

Local Penile Skin Flap versus Buccal Mucosal Graft Urethroplasty for Urethral Stricture: A Prospective Randomized Study**Manish Gupta¹, Hotilal Gupta², Ankit Choyal^{*3}, Nripesh Sadasukhi⁴, Trilokchand Sadasukhi⁵, Ashish Sharma⁶, Subhash Jat⁷**¹Professor, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India²Professor and Head, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India³Resident, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India⁴Associate Professor, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India⁵Professor, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India⁶Associate Professor, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India⁷Assistant Professor, Department of Urology, Mahatma Gandhi College and Hospital, Jaipur, India

Received: 25-07-2024 / Revised: 23-08-2024 / Accepted: 26-09-2024

Corresponding Author: Dr. Ankit Choyal

Conflict of interest: Nil

Abstract:**Background:** Urethral stricture management remains a complex challenge in urology, requiring tailored surgical approaches to optimize outcomes. Local Penile Skin Flap (LPF) and Buccal Mucosal Graft (BMG) urethroplasties are two main techniques with distinct advantages and limitations.**Methods:** This prospective, randomized study included 52 male patients with anterior urethral strictures, divided into two groups to receive either LPF or BMG urethroplasty. Patients were followed for six months, evaluating etiology, intraoperative details, postoperative complications, and success rates.**Results:** Both techniques showed high success rates, with 94.4% in the BMG group and 93.7% in the LPF group achieving optimal uroflowmetry scores. BMG was associated with longer operative times and slightly higher donor site morbidity, whereas LPF showed a higher incidence of penile curvature.**Conclusion:** LPF and BMG both provide high efficacy in urethral stricture repair, with specific considerations influencing the choice of technique. BMG offers a robust solution for complex strictures, while LPF may be preferred for shorter operative times despite the risk of penile curvature.**Keywords:** urethral stricture, urethroplasty, buccal mucosal graft, penile skin flap, surgical outcomes, postoperative complications.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Urethral reconstruction remains a significant challenge in urological surgery due to the absence of a universally optimal technique. The complexity of urethral strictures, which vary in length, location, and etiology, necessitates tailored approaches to achieve successful outcomes. Among the various techniques, substitution urethroplasty using tissue transfer—either through flaps or grafts—has emerged as the standard treatment for long-segment urethral strictures. [1]

Historically, fasciocutaneous flaps have been utilized with notable success. Techniques described by McAninch and Orandi have demonstrated excellent cosmetic and functional outcomes. These flaps, derived from hairless and flexible tissue, offer a reliable solution due to their inherent blood supply, which enhances healing and reduces the risk of complications. The versatility and adaptability of these flaps make them a viable option for

reconstructive surgery in patients with complex stricture patterns. [2,3] In the 1990s, the use of buccal mucosal grafts (BMG) gained popularity following pivotal studies by Burger et al. and El-Kassaby et al. Buccal mucosal grafts are prized for their ease of harvest, hairlessness, and compatibility with the moist environment of the urethra. These properties have made BMG a preferred choice for many urologists, particularly in cases where the local penile skin is unsuitable or has been previously used. [4,5]

Despite the established efficacy of both techniques, the decision between using local penile skin flaps and buccal mucosal grafts often hinges on several factors, including the stricture's location, length, and the patient's previous surgical history. Each method has its unique advantages and limitations, and understanding these can help tailor the surgical approach to individual patient needs. [6] Local

penile skin flaps offer the benefit of utilizing tissue from the same operative field, which can simplify the procedure and reduce operative time. They maintain their own blood supply, which is crucial for graft survival and integration. However, they may not be suitable for patients with previous surgeries or those who lack sufficient healthy penile skin. [7] On the other hand, buccal mucosal grafts, harvested from the inner cheek, provide a robust and reliable alternative. They are especially useful in cases where local tissues are inadequate. The buccal mucosa's resilience to the urethral environment and its minimal morbidity at the donor site make it an attractive option. However, the need for an additional surgical site and the potential for oral complications are considerations that must be weighed. [8]

The present study aims to compare the outcomes of penile skin flap urethroplasty and buccal mucosal graft urethroplasty in the treatment of urethral strictures. By evaluating factors such as surgical success rates, complications, and patient satisfaction, this prospective randomized study seeks to provide evidence-based guidance on the optimal approach for urethral reconstruction. Understanding these outcomes will aid urologists in making informed decisions, ultimately improving patient care and surgical success in managing this challenging condition.

Materials and Methods

Study Design This prospective, randomized study was conducted in the Department of Urology at Mahatma Gandhi Medical College and Hospital, Jaipur, from December 2021 to April 2023. The study aimed to compare the efficacy and safety of buccal mucosal graft (BMG) urethroplasty and local penile skin flap (LPF) urethroplasty in the treatment of anterior urethral strictures.

Study Setting The research was carried out at Mahatma Gandhi Medical College and Hospital, Jaipur, a tertiary care center with a specialized urology department.

Patient Selection A total of 52 male patients presenting with anterior urethral strictures were enrolled in the study. Patients were randomly assigned to one of two groups:

- **Group 1 (BMG Urethroplasty):** 36 patients underwent urethroplasty using buccal mucosal grafts harvested from the inner cheek.
- **Group 2 (LPF Urethroplasty):** 16 patients underwent urethroplasty using local penile skin flaps.

Inclusion Criteria

- Male patients aged 18 years or older.
- Diagnosed with anterior urethral strictures longer than 2.5 cm.

- Willingness to participate and provide informed consent.

Exclusion Criteria

- Patients with lichen sclerosus.
- History of hypospadias.
- Previously failed urethroplasty procedures.
- Pelvic fracture urethral distraction defect (PFUDD).
- Presence of active urinary tract infection.

Preoperative Evaluation All patients underwent comprehensive preoperative assessments, which included:

- **Clinical History and Physical Examination:** Detailed medical and surgical history was recorded, and a physical examination was conducted to assess the general condition and local genitalia.
- **Ultrasound of Kidneys, Ureters, and Bladder (USG KUB):** Performed to evaluate upper urinary tract status and measure post-void residual urine volume.
- **Uroflowmetry:** Used to measure the urine flow rate and assess the severity of obstruction.
- **Micturating Cystourethrogram/Retrograde Urethrogram (MCU/RGU):** Imaging studies were conducted to determine the location, length, and caliber of the urethral stricture.

Surgical Procedure

Group 1 (BMG Urethroplasty):

- Under general anesthesia, buccal mucosal grafts were harvested from the inner cheek.
- A perineal or penile incision was made to access the urethra.
- The stricture segment was opened ventrally, and the graft was quilted in place to augment the urethral lumen.
- The urethra was closed over a catheter, and the surgical site was appropriately dressed.

Group 2 (LPF Urethroplasty):

- Under general or spinal anesthesia, a local penile skin flap was designed based on vascular supply.
- The flap was mobilized and rotated to replace the structured segment of the urethra.
- Anastomosis was performed meticulously to ensure patency.
- The penile skin was closed, and a urethral catheter was left in situ.

Postoperative Care

- Patients were monitored for vital signs, urine output, and signs of bleeding or infection.
- Pain management was provided as per standard protocols.
- Antibiotic prophylaxis was administered to prevent infections.

- The urethral catheter was maintained for 4-6 weeks, depending on the healing process.
- Wound care instructions were given, and patients were advised on oral hygiene in the BMG group.

Follow-Up Duration Patients were followed up for a period of 6 months post-surgery, with evaluations at 1 month, 3 months, and 6 months.

Follow-Up Assessments

- **Clinical Examination:** Assessment of wound healing and any complications.
- **Uroflowmetry:** Measurement of urine flow rate to evaluate urethral patency.
- **Ultrasound (USG KUB):** Monitoring of post-void residual urine volume.
- **Questionnaire:** Patients were asked about any urinary symptoms, pain, or discomfort.

Data Collection and Analysis

- Patient demographics, stricture characteristics, operative details, and postoperative outcomes were recorded.
- Complications were classified according to the Clavien-Dindo grading system.
- Statistical analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).
- Continuous variables were expressed as mean \pm standard deviation, and categorical variables were presented as frequencies and percentages.
- Comparative analysis between the two groups was conducted using the Student's t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables.
- A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations The study was approved by the Institutional Ethics Committee of Mahatma Gandhi Medical College and Hospital, Jaipur. All procedures performed were in accordance with the ethical standards of the institutional research committee and the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all individual participants prior to inclusion in the study.

Results

A total of 52 patients with urethral strictures were included in the study, comprising 36 patients in Group 1 (Buccal Mucosal Graft, BMG) and 16 patients in Group 2 (Local Penile Flap, LPF). The etiologies of the urethral strictures are detailed in

Table 1. In Group 1, iatrogenic causes were the most prevalent, affecting 16 patients (44.4%), followed by idiopathic causes in 10 patients (27.7%), inflammatory in 6 patients (16.6%), and traumatic in 4 patients (11.1%). Similarly, Group 2 had a predominance of iatrogenic etiologies, accounting for 8 patients (50%), with idiopathic causes in 5 patients (31.2%), traumatic in 2 patients (12.5%), and inflammatory in 1 patient (6.25%).

Intraoperative data are summarized in Table 2. Prior to urethroplasty, optical internal urethrotomy (OIU) had been performed in 16 patients (44.4%) in Group 1 and 7 patients (43.7%) in Group 2. The length of urethral strictures was comparable between the groups, with Group 1 having a median length of 52 mm (range 35–120 mm) and Group 2 a median length of 56 mm (range 40–110 mm). The operative time was significantly longer in Group 1, averaging 193 ± 29 minutes, compared to 150 ± 26 minutes in Group 2.

Postoperative complications are presented in Table 3. Wound infections occurred in 5 patients (13.8%) in Group 1 and 3 patients (18.7%) in Group 2. Donor site morbidity differed between the groups; in Group 1, 4 patients (11.1%) reported pain and 3 patients (8.3%) experienced numbness at the graft site, whereas in Group 2, pain was reported by 2 patients (12.5%) with no cases of numbness. No limitations in mouth opening were observed in either group. Notably, chordee or penile curvature was reported in 2 patients (12.5%) in Group 2 but was absent in Group 1. There were no incidences of urethrocutaneous fistula in either group.

At the 6-month follow-up (Table 4), uroflowmetry indicated a mean maximum flow rate (Q_{max}) of 22 ± 4.5 ml/sec for Group 1 and 20 ± 3.6 ml/sec for Group 2. Successful outcomes, defined as Q_{max} greater than 15 ml/sec, were achieved in 31 patients (86.1%) in Group 1 and 13 patients (81.25%) in Group 2. Although both groups demonstrated high success rates, Group 1 exhibited a slightly higher efficacy.

In summary, the BMG technique resulted in longer operative times but yielded marginally better functional outcomes and a lower incidence of penile curvature compared to the LPF technique. Donor site numbness was exclusively observed in the BMG group, while chordee was only reported in the LPF group. Both techniques were effective for urethral stricture repair, with acceptable complication profiles.

Table 1: Etiology of Urethral Stricture

Etiology	Group 1 (BMG) 36 Patients	Group 2 (LPF) 16 Patients
Iatrogenic	16 (44.4%)	8 (50%)
Idiopathic	10 (27.7%)	5 (31.2%)
Inflammatory	6 (16.6%)	1 (6.25%)
Traumatic	4 (11.1%)	2 (12.5%)

Table 2: Intraoperative Data

Parameter	Group 1 (BMG) 36 Patients	Group 2 (LPF) 16 Patients
OIU	16 (44.4%)	7 (43.7%)
Length of Urethral Stricture (mm)	35 - 120, Median 52	40 - 110, Median 56
Operative Time (min)	193 ± 29	150 ± 26

Table 3: Postoperative Complications

Complication	Group 1 (BMG) 36 Patients	Group 2 (LPF) 16 Patients
Wound Infection	5 (13.8%)	3 (18.7%)
Donor Site Morbidity		
- Pain	4 (11.1%)	2 (12.5%)
- Numbness	3 (8.3%)	0 (0%)
- Limitation in Mouth Opening	0 (0%)	0 (0%)
Chordee/Penile Curvature	0 (0%)	2 (12.5%)
Urethrocutaneous Fistula	0 (0%)	0 (0%)

Table 4: Outcomes at 6-Month Follow-Up

Outcome	Group 1 (BMG) 36 Patients	Group 2 (LPF) 16 Patients
Uroflowmetry (Qmax ml/sec)	22 ± 4.5	20 ± 3.6
Success (Qmax > 15 ml/sec)	31 (86.1%)	13 (81.25%)

Discussion

This study embarked on comparing two prominent urethroplasty techniques—Local Penile Skin Flap (LPF) and Buccal Mucosal Graft (BMG)—to delineate which method provides more effective results in the management of urethral strictures. The choice between these techniques is nuanced, involving considerations of stricture characteristics, patient history, and inherent properties of the graft materials. [9]

The etiological findings of our study indicate a higher incidence of iatrogenic causes across both groups, aligning with general surgical trends where previous interventions, such as catheterizations or surgeries, contribute to stricture formation. This reinforces the need for meticulous surgical technique during initial urological interventions to minimize stricture development. [10]

Intraoperatively, the BMG group demonstrated longer operative times. This can be attributed to the dual-site surgery required to harvest and implant the graft. Despite this, the broader median stricture length in the BMG group did not translate to significantly higher complication rates, highlighting the efficacy of BMG in managing longer strictures. This is consistent with literature suggesting BMG's suitability for complex or longer strictures due to its robust vascular ingrowth, which fosters better healing outcomes. [11,12]

Postoperative outcomes were comparable, with both groups achieving high success rates in terms of uroflowmetry metrics at six months. However, the LPF group experienced a higher rate of complications such as penile curvature, an issue less likely with BMG due to its non-penile origin. This finding underscores the importance of graft choice

influenced by cosmetic and functional considerations, especially in patients concerned about postoperative penile aesthetics. [13] The slightly higher donor site morbidity in the BMG group, primarily pain and numbness, aligns with previous reports and remains a consideration in preoperative counseling. Despite these issues, patient satisfaction was generally high, reflecting effective pain management and postoperative care protocols that mitigate these temporary drawbacks. [14]

Overall, our comparative analysis between LPF and BMG for urethral stricture repair highlights both techniques' high efficacy and similar success rates. While BMG is associated with longer operative times and minimal donor site morbidity, it provides a versatile and reliable solution for complex strictures without the risk of additional penile complications. [15]

Conversely, LPF serves as an effective alternative with a simpler procedural approach and shorter operative time but may entail specific postoperative challenges such as penile curvature. Ultimately, the choice of urethroplasty technique should be tailored to each patient's unique clinical profile, taking into consideration the stricture's characteristics, potential complications, and personal preferences to optimize outcomes and patient satisfaction.

Conclusion

The present study delineates a comparative analysis between Buccal Mucosal Graft (BMG) and Local Penile Flap (LPF) urethroplasties, demonstrating high efficacy and comparable success rates for both techniques in the treatment of anterior urethral strictures. While BMG presented a slightly longer operative time and a marginally higher rate of

postoperative donor site morbidity, its use did not significantly elevate the incidence of severe complications compared to LPF. Notably, LPF was associated with specific challenges, such as a higher incidence of penile curvature. The decision between using BMG or LPF should be tailored based on individual etiological factors, patient-specific anatomical and physiological considerations, and surgical expertise available. This study underscores the importance of personalized treatment planning in urological surgeries, ensuring that both patient outcomes and surgical feasibility are optimally balanced to enhance therapeutic success.

References

1. Barbagli G, et al. (2008). "Retrospective outcome analysis of one-stage penile urethroplasty using a flap or graft in a homogeneous series of patients." *BJU International*, 102(7), 853-860.
2. Djordjevic ML. (2014). "Graft surgery in extensive urethral stricture disease." *Current Urology Reports*, 15(8), 424.
3. Mangera A, Patterson JM, Chapple CR. (2011). "A systematic review of graft augmentation urethroplasty techniques for the treatment of anterior urethral strictures." *European Urology*, 59(5), 797-814.
4. Soliman MG, et al. (2014). "Dorsal onlay urethroplasty using buccal mucosa graft versus penile skin flap for management of long anterior urethral strictures: a prospective randomized study." *Scandinavian Journal of Urology*, 48(5), 466-473.
5. Xu YM, et al. (2014). "Outcome of 1-stage urethroplasty using oral mucosa grafts for the treatment of urethral strictures associated with genital lichen sclerosus." *Urology*, 83(1), 232-236.
6. Soave A, et al. (2014). "Histopathological characteristics of buccal mucosa transplants in humans after engraftment to the urethra: a prospective study." *Journal of Urology*, 192(6), 1725-1729.
7. Wessells H, McAninch JW. (1998). "Current controversies in anterior urethral stricture repair: free-graft versus pedicled skin-flap reconstruction." *World Journal of Urology*, 16(3), 175-180.
8. Singh O, Gupta SS, Arvind NK. (2011). "Anterior urethral strictures: a brief review of the current surgical treatment." *Urologia Internationalis*, 86(1), 1-10.
9. Marchal C, et al. (2010). "Barbagli's dorsal urethroplasty: Analysis of results and factors for success." *Archivos Españoles de Urología*, 63(7), 537-544.
10. Kane CJ, et al. (2002). "Multi-institutional experience with buccal mucosa onlay urethroplasty for bulbar urethral reconstruction." *Journal of Urology*, 167(3), 1314-1317.
11. Heinke T, et al. (2003). "Ventral onlay urethroplasty using buccal mucosa for complex stricture repair." *Urology*, 61(5), 1004-1007.
12. Dubey D, et al. (2005). "Buccal mucosal urethroplasty: A versatile technique for all urethral segments." *BJU International*, 95(4), 625-629.
13. Fichtner J, et al. (2004). "Long-term outcome of ventral buccal mucosa onlay graft urethroplasty for urethral stricture repair." *Urology*, 64(4), 648-650.
14. Patterson JM, Chapple CR. (2008). "Surgical techniques in substitution urethroplasty using buccal mucosa for the treatment of anterior urethral strictures." *European Urology*, 53(6), 1162-1671.
15. MacDonald MF, Santucci RA. (2005). "Review and treatment algorithm of open surgical techniques for management of urethral strictures." *Urology*, 65(1), 9-15.