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FEMALE UROLOGY

Surgical Technique

Technical modifications in dorsal onlay female urethroplasty: Time to make way for amendments

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ABSTRACT

Objective: Surgical treatment for female urethral stricture is varied and lacks consensus. Dorsal and ventral approaches of urethroplasty have comparable success rate with debatable limitations. We describe modifications in dorsal onlay graft urethroplasty to mitigate the surgical limitations and improve functional outcomes.

Material and methods: We retrospectively analyzed 8 patients with strictures treated with dorsal onlay urethroplasty at our center. The inclusion criteria were American Urology Association (AUA) score >20, calibration <14 Fr, positive voiding cystourethrogram, urodynamics with maximum urine flow rate (Qmax) <12 mL/s, detrusor pressure at maximum flow >24 cmH_2O, and urethroscopic visualization of the stricture. Surgical modifications included dorsal plane dissection away from the clitoris; limited lateral urethral dissection; omitting graft quilting onto the clitoris, and urethral slitting directly at the stricture site (for mid and proximal strictures), sparing the meatus and using canoe-shaped grafts for distal strictures. Success was defined as improvement in the AUA scores and Qmax >12 mL/s, without requiring any further intervention.

Results: The mean age was 50.5±10.6 years. Statistically significant improvements in mean AUA score [14.5±2.20 (p=0.012)], Qmax [23.63±2.44 (p=0.012)], post-void residual urine [107.88±40.37 (p=0.012)], and sexual function scores [6.833±2.23 (p=0.027)] were noted at a mean follow-up of 3 months. Distal strictures were more common. Mean urethral caliber was 9.62 Fr. No cases of *de novo* incontinence or sexual dissatisfaction were reported.

Conclusion: In our experience, the dorsal onlay technique works well, but without a comparative evidence for ventral onlay, it is difficult to conclude that one is preferred over the other.

Keywords: Dorsal onlay; female urethral stricture; modifications; urethroplasty.

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Introduction

Urethral stricture disease in women is a rare condition. Lack of standard definition or diagnostic criteria makes its diagnosis more challenging; hence, a strong index of suspicion is mandatory.[1]

Reconstruction Urethroplasty is performed widely with encouraging results using both dorsal and ventral approaches. Each of these approaches are individualized according to the patient and surgeon factors and have their own limitations.[2] The dorsal approach is presumably associated with female sexual dysfunction and incontinence by causing an inadvertent injury to the clitoral neurovascular bundle (NVB) and urethral sphincter, respectively. In contrast, the ventral approach raises concerns regarding the development of urethrovaginal fistula, compromising the planes for future continence surgery.[3]

We describe our experience of dorsal onlay vaginal graft urethroplasty (DOVU) performed with certain modifications to optimize the long-term benefits in terms of objective indices of symptom relief and sexual functions, for which the data are limited worldwide.

Material and methods

After obtaining institutional review board approval, we retrospectively evaluated 24 women

presenting to our outpatient department with bothersome obstructive lower urinary tract symptoms (LUTS) with or without history of prior urethral dilatation. Of these, 8 candidates who underwent DOVU by a single surgeon, for diagnosed urethral strictures between January 2019 and January 2020, were eligible for the study.

Preoperative evaluation included history related to demographics, etiology, previous interventions on the urethra, and presenting complaints using the American Urology Association (AUA) symptom scores; physical examination including urethral calibration; ultrasonography of the kidney, ureter, and bladder regions to delineate upper-tract changes, urinary bladder appearance and assessment of post-void residual urine (PVRU); and non-invasive urine flow rates. In addition, voiding cystourethrogram showing proximal urethral dilatation and distal narrowing, urodynamic study with an evidence of bladder outflow obstruction (BOO), and cystourethroscopy under local anesthesia with 8-Fr ureteroscope and 30° lens were performed in all patients to confirm the presence of stenosis. Vaginal estrogen creams were not used in preoperative and postoperative setting in any patient.

A stricture was defined as failure of calibration by 14-Fr ureteroscope, maximum flow rate <12 mL/s, detrusor pressure at maximum flow (PdetQmax) >24 cmH_2O, and a radiographic or endoscopic evidence of anatomical narrowing of the urethra. Women with neurogenic bladder/underactive detrusor, urethral injury, prior urethral surgery, pelvic fracture/ urethral disruption, or genitourinary malignancy were excluded. Probable etiology and site and length of the stricture were noted for each patient. The Female Sexual Function Index (FSFI) score was calculated for all sexually active patients preoperatively. All patients were followed up at 3 weeks, 1 month, and 3 months. Trial without catheter was given after 3 weeks. Coitus was allowed after 6 weeks. The AUA scores, Qmax, PVRU, and FSFI scores were reassessed at 1 month and 3 months. Urinary incontinence was assessed by direct questions. Primary outcome was success rate and feasibility of new modifications, and secondary outcome was complications of the procedure. Success was defined as subjective improvements in the AUA scores, Q_{max} >12 mL/s, insignificant PVRU, and improved FSFI. Failure was defined as the need for any further intervention, including urethral dilatation or redo-urethroplasty. Recurrence was defined by the same criteria used preoperatively in cases where postoperative uroflow was indicative of a recurrent stricture.

Main Points:

- Urethral stricture is a rare disease affecting women, which needs a stong clinical suspicion for making diagnosis.
- Dorsal and ventral onlay graft are well defined surgical approaches to manage this condition with fair share of shortcomings and success.
- Modified dorsal onlay graft urethroplasty is a safe, feasible, and effective procedure with favorable outcomes and with a potential to minimize complications.

Statistical analysis

We calculated means and percentages for all variables included in the study. A comparison of preoperative and postoperative mean AUA score improvement, mean Qmax improvement, and mean PVRU improvement at 3 months follow-up were calculated and analyzed using the Wilcoxon signed-rank test with the level of significance as 0.05.

Operative description

After positioning and preparing the patient in dorsal lithotomy under spinal anesthesia, urethroscopy was performed using an 8-Fr ureteroscope to determine the stricture site and length (Figure 1a). Furthermore, 2 stay sutures were taken at 5 O'clock and 7 O'clock positions on the urethral meatus using catgut 3-0 suture. A semi-lunar supra-meatal incision was made, and a plane was developed through the vestibular membrane dorsal to the urethra (Figure 1b). The ideal plane of dissection was toward the pubic bone, away from the clitoral NVBs. Excessive mobilization of the urethra and overenthusiastic lateral dissection (more than 10 O' clock and 2 O' clock) is unnecessary and is avoided to prevent devascularization and minimize blood loss (Figure 1c). Dissection should surpass the stricture segment. In cases of more proximal or pan-urethral stricture segments, the entire urethra is carefully dissected up to the bladder neck. Our modifications of urethral incision included slitting the urethra dorsally directly over the stricture segment without incising the entire urethra in midurethral strictures (Figure 1d). For distal stric-

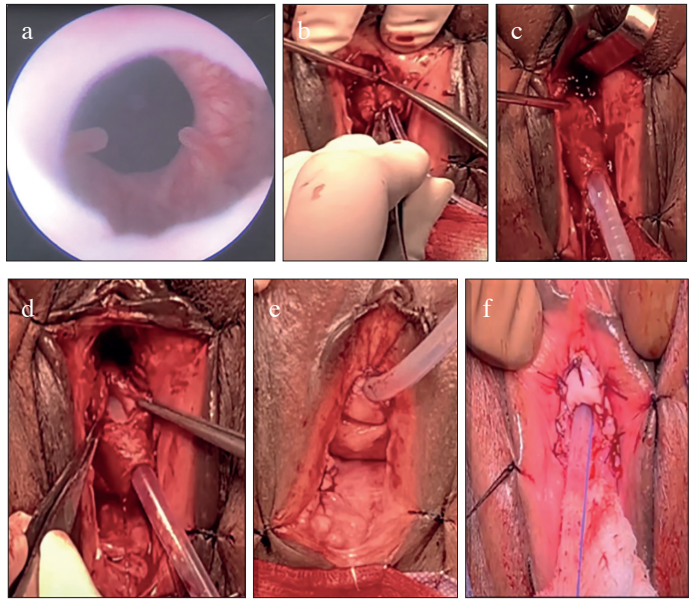

Figure 1. a-f. Surgical steps of modified dorsal onlay urethroplasty

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tures, grafts were remodeled into canoe or spindle shapes with smaller tips (Figure 1e). These modifications not only yielded good results but also obviated the need of meatal reconstruction for widened meatus (Figure 1f) or splaying of stream. A 22-Fr Foley's catheter was then passed beyond the stricture segment.

Thereafter, a free graft of optimal length was harvested from the posterior vaginal mucosa and soaked in an antibiotic solution. The harvest site was examined, and the vaginal packs were inserted. The mucosal surface of the graft was sutured facing the urethral lumen with three 3-0 vicryl at the apex on the right and left side of the graft. The graft was reposited in place by parachute technique and sutured with the tissue bed over 22-Fr Foley's catheter to achieve the desired caliber. Proper approximation of the graft to the urethral mucosa is inevitable to minimize the risk of recurrent stricture. To tackle the postoperative shrinkage, the graft should be left slightly redundant. Trimming of excess redundant graft with reconstruction of the dorsal paraurethral and vestibular region was then completed. Donor site in the vagina was closed using continuous vicryl 2-0 sutures after achieving hemostasis. A vaginal pack was kept for 24 hours. An 18-Fr silastic catheter was left in place for 3 weeks.

Results

Mean age of all 8 patients was 50.5±10.6 years. Voiding LUTS, especially poor urinary stream and incomplete evacuation, were the most common. Among the storage symptoms, increased daytime frequency of urination was the most common. Preoperatively, the mean AUA score, Q_{max}, PVRU, $P_{det}Q_{max}$, and FSFI scores were 22.88±1.64, 5.94±2.68 mL/s, 131.13±37.30 mL, 116.25 cmH_2O, and 18.83±2.79, respectively (Table 1). The most common etiology was idiopathic (50%), followed by infection (25%) and iatrogenic (25%). Stricture site was proximal in 2, mid in 3, and distal in 4 patients. The mean urethral caliber was 9.62 Fr. Stricture was 1–2 cm in length in all, except 1 (3 cm). The mean operative duration was 85 minutes. No stricture recurrence was seen at the mean follow-up of 3 months. There was a statistically significant improvement in the AUA scores (14.5±2.20); peak flow rates (23.63±2.44 mL/s); PVRU (107.88±40.37 mL) at 3 months postoperatively (Table 2). Moreover, 6 patients were sexually active; mean improvement in sexual functions as evident by FSFI score was 6.833±2.23. Postoperative period was uneventful, and none of the patients had significant postoperative pain. No patient had abnormal

Table 1. Patients' demographic data and stricture characteristics at presentation

Patient	Age (years)	Symptoms	SUI	AUA score	Qmax (mL/s)	PdetQmax (cmH_2O)	PVRU (mL)	FSFI	Etiology	Site	Caliber (Fr)	Length of stricture (cm)
1	58	V+S	No	24	5	154	116	16	Infection	Proximal	8	1
2	38	V	No	25	8	146	121	20	Post-catheter	Mid	10	1
3	51	V	No	22	10.3	61	130	19	Infection	Proximal	12	2
4	42	V+S	No	24	2.6	64	110	15	Previous dilatation	Mid	9	1
5	38	V	No	22	7.4	121	105	21	Idiopathic	Distal	4	2
6	50	V+S	No	20	6.3	97	112	22	Idiopathic	Distal	12	1
7	62	V+S	No	22	5.5	189	135	Sexually inactive	Idiopathic	Mid	12	3
8	65	V	No	24	2.4	98	220	Sexually inactive	Idiopathic	Distal	10	1
Mean	50.5±10.6			22.88	5.93	116.25	131.12	18.83			9.62	

V: voiding lower urinary tract symptoms; S: storage lower urinary tract symptoms; SUI: stress urinary incontinence; AUA: American Urology Association; PVRU: post-void residual urine; FSFI: Female Sexual Function Index; PdetQmax: detrusor pressure at maximum flow; Qmax: maximum flow rate

Table 2. Postoperative parameters and their mean improvement at 3 months

Parameter	Preoperative (mean±SD)	1 month (mean±SD)	3 months (mean±SD)	Mean improvement (preoperative-postoperative) at 3 months (mean±SD)	p (preoperative vs. 3 months) (<0.005)
Mean AUA	22.88±1.64	6±1.07	8.38±0.92	14.5±2.20	0.012
Mean Qmax	5.94±2.68	31.9±2.17	29.56±2.66	23.63±2.44	0.012
Mean PVRU	131.13±37.30	17.13±5.51	23.25±4.56	107.88±40.37	0.012
Mean FSFI (n=6)	18.83±2.79	NA	25.67±3.20	6.833±2.23	0.027

AUA: American Urology Association; Qmax: maximum flow rate; PVRU: post-void residual urine; FSFI: Female Sexual Function Index; SD: standard deviation

vaginal bleeding/discharge or graft necrosis on follow-up. No patient complained of *de novo* urinary incontinence. No patient was lost to follow-up.

Discussion

Female urethral stricture is a lesser known cause of BOO. The incidence ranges between 3% and 8% worldwide.[4] Urethroplasty is being widely accepted as the standard treatment as well as traditional practices for urethral dilatations and urethrotomies.

Both ventral and dorsal approaches give good results with a fair share of shortcomings and success, and neither is superior.[5] We obtained extremely satisfactory results (100%) of DOVU at a short follow-up of 3 months, reflected by statistically significant improvement in scores of validated questionnaires and investigatory parameters.

We preferred using vaginal graft in all our patients that could be procured with ease and less morbidity without the need for general anesthesia. However, short follow-up in our study is a limitation to conclude the superiority of vaginal grafts over buccal grafts. Long-term follow-up may help in better understanding of the complications as well as the pros and cons associated with the use of vaginal grafts.

We also found an improvement in sexual functions in women as depicted by the FSFI scores, in contrast to the popular belief that the dorsal approach may cause sexual dysfunction by damaging the clitoris. Although there is limited reporting on the context of sexual functions, our findings are consistent with those of Manasa et al.[6] who also reported an improvement in sexual functions after DOVU.

Clitoris is a multiplanar structure with non-erectile (glans) and erectile tissues (bulbs, corpora, and crura). It provides dorsal support to the urethra and is also intimately related to the vagina, pubic arch, mons pubis, and labia. The clitoral NVBs travel along the ischiopubic ramus, below the pubic ramus in the midline, and intertwine to run through the cephalad surface of the clitoral body toward the glans, away from dorsal dissection planes. The manner in which distal vagina is anatomically hugged by the clitoral complex may expose it to injury during the ventral approach as well; however, it needs to be evaluated further in future studies. Hence, modified dorsal approach with dissections in ideal surgical planes abates the risks of clitoral injury.[6]

The clitoris provides a strong mechanical support to the graft along with a rich vascular bed, thereby promoting better healing and preventing graft sacculation and shrinkage. This type of reconstruction is presumed to be more physiological and directs the stream away from the vagina because of the preservation of anterior angulation of the urethra.[6] Sparing the meatus, as previously described, also prevents stream splaying.

The technical difficulties encountered with the dorsal approach for the proximal strictures can be successfully tackled by maintaining correct planes, avoiding disruption of the urethra proper, and using the pubic bone as a guide in identification of an appropriate proximal dissection end-point where one can easily reach the bladder neck with minimal blood loss.[7]

Reducing overenthusiastic urethral dissection, avoiding graft quilting to the clitoris, and sparing full-length urethrolysis offer postoperative pain alleviation and preservation of neurosensory sexual and continence functions as potential benefits of the modified dorsal approach.

Female urethra is surrounded by smooth and striated muscular coats. The horse-shoe shaped striated urethral sphincter traverses about 20%–60% of the urethral length, surrounding the smooth muscle layer. This layer is bulkier dorsally and laterally and thin ventrally. It is also the thickest in the middle third and contributes greatly to continence.[8] This anatomic orientation of the urethra theoretically predisposes it to injury during dorsal dissection, which may be completely avoided using the proposed amendments. Our results showed no case of postoperative incontinence, substantiating the same.

The dorsal approach is simple with little distortion of the vagina and peri-vaginal tissues. The ventral aspect is spared for further need of any anti-continence surgery. Theoretically, it is associated with a lesser risk of urethrovaginal fistula and ureteral injury.[9]

The strengths of our study were the clearly defined primary and secondary outcomes according to the subjective as well as objective parameters; heterogeneity was minimized by using a single surgical approach for all women and performed by the same surgeon. The shortcomings of this study are its small sample size, retrospective design, recall bias, short follow-up durations, and unavailability of patient-validated outcome measures. The results of our modifications may vary with further experience and longer follow-up.

In conclusion, modified dorsal onlay graft urethroplasty is a safe, feasible, and effective procedure with favorable outcomes and potential to minimize the complications. A sound knowledge of the regional anatomy is the cornerstone for a lasting reconstruction with minimal impact on continence and neurosensory sexual functions.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of All India Institute of Medical Sciences, Rishikesh (AIIMS/IEC/20/337).

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Informed Consent: Written informed consent was obtained from patients who participated in this study.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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