

Outcomes of Buccal Mucosal Graft Urethroplasty for Long-Segment Anterior Urethral Strictures

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ABSTRACT

Background: A prevalent urologic illness in men, urethral stricture is accompanied by a significant financial burden as well as a decline in the quality of life for afflicted men and their families. Buccal mucosal grafts (BMG) are now often utilised to repair lengthy anterior urethral strictures.

Objective: To assess the effectiveness of buccal mucosal graft urethroplasty for long-segment anterior urethral stricture resulting from various etiologies, including previously complex hypospadias repair.

Patients and methods: This prospective cohort study included 65 patients with long-segment anterior urethral stricture due to different etiologies. Complete medical history and physical examination were done to each patient during enrollment. Urological investigations were done to confirm the diagnosis and to determine the accurate site of urethral stricture. All patients underwent buccal mucosal graft urethroplasty and all outcomes were reported.

Results: The mean age of the patients was 27.6 ± 13.15 SD years. Regarding the presenting symptoms, 63.1% of the patients complained from obstructive symptoms, and 39.9% complained from retention symptoms. Post hypospadias repair failure was the main etiology of strictures ($n = 24$; 36.9%). The success rate was found to be 84.6%, while 15.4% had recurrent stricture. The volume of blood loss was significantly affected success rate (P value=0.001). Also, the success rate was significantly affected by age (P value < 0.04), stricture site (P value < 0.006), cause of stricture (P value < 0.01), type of BMG urethroplasty (P value < 0.003), wound infection (P value < 0.001), hematoma formation (P value < 0.01), and catheterization time (P value < 0.001).

Conclusion: BMG either dorsal or ventral onlay is an effective technique for treatment of urethral strictures of different etiologies.

Keywords: Urethral stricture, Buccal mucosal graft, BMG, Post hypospadias repair failure.

INTRODUCTION

In males, urethral stricture is a prevalent urologic condition, and it is associated with a high economic burden as well as a reduction in the quality of life of affected males and their families^[1]. Urethral stricture can affect men at any age^[2]. However, it is common in old age males with a prevalence of 229 - 627/100,000 males^[3]. The cause of urethral stricture differs according to the geographical area and may be congenital or acquired^[4].

Acquired causes include the following: iatrogenic, traumatic, inflammatory, idiopathic, and lichen sclerosis. The most important cause in the western countries is iatrogenic, and in the developing countries is the non-specific urethritis after venereal infections^[5]. The anterior urethra, which comprises the bulbar and penile urethra, and the posterior urethra, which includes the membranous and prostatic urethra, are the two divisions of the male urethra^[6].

So, urethral strictures can be divided into; posterior urethral stricture, and anterior urethral stricture, which is the commonest (92.2%). The anterior urethral strictures might be pan urethral, bulbar, penile, or bulbo-penile. A weak stream, intermittency, hesitation, and dripping are among the obstructive symptoms experienced by around 70% of urethral stricture patients. Additionally, acute blockage or hematuria may occur^[7].

The initial investigation to diagnose the urethral stricture is the uroflowmetry in which, if the maximal

urinary flow rate is less than 15 mL/s, it will be suspicious for obstruction in the lower urinary tract. Another investigations that can be used for diagnosis include; urethroscopy which is fast and easy to diagnose, urethrography, and urethral ultrasound^[5]. Management of urethral stricture is difficult, and the recurrence rate is high. Treatment options for urethral stricture include urethral dilations, optical internal urethrotomy, and open urethroplasty. Choice of the best option depends on several factors such as cause, site, length, previous treatments, and narrowing degree^[6-8].

With a 90% success rate, urethroplasty is regarded as the gold standard therapy for anterior urethral strictures. It is possible to expel or expand the urethra. Excision urethroplasty involves removing the narrow section and anastomosing the two remaining ends. In an augmentation urethroplasty, a flap or graft of replacement epithelium made from penile skin or oral mucosa is inserted into the restricted section to enlarge it^[9].

It was said that the best tissue to replace the urethra is urethra. This is only true for short bulbar urethral stricture in which the resection and anastomosis can be done. However, in long strictures it is not possible to be done to avoid excessive penile curvature^[10]. Recently, the BMG is frequently used to repair lengthy anterior urethral strictures and is chosen over other grafts due to its ease of harvesting, availability, and handling, excellent immunological properties, excellent microvasculature, minimal contracture, and less donor

complications^[11]. Different outcomes were reported after BMG urethroplasty^[9].

So, this study aimed to assess the effectiveness of buccal mucosal graft urethroplasty for long-segment anterior urethral stricture resulting from various etiologies, including previously complex hypospadias repair.

PATIENT AND METHODS

Study populations

This prospective cohort study was done in the Urosurgery Department, Al-Azhar University, Assuit, Egypt. With a power of 80%, a sample size of 65 patients was calculated.

Inclusion criteria:

Any patients who have long-segment anterior urethral stricture from a variety of causes, such as a prior difficult hypospadias repair.

Exclusion criteria:

1. Refusing to take part in the study.
2. Patients with posterior urethral distraction injury secondary to pelvic fracture.
3. Co-morbidities that prevent the patient from receiving anesthesia.
4. Urinary tract infection that is active.
5. Pre-existing conditions affecting the mouth, such as submucosal fibrosis, and epidermolysis bullosa with previous bulbar graft harvesting.

Data collection:

Complete medical history especially; stricture cause, complaint severity, and previous endoscopic or open surgical procedures, and physical examination were made during enrollment. International prostate symptom score (IPSS) assessment was done to each patient. Urine flow rate with estimation of post void residual urine and renal ultrasound scan was done to all patients as a routine study to ensure the patency of the upper tract. Ascending and voiding cysto-urethrogram was done for all patients to visualize the stricture site and extent. Outcome assessment was done preoperatively and postoperatively by face to face interviewing the patients. All data were collected in structured sheet prepared for analysis.

Surgical procedure:

All patients received antiseptic mouthwash 2 days before surgery. The operation was done under general anesthesia using nasal or oral endotracheal intubation. Patients were positioned in the lithotomy position. Sterilization of the penile and perineal areas were done using povidine iodine 1% solution. In order to determine the location and extent of the stricture, the degree of blockage, and the integrity of the distal urethra, we first performed an intraoperative urethroscopy. Using a Nelaton catheter, the distal end

of the stricture was localised. A guidewire was inserted using a urethroscope in situations of severe stenosis to aid identify the urethral lumen during surgery. After that, methylene blue was injected to stain the urethral mucosa. A longitudinal perineal incision was performed in the perineum, and the ischiocavernosus muscle was entirely dissected away from the corpus spongiosum muscle at its midline union. Additionally, the corpus spongiosum, corpora cavernosa, and triangle ligament were detached.

When performing a dorsal urethroplasty, the distal limit of the stricture was indicated on the urethra with a suture while a Nelaton catheter was inserted into the urethra. The dissected bulbar urethra was opened dorsally after being rotated 180 degrees. The penis was invaginated from the perineal incision in the case of the penile urethra, and the penile urethra was similarly dissected up to the coronal sulcus. The urethra was healthy and the stricturotomy was prolonged around 1-1.5 cm proximally and distally.

Calibration of the proximal and distal urethral was performed to ensure proximal and distal patency. The urethral defect was accurately measured and the urethral was packed with gauze until the buccal graft was harvested from the mouth. The corpora cavernosa had the graft spread out and adhered to it. A sharp knife was used to mesh the graft, and the edge of the graft was then sutured to the spatulated urethra. This was done by 4-0 Vicryl sutures. In case of ventral urethroplasty; through a longitudinal midline perineal incision dissection was carried out to expose the pathological proximal bulbar urethra. Followed by ventral stricturotomy, which was also extended into healthy urethra proximal and distal. This was followed by ventral buccal mucosa grafting.

A vascular bed was secured beneath the graft by suturing the majority of the corpus spongiosum over it after the graft was implanted. Before sealing the urethra, a 16 Fr Foley silicon urethral catheter was administered. Hemostasis was confirmed. The bulboocavernosus muscles and Colle's fascia were closed in the midline. Subcutaneous and skin closure followed by occlusive dressing was put over the wound. Graft harvesting was done by the following technique;

- Sterilization of the mouth and perioral area using betadine.
- The lower lip was stretched and small retractor used over the tongue.
- The Stensen duct in the parotid duct was located. One or both cheeks had visible signs of the graft. To stretch and lessen bleeding, a solution of lidocaine and 1/200 000 epinephrine was injected along the lateral boundaries of the proposed graft.
- With the use of a little blade, the mouth mucosa was cut, and then the graft was weakened and pulled off the underlying cheek muscle with the aid of precise scissors.
- Bipolar cautery was used to check the donor site for

hemostasis, and continuous 4/0 Vicryl fast suture was used to seal the donor site.

- In order to assist the graft, took at the recipient site, the graft was hold for de-fattening over the surgeon's finger.
- The graft was soaked in gentamicin-laced saline solution and permitted to dry before being inserted into the urethra.

In all subjects the same team that harvested the graft, rescrubbed and moved to the perineum.

Follow-up:

For the first 24 hours, the patient was kept in bed, and the catheters were withdrawn after 3 weeks. A semisolid food and cold fluids were first tolerated, followed by a conventional diet. Atelectasis prevention, DVT, and neurovascular checks for compartment syndrome were all taken into consideration. If there were no extravasations seen during the patient's 3-week follow-up peri catheter urethrogram, the catheter was withdrawn. If any extravasation was seen in the urethrogram the catheter was left in situ and the peri catheter urethrogram was repeated one week later. Patients were reviewed weekly for the first month then at three months and six months. The patient follow up was done by checking patient symptoms and repeat the urine flow rate. A successful result was one in which the postoperative voiding pattern returns to normal without the need for any treatment.

Ethical approval:

Ethics Committee of Al-Azhar University's Faculty of Medicine granted the study approval. All adult participants and caregivers of child participants signed an informing consent after a thorough explanation of the goals of the study. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

Using SPSS version 25, we examined our data. The Shapiro-Wilk test was initially used to check the continuous data for normality. Parametric data were presented as means and standard deviations, while nonparametric data were presented as medians and interquartile ranges (IQR). Categorical variables were shown as percentages and integers. A significant test for categorical variables was the chi-square. If the P value was 0.05 or below, it was deemed significant.

RESULTS

Our study included 65 patients complaining from urethral stricture at multiple different sites. The mean

age of the patients was 27.6 ± 13.15 SD years. Regarding the presenting symptoms, 63.1% of the patients complained from obstructive symptoms. Post hypospadias repair failure was the main etiology of strictures. Regarding the features of strictures, the majority of the patients had cripple hypospadias stricture. As regards the history of pervious surgery management, 13 patients underwent urethral dilatation and 10 patients underwent visual internal urethrotomy. Regarding the intraoperative outcomes, most of the patients underwent dorsal onlay operation, had blood loss volume less than 500 ml, had operation time > 2 h and used 16 FR catheter size (Table 1).

Table (1): Demographic and clinical characteristics of the patients (N=65)

Characteristics	
Age (years) (Mean ± SD)	27.6 ± 13.15
Presentations	N (%)
Obstructive	41 (63.1%)
Retention	24 (39.9%)
Stricture site	N (%)
Cripple hypospadias	24 (36.9%)
Distal bulbar urethra and proximal penile	13 (20.0%)
Strictural Penile urethra	9 (13.8%)
Pan urethral strictures	9 (13.8%)
Strictural proximal bulbar urethra	5 (7.7%)
Meatus and fossa navicularis	3 (4.6%)
Short bulbar	2 (3.1%)
Etiology	N (%)
Post hypospadias	24 (36.9%)
Idiopathic	12 (18.8%)
Iatrogenic	11 (16.9%)
Lichen sclerosis	9 (13.8%)
Inflammatory	5 (7.7%)
Traumatic	4 (6.2%)
Stricture duration (months) (Median and IQR)	9 (6 – 14)
Stricture length (cm) (Median and IQR)	5 (3 – 7)

The success rate was found to be 84.6%. 10 patients had wound infection, while 8 patients had hematoma. The success rate was 87.3% in those who lost less than 500 ml of blood compared to no patients in those who lost more than 500 ml of blood, indicating a strong relationship between the volume of blood loss and results. Also, the success rate was significantly affected by age, stricture site, cause of stricture, type of BMG urethroplasty, wound infection, hematoma formation, and catheterization time (Table 2).

Table (2): Patients with anterior urethral strictures who had BMG urethroplasty had their outcomes predicted by these factors (N=65)

Variables	Success. (n = 55)	Failure. (n = 10)	P value
Age (years)			< 0.04
< 10	21 (77.7%)	6 (22.2%)	
10 – 20	6 (66.6%)	3 (33.3%)	
> 20	28 (96.5%)	1 (3.4%)	
Stricture site			< 0.006
Penile	27 (75%)	9 (25%)	
Bulbo – penile	13 (100%)	0 (0)	
Pan urethral	9 (100%)	0 (0)	
Bulbar urethra	6 (85.7%)	1 (14.2%)	
Etiology of stricture			< 0.01
Post hypospadias repair	15 (62.5%)	9 (37.5%)	
Idiopathic	13 (100%)	0 (0)	
Iatrogenic	9 (90%)	1 (10%)	
Lichen sclerosis	9 (100%)	0 (0)	
Inflammatory	5 (100%)	0 (0)	
Traumatic	4 (100%)	0 (0)	
Types of BMG urethroplasty			< 0.003
Dorsal onlay	34 (97.1%)	1 (2.8%)	
Ventral onlay	18 (66.6%)	9 (33.3%)	
Combined	3 (100%)	0 (0)	
Duration of stricture (months)			= 0.3
< 10	29 (82.8%)	6 (17.1%)	
10 – 20	16 (80%)	4 (20%)	
10 – 20	10 (100%)	0 (0)	
Expected blood loss			< 0.001
< 500 ml	55 (87.3%)	8 (12.6%)	
> 500 ml	0 (0)	2 (100%)	
Operation time			= 0.1
1-2 hours	18 (75%)	6 (25%)	
> 2 hours	37 (90.2%)	4 (9.75%)	
Wound infection	3 (30%)	7 (70%)	< 0.001
Hematoma formation	4 (50%)	4 (50%)	< 0.01
Stricture length (Cm)			= 0.1
< 5	35 (92.1%)	3 (7.8%)	
> 5	20 (74%)	7 (70)	
Catheter size (FR)			= 0.3
16	47 (85.4%)	7 (25.9%)	
8	7 (77.7%)	2 (22.2%)	
10	1 (50%)	1 (50%)	
Catheter time			< 0.001
1 week	15 (62.5%)	9 (37.5%)	
3 weeks	19 (100%)	0 (0)	
1 month	21 (95.4%)	1 (4.6%)	
Previous visual internal urethrotomy	9 (90%)	1 (10%)	= 0.7
Previous urethral dilatation	13 (100%)	0 (0)	< 0.08

DISCUSSION

Repair of the long segment of the anterior urethral structure is still difficult, and there is no agreement on the best choice intervention for treatment^[11]. Buccal mucosal graft was firstly used by Humby in 1941 for the repair of hypospadias, then in 1993 it was firstly used for the treatment of strictures in the penile and pulper urethra^[12].

Alwaal et al.^[3] reported that urethral stricture increases with old age, which disagrees with our results as we found that more than 50% of our patients had age below 20 years old, this may be due to that we included 24 (36.9%) patients with stricture due to post hypospadias repair failure which is common in young age. In our study, the most common site of stricture was penile 36 (55.3%). This agrees with **Fathi et al.**^[13], who included 30 patients with urethral stricture and found that 53.5% of them had penile urethral stricture, and disagrees with the result of **Tritschler et al.**^[14], who reported that 50% of the stricture was in the bulbar urethra.

This disagreement may be due to that we included large number of cases with urethral stricture post hypospadias repair failure and it is known that the hypospadias occurs in the penile urethra. **Saavedra and Rourke**^[15], reported that the primary symptoms of urethral stricture were lower urinary tract symptoms followed by retention symptoms. Also, **Kuo et al.**^[16], found that (68.6%) of the patients presented with obstructive symptoms, this is in line with our results as 63.1% of our patients presented by obstructive symptoms followed by 39.9% presented by retention symptoms.

In this study the common causes of strictures were, post hypospadias repair failure, idiopathic, iatrogenic, and lichen sclerosis, 24 (36.9%), 12 (18.8%), 11 (16.9%), and 9 (13.8%) respectively. However in the study of **Awad et al.**^[12], the causes of stricture were catheterization in (76.7%), cystoscopy in (26.7%), perineal pelvic injury in (23.3%) pelvic surgery in (13.3%), transurethral resection of the prostate in (10%), and STDs or non-gonococcal urethritis in (13.3%).

In another study by **Selim et al.**^[17], the causes of stricture were idiopathic in 47 (38%) patients, post failed hypospadias repair in 35 (29%) patients, lichen sclerosis in 26 (21%) patients, and inflammatory in 15 (12%) patients. Increasing incidence of stricture post hypospadias repair is due to the technique of repair as explained by **Malone**^[18] who suggested that techniques that used an end to end anastomosis caused stricture formation. As regards to the technique of urethroplasty most of the patients underwent dorsal onlay surgery (n=35; 53.8%). This can be explained by that the dorsal onlay technique has the following advantages; more stable, the graft bed is well vascularized, and has a lower risk of sacculation. This is in line with the result of **Mangera et al.**^[19].

In our study we found that 53.8% of the patients had stricture duration less than 10 months and this has a big role in success rate as we found that patients with stricture duration less than 10 months had success rate 82.8%. Our study reported overall success rate of 84.6% (n = 55 patients). **Awad et al.**^[12], treated 60 patients with anterior stricture of urethra using BMG and they reported 90% success rate. Also, **Bakbagli et al.**^[20], reported 84% success rate in 50 patients complaining from bulbar urethral stricture by using buccal mucosa graft with 4.2 cm mean graft length for 42 months mean follow up period.

In the study of **Vasudeva et al.**^[21] who compared the dorsal onlay versus ventral onlay for treating bulbar urethral stricture by BMG, they reported 92.5% success rate when using dorsal onlay technique and 90% success rate when using ventral onlay procedure. In a metanalysis that was done by **Bagchi et al.**^[22], who compared between the different types of grafts that used in urethral reconstructions after stricture, they found that the success rate when using BMG is 85.9%, which is in line with our study findings.

On the other hand **Spilotros et al.**^[23] and **Yalcinkaya et al.**^[24] reported success rate lower than our results, 81% and 70% respectively. This difference in success rate between the studies may be due to; the difference in sample size, geographical area, strictural etiologies, strictural sites, and surgical technique. As regarding to postoperative complications, 15.4% of our patients developed wound infection and 12.3% developed wound hematoma. This agrees with the findings of **Alsagheer et al.**^[11], who reported 17.5% wound infection and 13% wound hematoma.

In our study we found that the success rate was significantly affected by the age of the patients. Patients with age more than 20 years old had higher success rate. Which disagrees with **Awad et al.**^[12] and **Yalcinkaya et al.**^[24] who found that the outcomes of BMG urethroplasty were not significantly affected by success rate. Regarding stricture length, we found that the success rate in the patients with stricture length < 5 cm was 92.1%. Also, we found that the success rate was not affected by stricture length (p value = 0.1), which is in line with **Warner et al.**^[25], who found that stricture length is not significant predictor for success rate.

The type of the operative procedure was significantly affected the success rate (P value < 0.003) as it was high in dorsal onlay (97.1%) more than ventral onlay (66.6%), which disagrees with the result of **Bagchi et al.**^[22], who found no significant difference between the two procedures as regarding the success rate. Volume of blood loss significantly affects the success rate (P value = 0.001) as the percentage of succeed patients in those who lost < 500 ml blood was 87.3% and in those who lost > 500 ml was 0%. Regarding the operation time, the success rate was higher in the patients with time > 2 hours (90.2%) than those with operative time 1-2 hours. This disagrees with

the result of **Awad *et al.*** [12] who found that the success rate was higher in the patients with operative time 1-2 hours. This disagreement may be explained by that we included large number of patients with previous hypospadias repair, so the fibrous tissue will be more in those patients, increasing the operative time of them. Our study has some limitations such as; small sample size, short follow-up period, and patients' heterogeneity due to different causes. So, we recommend for the future researchers to do larger studies with larger sample size and longer follow-up periods.

CONCLUSION

BMG either dorsal or ventral onlay is an effective technique for treatment of urethral strictures of different etiologies.

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- **Competing interests:** Nil.

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