

Dorsal vaginal mucosal substitution urethroplasty: a worthwhile approach for the management of female urethral stricture

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ABSTRACT

Background: Female urethral stricture (FUS) is a rare condition with diagnostic challenges and poor outcomes with traditional treatments. This study aimed to evaluate the effectiveness and sustainability of dorsal vaginal mucosal graft substitution urethroplasty in managing female urethral stricture.

Methods: This quasi-experimental study was conducted from June 2020 to May 2023 in the Department of Urology at BIRDEM General Hospital, Enam Medical College Hospital, Dhaka Community Medical College Hospital, Evercare Hospital and Hi-Care General Hospital, Dhaka, Bangladesh. A total of 30 female patients with urethral stricture who underwent vaginal mucosal graft urethroplasty were included in the study. All participants were followed for a period of one year. Statistical analysis was performed using SPSS version 21.

Results: Thirty patients underwent labial mucosal graft urethroplasty, with a mean age of 41 years and an average follow-up of 12 months. Etiologies included idiopathic (50%), iatrogenic (33.33%), traumatic (6.67%) and recurrent nonspecific urethritis (10%). The mean operative time was 90 ± 11.12 minutes, with a 100% success rate. No patient experienced severe postoperative pain, wound infection, vaginal narrowing or dyspareunia. All maintained good voiding at the 1-year follow-up.

Conclusion: Dorsal vaginal mucosal graft substitution urethroplasty is an effective, sustainable and reproducible technique for treatment of female urethral stricture with minimal complications and low recurrence.

Key words: dorsal vaginal mucosa, urethral stricture, female, urethroplasty.

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INTRODUCTION

Female urethral stricture (FUS) remains as a complex condition within reconstructive urology often overlooked due to the lack of standardized diagnostic criteria and limited large-scale studies.^{1,2} Although it accounts for an estimated 4% to 13% of female bladder outlet obstruction (BOO) cases,²⁻⁶ the condition imposes

a notable burden on healthcare systems. Patients typically present with distressing lower urinary tract symptoms, including increased urinary frequency and urgency, weak stream, straining during voiding, a sensation of incomplete bladder emptying and recurrent urinary tract infections.⁷⁻⁹ These symptoms can greatly diminish overall quality of life. Despite being described

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in medical literature for nearly two centuries, FUS continues to be a diagnostic and therapeutic challenge in clinical practice.

A major challenge in managing FUS is its frequent misdiagnosis or delayed identification, primarily due to symptom overlap with other lower urinary tract conditions. At present, there is no universally endorsed definition or standardized diagnostic protocol for FUS. Osman et al.² characterized it as “a symptomatic anatomical narrowing of the urethra identified through failure in catheterization, urethral calibration or via endoscopic and radiographic visualization”. Complementing this, DeFreitas et al. proposed that a detrusor pressure (Pdet) of ≥ 25 cm H₂O combined with a maximum urinary flow rate (Qmax) of ≤ 12 ml/sec could indicate the presence of an obstruction.¹⁰ Diagnostic tools such as uroflowmetry, micturating cystourethrogram (MCUG) and cystoscopy are instrumental in confirming and evaluating the extent of urethral narrowing in female patients.

Traditional treatment modalities for FUS, such as urethral dilatation and internal urethrotomy are often associated with high rates of failure and recurrence. These procedures are usually followed by long-term self-urethral dilatation, which can lead to fibrotic tissue formation due to complications like urethral injury, bleeding and urinary extravasation,¹ which diminishes their long-term effectiveness. Research indicates that the success rate for urethral dilation is below 50%, underscoring the need for more durable treatment strategies.¹¹ As a result, urethroplasty has gained popularity in recent years, with many surgeons opting for surgical intervention as a more definitive and reliable approach to managing urethral strictures.¹²

Surgical reconstruction serves as an effective alternative, particularly for patients who do not respond to urethral dilatation. Commonly used techniques include meatoplasty for distal urethral strictures and the use of grafts or flaps for mid- and proximal-urethral strictures. Recent developments show promising outcomes with substitution urethroplasty, utilizing various grafts, such as vaginal mucosa.¹³ Both onlay and inlay methods have been investigated, with vaginal mucosa grafts emerging as particularly effective. The dorsal approach has gained favor due to the proximity, vascularity and minimally invasive nature of vaginal

mucosa harvesting, offering a more durable solution compared to traditional treatment options.

Despite advancements in urethral stricture management, there remains a gap in the literature regarding the long-term effectiveness and sustainability of dorsal vaginal mucosal substitution urethroplasty, in the management of FUS. While several studies have examined various surgical techniques, including the use of buccal mucosa and vaginal flaps, few have provided robust data on the durability of these procedures or compared them directly in terms of recurrence rates and quality of life post-surgery. The aim of the study was to evaluate the clinical effectiveness and sustainability of dorsal vaginal mucosal substitution urethroplasty in the management of female urethral stricture.

METHODS

This quasi-experimental study was conducted at the Department of Urology, BIRDEM General Hospital, Enam Medical College Hospital, Dhaka Community Medical College Hospital, Evercare Hospital and Hi-Care General Hospital, Uttara, Dhaka, Bangladesh, between June 2020 to May 2023. A total of 30 female patients were included in the study, who were selected based on specific clinical and diagnostic criteria for the evaluation of the effectiveness and sustainability of dorsal vaginal mucosal substitution urethroplasty in the management of FUS.

Female patients with symptomatic urethral stricture (e.g., poor flow, incomplete voiding, urgency or recurrent UTIs) whose diagnosis was confirmed by clinical examination and investigations (Qmax < 10 mL/sec, high PVR, and MCUG findings) and agreed to undergo dorsal vaginal mucosal substitution urethroplasty were included in this study. Patients with neurogenic bladder and abnormal focal neurological signs were excluded from this study.

Informed consent was obtained from all participants, ensuring they understood the procedure, potential risks and importance of the follow-up visits. All participants underwent a comprehensive preoperative evaluation that included clinical assessments, urine flow studies (Qmax), post-void residual (PVR) measurements and micturating cystourethrogram (MCUG) to confirm the diagnosis of urethral stricture. The procedure was performed under spinal anesthesia with the patient in the dorsal lithotomy position. 2% lidocaine with 0.0005% epinephrine was injected circumferentially around the

urethral meatus and periurethral tissues to aid haemostasis and hydro-dissection. Periurethral inverted U-shaped incision was given from 9 o'clock to 3 o'clock position. Blunt and sharp dissection done anterior to the urethra staying close to the urethral mucosa and continued proximally to the site of stricture. Then, the urethra was sharply incised with scissors in the midline (at 12 o'clock position) dorsally. Stay sutures were placed on the urethral edge at the corner. An appropriate-sized mucosal graft was harvested from the posterior vaginal wall after injecting 2% lidocaine mixed with 0.0005% epinephrine to facilitate graft dissection and minimize donor site bleeding. Donor site closed primarily with 3-0 polyglactin. The grafting began by taking an apical and bilateral para-apical 5-0 polyglactin stitches and parachuting the graft. The graft was then sutured on the dorsal surface of the urethra as an onlay graft with 5-0 polyglactin interrupted stitch. An 18F Foley catheter was used to ensure bladder drainage. Procedure was completed by suturing both edges, trimming the graft at the meatus and closing the U-shaped incision. The average operative time was 90 ± 11.12 minutes. Postoperative care involved catheterization for 14 days and regular follow-ups for next 12 months to monitor recurrence.

Recurrence was defined as a return of symptoms, a Qmax <10 mL/sec, high PVR or failure to calibrate the urethra with a 12 Fr catheter. Statistical analysis was performed using SPSS version 21. Descriptive statistics were used to analyze demographic data, and the results were expressed as frequencies and percentages. Improvements in urodynamic parameters (Qmax, PVR, and urethral caliber) were analyzed with a paired t-test and the significance level was set at a p-value of <0.05 . Surgical outcomes, including complications, were reviewed and stricture recurrence was assessed at follow-up visits.

RESULTS

In this study, the demographic characteristics of the 30 patients who underwent dorsal vaginal mucosal substitution urethroplasty revealed a mean age of 41.0 ± 5.63 years, with the highest proportion in the 46–50 years age group (30%). The average follow-up duration was 12 months. Regarding the etiology of urethral stricture, most cases were idiopathic (50%), followed by iatrogenic (33.33%), with fewer cases attributed to recurrent urethritis (10%) and trauma (6.67%). In terms of presenting symptoms, incomplete voiding (60%) and poor urinary flow (50%) were the most frequently reported, while recurrent urinary tract infections (30%), acute urinary retention (20%), straining to void (16.67%) and urinary frequency (10%) were observed less commonly (Table I). At 12th months follow-up, surgical outcomes demonstrated significant improvements in urodynamic parameters. The maximum urinary flow rate (Qmax) increased from 6.2 ± 2.8 mL/s preoperatively to 24.1 ± 3.2 mL/s postoperatively ($p < 0.001$). Post-void residual (PVR) decreased from 125 ± 40 mL to 15 ± 10 mL ($p < 0.001$) and urethral caliber improved from 12 ± 2 French to 24 ± 3 French ($p < 0.001$) (Table II). No patient reported severe postoperative pain or wound infection. All had satisfactory voiding at the 1-year follow-up, with no incidences of vaginal narrowing or dyspareunia.

Table I. Distribution of Presenting Symptoms Among Study Participants (n = 30)

Presenting Symptom	Frequency Percentage	
	(n)	(%)
Poor flow	15	50.00
Incomplete voiding	18	60.00
Straining to void	5	16.67
Urinary frequency	3	10.00
Recurrent urinary tract infection	9	30.00
Acute urinary retention	6	20.00

Table II. Comparison of Preoperative and Postoperative Urodynamic Parameters and Surgical Outcomes (n=30)

Parameter	Preoperative	Postoperative	Improvement	p-value
Qmax (mL/s)	6.2 ± 2.8	24.1 ± 3.2	+17.9	<0.001
PVR (mL)	125 ± 40	15 ± 10	“110	<0.001
Caliber (Fr)	12 ± 2	24 ± 3	+12	<0.001

DISCUSSION

This study highlights the clinical effectiveness and sustainability of dorsal vaginal mucosal substitution urethroplasty in the management of female urethral stricture (FUS) across multiple centers in Bangladesh. FUS, though relatively rare, poses significant diagnostic and therapeutic challenges due to its nonspecific symptoms and high recurrence rates following conservative treatments. By evaluating surgical outcomes in a well-defined cohort, this study demonstrates that dorsal vaginal mucosal graft urethroplasty offers a durable and minimally invasive solution, with substantial improvements in urinary flow parameters and a low recurrence rate, supporting its role as a preferred reconstructive option in appropriately selected patients.

In the present study involving 30 patients, the mean age was 41 years, with the highest proportion of patients (30%) falling in the 46–50 years age group. This age distribution is comparable to findings by Sharma et al.¹⁴, who reported a similar mean age of 42 years among female patients undergoing urethral reconstruction. The mean follow-up duration was 12 months, offering a meaningful short-term window to assess surgical efficacy and early recurrence, even though it is shorter than the follow-up periods reported by Petrou et al.¹⁵ (22.7 months) and Chakraborty et al.¹⁶ (23 months).

Regarding etiology, idiopathic strictures accounted for the majority (50%) in our cohort, aligning with the trend reported by Prabhuswamy et al.¹⁷, where idiopathic causes predominated at 81.1%. Although our percentage is somewhat lower, it underscores the recurring clinical reality that many female urethral strictures lack a clearly identifiable cause. Iatrogenic causes were the second most common (33.33%), followed by recurrent nonspecific urethritis (10%) and trauma (6.67%). These findings reinforce the utility of dorsal vaginal mucosal substitution urethroplasty as a versatile and effective technique, especially in idiopathic and iatrogenic cases.

In the present study, the most common presenting symptom was incomplete voiding (60.0%), followed by poor urinary flow (50.0%). These findings align with those of Al-Misbah et al.¹⁸, who noted poor flow and straining to void in 66.67% of patients and incomplete voiding in 56.67%. Similarly, Singh et al.¹⁹ reported an even higher prevalence of incomplete voiding at 75%,

underscoring its diagnostic significance in female urethral stricture. Our observed rates for poor flow (50.0%) and straining to void (16.67%) closely resemble those reported by Prabhuswamy et al.¹⁷ (51.4% and 18.9%, respectively). The incidence of recurrent urinary tract infections (30.0%) and acute urinary retention (20.0%) in our cohort was higher than the 10.8% and 8.1% reported by Prabhuswamy et al.¹⁷, respectively, suggesting a more symptomatic patient group. These symptom patterns emphasize the importance of definitive surgical intervention. The dorsal vaginal mucosal graft technique effectively addresses both the anatomical narrowing and associated functional symptoms, offering significant symptomatic relief in this patient population.

In this study, significant improvements were observed in key postoperative parameters following dorsal vaginal mucosal substitution urethroplasty for female urethral stricture. The Qmax increased from 6.2 ± 2.8 mL/s preoperatively to 24.1 ± 3.2 mL/s postoperatively, reflecting a substantial improvement of 17.9 mL/s ($p < 0.001$). This is consistent with Mukhtar et al.²⁰, who reported a median increase in Qmax from 7 mL/s to 18 mL/s after ventral onlay BMG urethroplasty, although the improvement in our study was larger. Additionally, PVR decreased dramatically in our study, from 125 ± 40 mL to 15 ± 10 mL (improvement of >110 mL, $p < 0.001$), mirroring the findings of Mukhtar et al.²⁰, where PVR dropped from 100 mL to 15 mL. The increase in urethral caliber, from 12 ± 2 Fr to 24 ± 3 Fr (improvement of 12 Fr, $p < 0.001$), further supports the efficacy of dorsal vaginal mucosal substitution urethroplasty in restoring urethral patency. Although Mukhtar et al.²⁰ did not report specific values for urethral caliber, the improvements in Qmax and PVR in both studies suggest a similar functional restoration. Overall, the results of this study demonstrate that dorsal vaginal mucosal substitution urethroplasty is a highly effective technique for the management of female urethral stricture, offering significant improvements in urinary function, bladder emptying, and urethral caliber, with outcomes comparable to or even superior to other urethroplasty techniques.

Limitations of the study

This study had some limitations:

- The sample was not randomly selected.
- The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

Conclusion

Dorsal vaginal mucosal substitution urethroplasty is an effective and sustainable reconstructive technique for female urethral stricture, with excellent functional outcomes and a very low recurrence rate. This procedure demonstrates consistent success across diverse patient demographics and etiologies, while maintaining an excellent safety profile with minimal complications. The technique's standardized approach, reproducible results, and efficient operative characteristics support its adoption as a reliable primary surgical option for female urethral reconstruction.

Authors' contributions: TAM conceptualization, methodology, formal analysis, investigation, data interpretation, and writing original draft preparation. Dr. ATMMC contributed to the revision of the manuscript, provided critical insights during data analysis and supervised the overall study. Additionally, ANSA was involved in project administration and ensured compliance with the research process.

Conflict of Interest: Nothing to declare.

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