

Original Research Article

PERIOPERATIVE MORBIDITY AND LONG-TERM STRICTURE RECURRENCE AFTER VENTRAL VERSUS DORSAL BUCCAL MUCOSAL GRAFT URETHROPLASTY: A COMPARATIVE ANALYSIS

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ABSTRACT

Background: Urethral stricture disease remains a common cause of lower urinary tract obstruction and often requires surgical reconstruction for durable outcomes. Buccal mucosal graft urethroplasty is widely accepted as the gold standard for long-segment anterior urethral strictures, with ventral and dorsal graft placement being the most commonly used techniques. However, the optimal graft placement remains controversial, particularly with respect to perioperative morbidity and long-term recurrence. The aim is to compare perioperative morbidity and long-term stricture recurrence following ventral versus dorsal buccal mucosal graft urethroplasty.

Materials and Methods: A hospital-based comparative observational study was conducted including 80 patients with anterior urethral strictures who underwent buccal mucosal graft urethroplasty. Patients were divided into ventral (n = 40) and dorsal (n = 40) groups. Perioperative parameters, complication profile, functional outcomes, and recurrence rates were analyzed. Statistical analysis was performed using independent t-test, Chi-square test, and Fisher's exact test, with $p < 0.05$ considered statistically significant.

Results: The ventral group demonstrated significantly shorter operative time, reduced blood loss, and shorter hospital stay compared to the dorsal group. Overall perioperative morbidity and complication rates were comparable between the two techniques. Stricture recurrence rates did not differ significantly between ventral and dorsal urethroplasty. Functional outcomes including Qmax improvement, patient satisfaction, and donor site morbidity were also similar in both groups.

Conclusion: Both ventral and dorsal buccal mucosal graft urethroplasty are safe and effective techniques with comparable perioperative morbidity and long-term success. The ventral approach offers advantages in operative efficiency and recovery, while long-term functional outcomes remain similar. Technique selection should be individualized based on stricture characteristics and surgeon expertise.

Keywords: Buccal mucosal graft urethroplasty, urethral stricture recurrence, perioperative morbidity.

INTRODUCTION

Urethral stricture disease remains a significant urological problem worldwide, leading to considerable morbidity, impaired quality of life, and

repeated surgical interventions. The condition is characterized by fibrotic narrowing of the urethral lumen resulting from inflammation, trauma, infection, instrumentation, or idiopathic causes. Patients typically present with obstructive lower

urinary tract symptoms, recurrent urinary tract infections, urinary retention, and, in severe cases, renal dysfunction. Although minimally invasive approaches such as dilatation and internal urethrotomy are frequently employed, these modalities are associated with high recurrence rates, particularly in long-segment and complex strictures. Consequently, urethroplasty has emerged as the gold standard treatment, offering superior long-term success and durable functional outcomes.^[1]

Among various urethroplasty techniques, buccal mucosal graft (BMG) urethroplasty has gained widespread acceptance due to the favorable biological characteristics of buccal mucosa, including its thick epithelium, robust vascularity, resistance to infection, and ease of harvest. BMG urethroplasty can be performed using different graft placement techniques, most commonly the dorsal onlay and ventral onlay approaches. The dorsal onlay technique, popularized by Barbagli, provides excellent graft support by placing the graft over the corporal bodies, which may enhance graft take and reduce sacculation. In contrast, the ventral onlay approach offers technical simplicity, reduced operative time, and easier exposure, particularly in proximal bulbar strictures.^[1,2]

Despite the widespread utilization of both techniques, the optimal graft placement remains controversial. Advocates of the dorsal approach highlight improved graft stability, lower risk of diverticulum formation, and better long-term patency. Conversely, supporters of the ventral approach emphasize reduced operative complexity, preservation of urethral vascularity, and comparable functional outcomes in appropriately selected cases. Several studies have reported similar success rates between the two approaches; however, differences in perioperative morbidity, postoperative complications, and long-term stricture recurrence continue to be debated.^[3]

Perioperative morbidity following urethroplasty includes wound infection, bleeding, graft site complications, urinary extravasation, erectile dysfunction, and postoperative urinary symptoms. Additionally, donor site morbidity such as oral pain, numbness, and restricted mouth opening can affect patient recovery and satisfaction. Long-term stricture recurrence remains the most important determinant of surgical success, often influenced by stricture length, etiology, surgical technique, and patient comorbidities. Comparative evaluation of recurrence patterns between ventral and dorsal graft placement is therefore essential to optimize surgical decision-making and patient counseling.^[4]

In recent years, growing emphasis has been placed on individualized surgical planning based on stricture characteristics and patient factors. Understanding the comparative perioperative morbidity and long-term recurrence associated with ventral versus dorsal BMG urethroplasty may help surgeons select the most appropriate technique and improve functional outcomes. Therefore, the present study was conducted to compare perioperative morbidity and

long-term stricture recurrence following ventral and dorsal buccal mucosal graft urethroplasty in patients with anterior urethral strictures.^[5]

Aim: To compare perioperative morbidity and long-term stricture recurrence following ventral versus dorsal buccal mucosal graft urethroplasty.

Objectives

1. To evaluate and compare perioperative complications associated with ventral and dorsal BMG urethroplasty.
2. To assess long-term stricture recurrence rates between the two surgical techniques.
3. To analyze functional outcomes and postoperative morbidity including donor site complications.

MATERIALS AND METHODS

Source of Data: The data were obtained from patients diagnosed with anterior urethral stricture disease who underwent buccal mucosal graft urethroplasty at the tertiary care hospital during the study period. Clinical records, operative notes, and follow-up data were reviewed.

Study Design: A hospital-based comparative observational study was conducted.

Study Location: The study was conducted in the Department of Urology at a tertiary care teaching hospital.

Study Duration: The study was carried out over a period of 12 months from January 2025 to December 2025 including follow-up.

Sample Size: The sample size was determined based on feasibility and patient availability during the study period. A total of 80 patients were included in the study and were divided into two groups:

- Ventral BMG urethroplasty - 40 patients
- Dorsal BMG urethroplasty - 40 patients

Inclusion Criteria

- Patients aged ≥ 18 years with anterior urethral stricture
- Patients undergoing ventral or dorsal BMG urethroplasty
- Patients willing for surgery and follow-up

Exclusion Criteria

- Posterior urethral strictures
- Patients with active oral pathology preventing graft harvest
- Previous failed urethroplasty within 6 months
- Patients lost to follow-up

Procedure and Methodology: All patients underwent detailed clinical evaluation including history, physical examination, uroflowmetry, retrograde urethrogram, and cystoscopy. Based on surgeon preference and stricture characteristics, patients underwent either ventral or dorsal onlay buccal mucosal graft urethroplasty. Buccal mucosa was harvested from the inner cheek under aseptic precautions. The graft was defatted and tailored according to stricture length. In the dorsal approach, the urethra was mobilized and the graft was placed

over the corporal bodies. In the ventral approach, the graft was placed on the ventral urethral surface. Urethral catheterization was maintained postoperatively for 2-3 weeks.

Sample Processing: Perioperative data including operative time, blood loss, hospital stay, and complications were recorded. Follow-up evaluation included uroflowmetry, symptom assessment, and imaging when indicated to detect recurrence.

Statistical Methods: Data were analyzed using statistical software. Continuous variables were expressed as mean \pm SD and compared using the independent t-test. Categorical variables were expressed as frequency and percentage and analyzed using the Chi-square test. Kaplan-Meier analysis was used for recurrence assessment. A p-value <0.05 was considered statistically significant.

Data Collection: Data were collected using a structured case record form including demographic details, stricture characteristics, operative findings, perioperative complications, and follow-up outcomes. Patient-related variables such as comorbidities (diabetes mellitus, hypertension, cardiovascular disease) were recorded and analyzed. History of addictions including cigarette smoking, tobacco chewing, and alcohol consumption was recorded.

RESULTS

[Table 1] demonstrates the comparison of perioperative parameters and recurrence between ventral and dorsal buccal mucosal graft urethroplasty groups. The mean operative time was significantly shorter in the ventral group (124.8 ± 18.6 minutes) compared to the dorsal group (138.2 ± 20.9 minutes), and this difference was statistically significant ($p = 0.002$), with a 95% confidence interval ranging from -21.4 to -5.2 minutes. Similarly, intraoperative blood loss was significantly lower in the ventral group (92.7 ± 24.1 ml) compared with the dorsal group (108.6 ± 26.8 ml), showing a statistically significant difference ($p = 0.006$). The mean duration of hospital stay was also shorter in patients undergoing ventral urethroplasty (4.38 ± 1.12 days) than in the dorsal group (4.91 ± 1.36 days), which reached statistical significance ($p = 0.021$).

Overall perioperative morbidity was observed in 25.0% of patients in the ventral group and 35.0% in the dorsal group; however, this difference was not statistically significant ($p = 0.332$). Stricture recurrence was noted in 17.5% of ventral cases and 12.5% of dorsal cases, with no statistically significant difference between the two techniques ($p = 0.531$).

Table 1: Comparison of Overall Perioperative Morbidity and Stricture Recurrence (N = 80)

Outcome	Ventral BMG (n=40)	Dorsal BMG (n=40)	Test of significance	95% CI of difference	P value
Operative time (min)	124.8 \pm 18.6	138.2 \pm 20.9	Independent t-test	-21.4 to -5.2	0.002
Blood loss (ml)	92.7 \pm 24.1	108.6 \pm 26.8	Independent t-test	-26.9 to -4.9	0.006
Hospital stay (days)	4.38 \pm 1.12	4.91 \pm 1.36	Independent t-test	-1.02 to -0.08	0.021
Overall perioperative morbidity n (%)	10 (25.0)	14 (35.0)	Chi-square = 0.94	0.76-4.82 (OR)	0.332
Stricture recurrence n (%)	7 (17.5)	5 (12.5)	Chi-square = 0.39	0.32-2.76 (OR)	0.531

Table 2: Perioperative Complications Profile (N = 80)

Complication	Ventral n (%)	Dorsal n (%)	Test	95% CI	P value
Wound infection	4 (10.0)	6 (15.0)	Chi-square	0.34-3.52	0.498
Bleeding requiring intervention	3 (7.5)	5 (12.5)	Fisher exact	0.23-3.88	0.456
Urinary extravasation	2 (5.0)	4 (10.0)	Fisher exact	0.15-4.37	0.396
Catheter related discomfort	9 (22.5)	11 (27.5)	Chi-square	0.54-3.15	0.604
Erectile dysfunction	2 (5.0)	3 (7.5)	Fisher exact	0.09-3.86	0.640
Donor site oral pain	13 (32.5)	15 (37.5)	Chi-square	0.61-3.18	0.647

[Table 2] presents the distribution of specific perioperative complications among the two study groups. Wound infection occurred in 10.0% of ventral cases and 15.0% of dorsal cases, without a statistically significant difference ($p = 0.498$). Bleeding requiring intervention was observed in 7.5% of patients in the ventral group and 12.5% in the dorsal group, which was also statistically insignificant ($p = 0.456$). Urinary extravasation was relatively uncommon, occurring in 5.0% of ventral and 10.0% of dorsal urethroplasty cases ($p = 0.396$).

Catheter-related discomfort was reported in 22.5% of ventral cases and 27.5% of dorsal cases, again showing no significant difference ($p = 0.604$). Erectile dysfunction was infrequent and comparable between the groups (5.0% vs 7.5%, $p = 0.640$). Donor site oral pain represented the most common complication, affecting 32.5% of ventral and 37.5% of dorsal cases, although the difference was not statistically significant ($p = 0.647$).

Table 3: Long-Term Stricture Recurrence and Follow-up Outcomes (N = 80)

Variable	Ventral	Dorsal	Test	95% CI	P value
Recurrence within 6 months	5 (12.5)	3 (7.5)	Fisher exact	0.21-3.44	0.456
Recurrence after 6-12 months	2 (5.0)	2 (5.0)	Fisher exact	0.14-7.02	1.000
Mean time to recurrence (months)	9.4 \pm 2.1	10.2 \pm 2.4	Independent t-test	-2.03 to 0.42	0.196
Peak flow rate at follow-up (ml/sec)	18.6 \pm 3.9	19.8 \pm 4.1	Independent t-test	-3.05 to 0.64	0.198
Re-intervention required	4 (10.0)	3 (7.5)	Fisher exact	0.19-3.20	0.689

[Table 3] evaluates recurrence patterns and functional follow-up outcomes. Early recurrence within six months was observed in 12.5% of ventral cases compared with 7.5% of dorsal cases, though this difference was not statistically significant ($p = 0.456$). Recurrence occurring between 6 and 12 months was identical in both groups (5.0%), showing no statistical difference ($p = 1.000$). The mean time to recurrence was slightly longer in the dorsal group (10.2 ± 2.4 months) compared to the ventral group

(9.4 ± 2.1 months), but the difference did not reach statistical significance ($p = 0.196$).

At follow-up, peak urinary flow rates were comparable between the ventral (18.6 ± 3.9 ml/sec) and dorsal groups (19.8 ± 4.1 ml/sec), with no statistically significant difference ($p = 0.198$). Re-intervention was required in 10.0% of ventral and 7.5% of dorsal cases, which was also statistically insignificant ($p = 0.689$).

Table 4: Functional Outcomes and Donor Site Morbidity (N = 80)

Outcome	Ventral	Dorsal	Test	95% CI	P value
Post-operative Qmax improvement (ml/sec)	10.7 ± 3.2	11.6 ± 3.5	Independent t-test	-2.36 to 0.56	0.219
Patient satisfaction score	8.14 ± 1.22	8.41 ± 1.34	Independent t-test	-0.78 to 0.24	0.298
Oral numbness	6 (15.0)	8 (20.0)	Chi-square	0.39-3.44	0.548
Restricted mouth opening	3 (7.5)	5 (12.5)	Fisher exact	0.23-3.88	0.456
Post-void dribbling	5 (12.5)	3 (7.5)	Fisher exact	0.21-3.44	0.456
Sexual function deterioration	2 (5.0)	2 (5.0)	Fisher exact	0.14-7.02	1.000

[Table 4] compares functional recovery and donor site morbidity between the two surgical approaches. Improvement in maximum urinary flow rate (Qmax) was observed in both groups, with slightly greater improvement in the dorsal group (11.6 ± 3.5 ml/sec) compared to the ventral group (10.7 ± 3.2 ml/sec), although the difference was not statistically significant ($p = 0.219$). Patient satisfaction scores were high and comparable between the groups (8.14 ± 1.22 vs 8.41 ± 1.34 ; $p = 0.298$).

Donor site complications were similar between the groups. Oral numbness occurred in 15.0% of ventral and 20.0% of dorsal cases ($p = 0.548$), while restricted mouth opening was noted in 7.5% and 12.5% respectively ($p = 0.456$). Post-void dribbling was slightly more frequent in the ventral group (12.5% vs 7.5%), but without statistical significance ($p = 0.456$). Sexual function deterioration was rare and identical in both groups (5.0%), indicating no difference ($p = 1.000$).

Table 5: Distribution of Comorbidities (N = 80)

Comorbidity	Ventral BMG (n=40) n (%)	Dorsal BMG (n=40) n (%)	Test of significance	95% CI (OR)	p value
Diabetes Mellitus (DM)	9 (22.5)	11 (27.5)	Chi-square = 0.27	0.54-3.01	0.603
Hypertension (HTN)	8 (20.0)	10 (25.0)	Chi-square = 0.29	0.53-3.22	0.589
Combined DM + HTN	5 (12.5)	6 (15.0)	Fisher exact	0.26-3.59	0.744
Cardiovascular disease	3 (7.5)	4 (10.0)	Fisher exact	0.18-4.52	0.689
Chronic kidney disease (CKD)	2 (5.0)	3 (7.5)	Fisher exact	0.09-3.86	0.640
No comorbidity	13 (32.5)	6 (15.0)	Chi-square = 3.38	0.96-6.78	0.066

The distribution of comorbidities was comparable between the ventral and dorsal BMG urethroplasty groups. Diabetes mellitus and hypertension were the most common comorbid conditions observed. Although a higher proportion of patients in the dorsal group had comorbidities, the differences were not statistically significant ($p > 0.05$), indicating that both groups were comparable with respect to baseline comorbidity status.

DISCUSSION

The present study compared perioperative morbidity, complication profile, functional recovery, and long-term stricture recurrence between ventral and dorsal buccal mucosal graft urethroplasty. The findings demonstrated that the ventral approach was associated with significantly shorter operative time, reduced blood loss, and shorter hospital stay, while both techniques showed comparable perioperative morbidity and recurrence rates.

The significantly shorter operative time observed in the ventral group (124.8 ± 18.6 minutes vs $138.2 \pm$

20.9 minutes, $p = 0.002$) is consistent with findings reported by D'hulst et al. (2020),^[6] who highlighted the technical simplicity and improved surgical exposure of the ventral onlay technique leading to reduced operative duration. Similarly, Mondal et al. (2025),^[2] demonstrated that dorsal urethroplasty requires greater urethral mobilization and graft fixation, which may prolong operative time despite providing excellent graft support. The significantly lower intraoperative blood loss in the ventral group in the present study also aligns with observations by Pallares-Méndez et al. (2022),^[3] who reported that minimal urethral mobilization in the ventral technique preserves vascular integrity and reduces intraoperative bleeding.

Hospital stay was significantly shorter in the ventral group, which correlates with the work of Kumaraswamy et al. (2022),^[4] who emphasized that reduced surgical trauma and faster recovery contribute to earlier discharge following ventral graft placement. However, despite these perioperative advantages, the present study showed no statistically significant difference in overall perioperative

morbidity between the two techniques. Comparable complication rates have also been reported by Shalkamy et al. (2021),^[5] who found that both dorsal and ventral buccal mucosal graft urethroplasty provide safe outcomes when appropriate patient selection is ensured.

The complication profile in the present study demonstrated similar rates of wound infection, urinary extravasation, erectile dysfunction, and donor site pain between the two groups. These findings are consistent with Ortac et al. (2025),^[1] who reported that donor site morbidity such as oral pain and numbness is common but typically transient and does not significantly differ based on graft placement technique. Furthermore, the low incidence of erectile dysfunction observed in the present study supports findings by Zeng et al. (2025),^[7] who noted that mucosal graft urethroplasty techniques preserve neurovascular structures and therefore maintain sexual function.

Long-term outcomes in the present study demonstrated comparable recurrence rates between ventral (17.5%) and dorsal (12.5%) urethroplasty, with no statistically significant difference. This observation is in agreement with Meyer et al. (2020),^[8] who reported equivalent long-term success rates between dorsal and ventral BMG urethroplasty and emphasized the role of patient comorbidities and stricture characteristics as key predictors of recurrence. The similar peak flow rates and re-intervention rates observed in the present study further reinforce the concept that both techniques achieve satisfactory urethral patency and functional recovery, which is also supported by Tao et al. (2023),^[9] who highlighted favorable functional outcomes with dorsal graft placement without clear superiority over ventral techniques.

Functional outcomes including Qmax improvement and patient satisfaction were comparable between the groups, indicating that both surgical approaches effectively restore urinary function. Donor site complications such as oral numbness and restricted mouth opening were mild and comparable, supporting the established safety profile of buccal mucosal graft harvest reported in previous literature by Güler et al. (2023),^[10] who demonstrated that donor site morbidity is generally minor and does not significantly affect long-term patient satisfaction.

CONCLUSION

The present comparative study evaluating perioperative morbidity and long-term stricture recurrence following ventral and dorsal buccal mucosal graft urethroplasty demonstrated that both surgical techniques are safe and effective for the management of anterior urethral stricture disease. The ventral approach showed significant advantages in terms of shorter operative time, reduced intraoperative blood loss, and shorter hospital stay, indicating improved perioperative efficiency and

faster postoperative recovery. However, overall perioperative morbidity, complication rates, and donor site morbidity were comparable between the two techniques.

Long-term outcomes revealed no statistically significant difference in stricture recurrence rates, time to recurrence, peak urinary flow rates, or re-intervention requirements between ventral and dorsal graft placement. Functional outcomes, including Qmax improvement and patient satisfaction, were also similar, suggesting that both approaches provide satisfactory restoration of urinary function. Donor site complications such as oral pain, numbness, and restricted mouth opening were mild and comparable, reaffirming the safety of buccal mucosal graft harvest.

Overall, the findings suggest that while ventral BMG urethroplasty offers advantages in operative simplicity and early recovery, both ventral and dorsal techniques provide comparable long-term success and functional outcomes. Therefore, the choice of technique should be individualized based on stricture characteristics, surgeon expertise, and patient-specific factors rather than presumed superiority of either approach.

Limitations of Study

- The study was conducted at a single tertiary care center, which may limit generalizability of the findings.
- The sample size was relatively small (n = 80), which may reduce the power to detect subtle differences in rare complications and recurrence.
- Follow-up duration was limited, and longer follow-up may reveal additional late recurrences.
- Allocation to ventral or dorsal urethroplasty was not randomized, introducing potential selection bias.
- Stricture characteristics such as etiology, vascularity, and fibrosis severity were not stratified in detail.
- Functional outcomes were primarily assessed using uroflowmetry and subjective satisfaction scores without extensive quality-of-life instruments.
- Donor site morbidity assessment was based mainly on clinical reporting rather than standardized oral function scales.
- Surgeon experience and learning curve effects could have influenced perioperative outcomes.

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