hospitalization was  $2.57 \pm 0.64$  days. Average post-operative Q<sub>max</sub> was  $15.82 \pm 3.27$  ml/s and the average PVR was decreased to  $27.35 \pm 18.76$  ml. After treatment, the mean voided volume was  $156.30 \pm 78.13$  ml. The mean follow-up period was  $16.21 \pm 10.39$  months, with a range of 3 to 37 months. Table 2 shows the characteristics of patients post-operatively. During the follow-up period, 1 patient who had had pre-operative urgency was bothered by severe urge incontinence post-surgery; however, she had convenient voiding. Also, 1 patients had a new onset of urgency and similar to the other case, had convenient voiding too. UDS results in both patients showed detrusor overactivity with a normal voiding phase. A low-dose botulinum toxin injection, alleviated their symptoms relatively. In addition, 2 patients suffered from SUI after surgery. In these two cases, the stricture was in a proximal part of the urethra. A bladder stress test was

used to simulate the accidental release of urine by asking the patient to cough. Also, UDS was performed for one of these patients recently in whom the Valsalva leak point pressure (VLPP) was less than 45 cmH<sub>2</sub>O and bladder capacity was reduced to 185 ml. Although one of these patients had severe SUI during the first few days after surgery, this improved after a 6-month follow-up period, but 1 patient still had persistent SUI and recently, a trans-obturator tape (TOT) sling procedure, was performed 12 months after stricture surgery.

In addition, PGI-I questionnaire results showed that after the surgery, most women (78.57%) were satisfied, with a statement of “very much better.” The mean AUA symptom index before treatment was  $27.71 \pm 4.4$ ; hence, all of them had severe LUTS. After treatment, this index decreased to  $3.78 \pm 1.31$ , which showed that these symptoms were ameliorated.

## Discussion

Urethral strictures demand careful and early surgical management. Similar to previous study results [3, 16, 24, 25], obstructive voiding symptoms were the commonest referral cause of urethral stricture in the current study. The other symptoms, including recurrent UTI, retention, and/or kidney damage are the sequelae of untreated strictures that influence the quality of life of these patients.

In this study, we present our single-institution experience of urethral reconstruction in 14 patients using an alternative anterior vaginal flap technique. In our study, it was often unclear why the initial procedures were performed for patients. We could not evaluate all of the patients before surgery using UDS because of the presence of a narrow urethra and failure of the placement of a urodynamic catheter. In only 5 patients was a full UDS possible before surgery. All patients with a full

**Table 1** Preoperative patient characteristics

Patient number	Age	Symptoms	Previous treatments	Stricture diagnosis	Stricture location	PVR (ml) <sup>a</sup>	Qmax (ml/s)	Maximum detrusor pressure at peak flow	DO	AUA symptom index
1	66	Micturition LUTS	Optical urethrotomy	Cystourethroscopy	Distal urethra	200	4.20	—	—	23
2	75	Storage and micturition LUTS	Dilation	Cystourethroscopy	Distal urethra	162	4.4	—	Terminal DO	25
3	45	Urgency, incontinence	Dilation	Cystourethroscopy	Mid urethra	177	4.9	—	—	28
4	62	Micturition LUTS	Dilation	Cystourethroscopy	Distal urethra	200	4	—	—	32
5	50	Micturition LUTS	Optical urethrotomy	Cystourethroscopy	Proximal urethra	>300	—	—	—	29
6	35	Overflow incontinence	Dilation	Cystourethroscopy	Distal urethra	>300	—	—	—	30
7	61	Micturition LUTS	Dilation	Cystourethroscopy	Distal urethra	107	5	151	—	20
8	63	Micturition LUTS	Dilation	Cystourethroscopy	Distal urethra	151	4	98	—	22
9	58	Overflow incontinence	Dilation	Cystourethroscopy	Proximal urethra	>300	—	—	—	23
10	37	Storage and micturition LUTS	Dilation	Cystourethroscopy	Mid urethra	130	5.1	—	Terminal DO	30
11	41	Micturition LUTS	Dilation	Cystourethroscopy	Mid urethra	150	1	85	—	32
12	65	Micturition LUTS	Dilation	Cystourethroscopy	Distal urethra	163	5.2	130	—	33
13	36	Micturition LUTS	Dilation	Cystourethroscopy	Mid urethra	102	8	151	—	27
14	67	Overflow incontinence	Dilation, tolterodine	Cystourethroscopy	Distal urethra	>300	—	—	—	34

<sup>a</sup> In patients in whom PVR was more than 300 ml, urinary retention was present and these patients were under clean intermittent catheterization  
LUTS lower urinary tract symptoms, PVR post-void residual urine, Qmax maximum urinary flow rate, DO detrusor overactivity, AUA American Urological Association

UDS had an obstructive pattern. Also, for all patients before surgery, cystourethroscopy was performed and stricture was confirmed by visualization of the narrow area. We evaluated the patients after operation, and this indicated that the urethral stricture was resolved. Before operation, all patients had a higher PVR according to the result of UDS or ultrasound, but this decreased significantly after treatment. These results were in accordance with the previously described similar approach by Gormley [3]. In her experiment, 12 symptomatic women with a history of difficult, unsuccessful or traumatic severe catheterization underwent urethroplasty with a vaginal flap and were followed up for 3 months to 9 years. Subjective symptoms were ameliorated and were able to undergo catheterization with a 14 Fr catheter. One patient was subjected to ventricular dilatation without recurrence 3 weeks after the initial operation, and another woman needed cystoscopy and catheterization 58 months after surgery. None of the patients had urinary incontinence. Irritative symptoms and the need for catheterization were seen in some patients, despite having a good technique. In our study, PGI-I results showed that after the surgery, most women were satisfied with the outcomes of their surgery, well-being, and also the reduction in the severity of LUTS symptoms according to the AUA symptom index. Gormley did not evaluate patient satisfaction objectively, but similar to our results, her patients reported being generally satisfied with their outcome. However, despite their satisfaction, they still had some symptoms.

In another previous experiment conducted by Simonato et al. [16], 6 women with urethral stricture underwent urethroplasty with a vaginal flap. In a mean follow-up period of 70 months, the outcome was acceptable. In 3 of the 6 patients with PVR measurement, 1 had a significantly increased PVR with a requirement for CIC.

In accordance with our results, a further cross-sectional study that was conducted by Romero-Maroto et al. on 9 female patients with urethral stricture by using the anterior vaginal wall flap with anterolateral ventral urethroplasty and a follow-up period of 70.8 months (with a range of 12–198 months), all patients had fewer symptoms. The median caliber of the inserted catheter was reached above 20 Fr from 10.8 Fr. None of the patients had a recurrence of stricture and incontinence and there were no delayed early or late complications. The results of this study show that urethroplasty with an anterior vaginal wall flap is an effective method with durable and uncomplicated results [25].

In our study, voiding LUTs was improved or cured in all patients. In addition, the satisfaction rate was high in most patients. In the follow-up period, 2 women had urge incontinence, and 2 de novo SUI cases were observed. SUI only occurred in patients in whom the stricture was in the proximal part of the urethra. Although SUI is an uncommon condition after the procedure, it resolved in 1 patient in the 6-month follow-up period; however, mild SUI remained in 1 patient

**Table 2** Postoperative patient characteristics

Patient number	Operative time (min)	Blood loss (ml)	Mean duration of hospitalization (days)	PVR (ml)	Continence	Qmax (ml/s)	Follow-up (months)	PGI-I	AUA symptom score
1	80	180	2	0	Urgency incontinence	17	14	1	5
2	75	250	2	30	Continence	18	24	1	3
3	60	150	3	10	Urgency incontinence	12	8	3	4
4	60	200	2	10	Continence	17	12	1	3
5	70	170	3	75	Stress incontinence	20	3	1	3
6	50	180	2	21	Continence	14	18	2	3
7	60	150	3	20	Continence	20	19	1	5
8	70	200	3	17	Continence	18	18	1	3
9	50	160	4	50	Stress incontinence	18	12	1	3
10	70	180	3	30	Continence	19	6	1	4
11	50	140	3	20	Continence	11.1	16	2	3
12	60	160	2	30	Continence	21	37	1	2
13	70	150	3	40	Continence	11.4	9	1	5
14	50	180	2	30	Urgency	14	36	1	7

PVR post-void residual urine, Qmax maximum urinary flow rate, PGI-I Patient Global Impression of Improvement, AUA American Urological Association

and recently, a TOT sling procedure was performed 12 months after stricture surgery. The results of this study may contribute to the provision of documented information based on academic research to examine the outcomes of the above surgical procedure, and the success of it, making a large contribution to the treatment of urethral stricture in women, which can be taught and provided in other academic centers. However, the subjective and objective postoperative symptoms need to be assessed in more depth. Repeated PVR and urethral caliber measurement are necessary, and finally, UDS at a variety of time points may help to explain why some of these patients, despite having a technically good repair, better impression of improvement, and amelioration of the severity of symptoms, had a lower Qmax flow than accepted values.

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## Compliance with ethical standards

**Conflicts of interest** None.

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