Dorsal onlay urethroplasty using buccal mucosal graft and vaginal wall graft for female urethral stricture – Outcome of two-institution study

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ABSTRACT

Introduction: Female urethral stricture is an underdiagnosed condition and a diagnostic challenge. Traditionally treatment has been urethral dilatation. Recent studies have shown promising outcomes after female urethroplasty (FU). We report our two-institutional experience with dorsal onlay substitution FU using buccal mucosal graft (BMG) and vaginal wall graft (VWG).

Methods: In this retrospective study, 32 women who underwent dorsal onlay urethroplasty at two institutions in India and Portugal were included for comparison of outcomes between BMG and VWG. The need for re-intervention was defined as failure. Their assessment included American Urological Association (AUA) symptom score, peak flow rate (Qmax), urethral calibration, postvoid residual urine (PVR), voiding cystourethrogram, and cystoscopy. Other parameters such as age, need for suprapubic cystostomy, prior interventions, location, length, etiology, operating time, postoperative catheter time, complications, and follow-up were evaluated. Statistical analysis was done with two-sample t-test, Mann–Whitney test, and proportion test for equality.

Results: 21 patients underwent BMG and 11 underwent VWG, respectively. The overall mean age was 49 years (range: 25–75) and follow-up was 26 months (range: 13–62). The overall change in AUA symptom score was from 22 to 6, Qmax from 4ml/s to 26mL/s, and PVR from 185ml to 17 ml with no statistical difference between the two groups. Other parameters showed no difference except operating time. The overall urethral patency rate was 94% with no statistical difference in these groups (P = 0.0773).

Conclusions: Dorsal onlay substitution FU is easy to perform with low complication rate. We found no difference in outcome of FU in these groups. Early FU should be encouraged to avoid the adversities of repeated dilatations.

INTRODUCTION

Female urethral stricture (FUS) is an uncommon condition. Diagnosing bladder outlet obstruction in females is a challenge. Gravina has shown that bladder outflow obstruction index and peak flow identify women with functional and anatomical obstruction.¹ The most common etiology of FUS is iatrogenic due to repeated instrumentation. This trauma of repeated instrumentation results in a breach in the mucosa that causes extravasation. This is an irritant leading to fibrosis as a response to the chemical stimulus, finally resulting in stricture formation.² Traditionally, the treatment has been urethral dilatation and/or urethrotomy. In recent years, there is a surge of interest in surgical reconstruction. Substitution urethroplasty using different grafts and local flaps either with dorsal or ventral approach has been performed with promising results. These substitutions have been done either as onlay or inlay. We report our experience of multi-institutional study in treating FUS with dorsal onlay urethroplasty using buccal mucosal...
graft (BMG) and vaginal wall graft (VWG) performed in India and Portugal.

MATERIALS AND METHODS

Between May 2015 and May 2019, a total of 72 women with moderate-to-severe obstructive symptoms were identified and treated at two institutions in India and Portugal. The diagnosis of urethral stricture was confirmed in 38 patients. Three of these were found to have flimsy strictures. They were treated with dilatation. Out of the remaining 35 patients, three chose only dilatations. A total of 32 patients qualified for this retrospective study. Local ethics committee approval (Project Number 54, dated October 5, 2020) and patients' informed consent were obtained for the intervention. The ethical guidelines of the Declaration of Helsinki and its amendments were followed. The authors confirm the availability of, and access to, all original data reported in this study.

Patients presented with bladder outlet obstructive symptoms. Investigations confirmed urethral stricture. Out of the total 32 patients, 3 patients presented in acute urinary retention and needed a suprapubic catheter (SPC). One of these patients had six urethral dilatations and one urethrotomy previously. The last dilatation was through a false passage that resulted in degloving of the mucosal flap which had completely blocked the urethra at the bladder neck. This resulted in acute urinary retention needing SPC.

All the patients underwent evaluation including American Urological Association (AUA) symptom score, clinical examination, uroflowmetry for peak flow rate (Qmax), ultrasound for postvoid residual volume (PVR), voiding cystourethrogram (VCUG) [Figure 1], and urethral calibration. The final diagnosis was always confirmed by cystoscopy before urethroplasty using a 6 Fr pediatric cystoscope.

Dorsal onlay urethroplasty was done using BMG in 21 patients in India and VWG in 11 patients in Portugal. The grafts were chosen at these centers by the surgeons proficient in either technique.

**Technique of buccal mucosal graft urethroplasty**

The procedure was performed under general anesthesia with the patient in the dorsal lithotomy position. Periurethral inverted “U-” shaped incision was taken from 9 o’clock to 3 o’clock position. Saline with adrenaline (one in 100,000) was injected in the incision into the retropubic space anterior to the urethra. Stay sutures were placed on the urethral edge at the corner [Figure 2a]. Blunt and sharp dissection was done anterior to the urethra staying close to the urethral tube [Figure 2b]. Care was taken not to injure either the urethral tube or the sphincter muscle. The bulb and corporal bodies of the clitoris were also protected. The dissection continued proximal to the site of stricture that was localized with the help of an 18F soft catheter. A dorsal urethrotomy was then performed [Figure 2c]. An appropriate-sized BMG was harvested and sutured to this urethropotomy incision. The grafting began by taking an apical stitch and parachuting the graft [Figure 2d]. It was completed by suturing both edges, trimming the graft at the meatus, and quilting it on the corporal bodies of the clitoris [Figure 2e and f]. The procedure was completed by closing the U-shaped incision. These steps angulated the urethra anteriorly, thereby directing urinary flow away from the vagina. The suture material used was 5-0 polyglactin. An 18F Foley catheter was used to drain the bladder.

**Technique of vaginal wall graft urethroplasty**

The procedure was performed with the patient placed in the dorsal lithotomy position. Cystoscopy was done with a 6 Fr pediatric cystoscope to examine the stricture area and eventually assess its length from the bladder neck. Normal saline mixed with 1% adrenaline was used for hydrodissection circumferentially around the urethral meatus and periurethral tissues with care taken to avoid the clitoral tissue and nerves. The urethra was dissected dorsally and laterally from 3 to 9 o’clock position through an inverted U-shaped incision, and a periurethral plane was developed with care to avoid damage to the bulb and the clitoral body by staying close to the fibrous tissue of the urethra. This dissection was carried out to the level of the bladder neck to allow identification of the full extent of the stricture which was then sharply incised with scissors in the midline (at 12 o’clock position) dorsally. Stay sutures were placed at urethral angles to help in dissection and to facilitate placement of the graft. The urethra was again calibrated with an 18 Fr Foley catheter to ascertain that there was no residual proximal stenosis. The graft was harvested from the anterior vaginal wall using the standard harvesting techniques [Figure 3a], including hydrodissection with an injection of a mixture of normal saline and 1% lidocaine to facilitate graft dissection and minimize donor site bleeding. The graft was trimmed to size [Figure 3b], threaded with the...
preplaced apical sutures on each end of the urethrotomy, and was secured in place. The graft was then sutured on the dorsal surface of the urethra as an onlay graft with 4-0 polydioxanone sutures in an interrupted fashion. The surgical bed and graft were joined with quilting sutures to enhance revascularization. The vaginal donor site defect was closed and packed with an iodopovidone gauze for 24 h. An 18F Foley catheter was inserted.

Postoperatively, the patients were discharged in 24–48 h. The urethral catheter was kept in place for 2 weeks. The first follow-up visit included clinical evaluation and uroflowmetry. Thereafter, follow-up visits were scheduled every 3 months in the 1st year and yearly later with AUA symptom score, Qmax, and PVR.

The parameters such as age, need for SPC before urethroplasty, the number of prior interventions, location of stricture, length, etiology, average operating time, postoperative catheter time, complications, and follow-up were assessed in both the groups. Statistical analysis was performed with the two-sample t-test. The objective change in AUA symptom score, Qmax, and PVR was calculated in the BMG and VWG cohorts and analyzed with Mann–Whitney test.

In patients with symptomatic recurrence with a decrease in Qmax, further investigation such as cystoscopy was done. Any need for intervention for recurrent stricture was considered a failure. The urethral patency rate (success rate) was studied in these groups and statistically compared using proportion test for equality. All the statistical tests were done using SPSS package version 20 (IBM Corporation, Armonk, New York, USA).

**RESULTS**

The average age was 49 years (range: 25–75 years). The BMG cohort was younger than VWG with an average age of 45 and 55 years, respectively. The number of interventions before urethroplasty, location of stricture, length, etiology, postoperative catheter time, complications, and follow-up in both the groups were comparable [Table 1].

The overall duration of follow-up was 26 months (range: 13–62 months). The objective evidence of overall improvement was seen in AUA symptom score, Qmax, and PVR estimation at 2 weeks. The AUA symptom score improved from a mean of 22 (range: 15–28) to 6 (range: 4–10). The Qmax improved from a mean of 4 ml/s (range: 0–10) to 26 ml/s (range: 14–46). The PVR reduced from a mean of 185 ml (range: 100–260) to 17 ml (range: 0–40).

In the BMG group, the AUA symptom score improved from a mean of 21 (range: 15–28) to 5 (range: 4–7). The Qmax improved from a mean of 4 ml/s (range: 0–10) to 28 ml/s (range: 17–46). The PVR reduced from a mean of 166 ml (range: 100–250) to 10 ml (range: 0–25). In the VWG group, the AUA symptom score improved from a mean of 23 (range: 18–27) to 7 (range: 5–10). The Qmax improved

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**Figure 2:** Buccal mucosal graft. (a) Dorsal dissection of urethra through the inverted U incision with stay sutures, (b) Dorsal urethrotomy, (c) Parachuting the buccal mucosal graft to the apex of urethrotomy, (d) Suturing to urethral edge, (e) Quilting, (f) Final appearance.

**Figure 3:** Vaginal wall graft. (a) Vaginal wall graft harvested from anterior wall, (b) Trimmed vaginal wall graft ready for onlay.
from a mean of 4 ml/s (range: 1.9–6) to 24 ml/s (range: 14–31). The PVR reduced from a mean of 204 ml (range: 158–260) to 24 ml (range: 10–40).

The result of the Mann–Whitney test for these parameters in the BMG and VWG groups showed no statistical difference, with \( P > 0.05 \) (AUA symptom score– 0.9368, Qmax– 0.3936, PVR– 0.4640) \[ Figure 4 \( a-c \]. The average operating time was 91 min. However, it was 119 and 95 min for BMG and VWG, respectively, with a range of 50–150. This was statistically significant, with \( P = 0.019 \). Additional time required for BMG, being a separate harvest location, increased overall operating time.

**BMG urethroplasty**

Significant dysuria (Clavien–Dindo Grade I) was noted in five patients, however, documented urinary tract infection (Clavien–Dindo Grade II) among these was seen in two patients (6%) at 3-month and 6-month follow-up. One of them in due course had recurrent obstructive symptoms. Her flow decreased to 5 ml/s, and she developed significant PVR (150 ml). At cystoscopy, narrowing was noted at the proximal anastomotic site. It was dilated, and the patient was advised self-intermittent catheterization. The second patient with multiple (six) prior dilatations resulting in false passages as described above developed recurrent stricture 13 months after urethroplasty and needed intervention with dilatation. Postoperative pain was mild and transient and responded well to analgesics.

**VWG urethroplasty**

In this group, the patients (\( n = 5 \)) reported mild complications (Clavien–Dindo Grade I or II), such as transient dysuria, dyspareunia, and UTIs. One patient reported a decrease of urine flow 6 weeks following VWG urethroplasty which had stabilized at Qmax of 12 ml/s with PVR of 60 ml (voided volumes averaging 220 ml). This patient reported urethral stricture since childhood with no obvious reason. Before urethroplasty, she had a long history of urethral dilatation and a Qmax of 2 ml/s. After the urethroplasty, she did not wish for any further treatment. No patient developed recurrence in this group.

**DISCUSSION**

FUS has low prevalence and is also poorly understood and underdiagnosed. The prevalence of obstruction in women varies between 2.7% and 23% in the literature.\(^3\) Seventy–eight percent of obstructions are functional, and only 6.8% are secondary to urethral stricture.\(^3\)

The diagnosis of FUS is a contentious issue. Investigating and reaching a conclusion in these patients is a challenge. The diagnosis is based on symptoms, the stenosed appearance of the meatus, difficulty in standard size instrumentation, uroflowmetry, PVR, VCUG, and a final confirmation...
with cystoscopy. In this study at two centers in India and Portugal, all these parameters were used to reach a conclusive diagnosis and the patients were followed up in a similar manner.

Apart from trauma and idiopathic causes, the common cause is iatrogenic due to catheterization and instrumentation. The most common etiological factor in this study was iatrogenic due to repeated urethral dilatation; however, in the VWG group, the etiological factors were evenly distributed. Stricture is located predominantly in the mid or distal part of the urethra. The proximal urethra and bladder neck are infrequently affected. This study group had 23 mid-to-distal, 6 proximal, and 3 pan-urethral locations and compared well with the literature.

Urethral dilatation and clean intermittent self-catheterization have been traditional treatment modalities for this condition. In recent years, there has been an increase in the interest in reconstructive surgical options for FUS. Different techniques using different substitution materials have been described.

Female urethroplasty (FU) has been performed with grafts or flaps, either dorsally or ventrally. Tsivian and Sidi described dorsal VWG in 2006 in two patients. Later, Petrou published his results using dorsal vaginal graft in 11 patients. Other authors independently used inner labia graft, either ventrally or dorsally, with success rates of 75%–100%. Many studies have published excellent outcomes with the use of oral mucosa for dorsal onlay urethroplasty; however, these series were limited by small numbers and short-term follow-up data. In this study, dorsal onlay urethroplasty was performed either with BMG (India) or VMG (Portugal). The patient characteristics such as number of interventions before urethroplasty, location of stricture, etiology, duration of catheterization, complications, and follow-up were similar. The average age of the BMG group was younger compared to VWG (45 vs. 55). We attribute this finding to the geographical differences and selection by the individual surgeon. Three patients presented in retention and needed SPC before the urethroplasty in BMG and none in the VWG group. This shows that a higher proportion of patients in the BMG group presented late with retention, requiring SPC. This is probably an indicator of the cultural and geographical differences between the two groups. The surgical technique was similar in both the groups, differing only in graft chosen. The average operating time was longer in the BMG group compared to VWG (119 vs. 95 min). BMG harvest, being a separate operating location, required additional time, increasing overall operating time. This issue could have been addressed with a two-team approach in the BMG cohort. Both the groups experienced only minor complications, suggesting good tolerance toward the operating procedures. The functional outcome was similar in both the groups with no statistical difference in the patency rate.

Vaginal flaps were described by Blaivas and Montorsi. Tanello described labia minora pedicle flap tunneled under the vaginal epithelium. While flaps have the advantage of local blood supply, they may cause vaginal voiding and spraying. Additionally, flap rotation and tunneling is required resulting in distortion of the vagina and paravaginal tissues. These complications were not seen either in the BMG or VWG cohort, both being graft substitution urethroplasty.

The nomenclature of female urethral anatomy is unclear in terms of its dorsal and ventral sides. In female urethra, “dorsal” is anterior and “ventral” is posterior anatomically. In dorsal procedures, the dissection is challenging due to bleeding and damage to clitoral bodies, but they have better graft fixation and forward stream, as seen in both the groups.

Figure 4: Boxplot of comparison of change in buccal mucosal graft and vaginal wall graft groups in (a) American Urological Association symptom score, (b) Qmax, (c) postvoid residual
in this study. The ventral procedures, on the other hand, are technically easier, but they have higher urethrovaginal fistula rate, and the ventral area usually gets scarred in case any future incontinence surgery is required.

The buccal mucosa is a robust substitution material considered the gold standard in male urethroplasty. Numerous studies have substantiated its vital role in urethral reconstruction. The short length of the urethra and short stricture require only a small graft in females. The advantage of BMG over VWG is the absence of perimenopausal atrophy or narrowing of vaginal introitus seen in VWG, but the latter is useful in patients with poor oral hygiene, tobacco abuse, oral pathology, or following repeated harvesting. In females, the adjacent vaginal mucosa is an advantage, making an additional distant site of dissection unnecessary. Furthermore, VWG is possible if regional anesthesia is preferred for FU. BMG, on the other hand, requires general anesthesia and nasotracheal intubation. In our series, however, all the cases including the vaginal graft group were operated under general anesthesia.

Limitations
The limitation of our study was the lack of a validated questionnaire for quality-of-life assessment. However, all patients expressed satisfaction and willingness to undergo reconstruction even earlier in life. In addition, the low prevalence and/or clinical awareness of FUS limited the number of patients recruited in the study. Furthermore, in this study, the choice of graft was not randomized but was according to surgeon preference instead.

CONCLUSIONS
Dorsal onlay substitution urethroplasty using BMG and VWG is a safe, efficacious, and reliable treatment for FUS. The techniques are easy and have a low complication rate. We found no difference in outcome in FUS with either BMG or VWG.

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