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A Comparative Study of the Outcome of Dorsolateral and Ventral Onlay Buccal Mucosal Graft Urethroplasty for Long Segment Bulbar Urethral Stricture

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Abstract	Original Research Article

Background: Urethral strictures pose a significant challenge in urological practice, and substitution urethroplasty using a buccal mucosal graft is a widely accepted surgical technique. However, the optimal placement of the graft, whether dorsal onlay, ventral onlay or dorsolateral onlay is still unresolved. This study aimed to compare the outcomes of dorsolateral and ventral onlay buccal mucosal graft urethroplasty for long-segment bulbar urethral strictures. *Methods:* A prospective, quasi-experimental study was conducted at the Department of Urology, Dhaka Medical College Hospital, from July 2018 to September 2019. Fifty patients with long-segment bulbar urethral strictures were equally divided into two groups: Group-A (dorsolateral onlay) and Group B (ventral onlay). Patients were followed up for six months, and the groups were compared based on the International Prostate Symptom Score (IPSS), quality of life, maximum flow rate (Qmax), findings of retrograde urethrogram and voiding cystourethrogram, urethroscopic findings, complications and success rate. *Results:* Preoperative stricture lengths in Group-A and Group B were 3.62 ± 0.46 cm and 3.42 ± 0.54 cm respectively. Mean IPSS improved in both groups after surgery, with no significant difference between them. Mean Qmax also improved in both groups, with no significant difference between them. Success rates were 88% and 84% in Group-A and Group B respectively. Complications included wound hematoma, wound infection, and urethral diverticulum, while urethrocutaneous fistula and erectile dysfunction were not observed. Stricture recurrence rates were 12% in Group-A and 16% in Group B. Overall, both techniques demonstrated similar effectiveness and outcomes. *Conclusion:* Dorsolateral and ventral onlay buccal mucosal graft urethroplasty techniques yielded favourable short-term outcomes with low complication rates for long-segment bulbar urethral strictures. Both approaches were equally effective in terms of success rates and overall outcomes. Further research is needed to assess long-term results and determine the most suitable technique for individual patients.
Keywords: Urethral Stricture, Buccal Mucosal Graft, Dorsolateral Onlay, Ventral Onlay, Substitution Urethroplasty.

INTRODUCTION

A urethral stricture is a common condition characterized by the narrowing of the urethral lumen due to scar tissue formation in the subepithelial tissue of the corpus spongiosum [1]. These strictures can occur as a result of ischemia in the spongy tissue of the corpus spongiosum, often stemming from infections, inflammatory processes, or local trauma [2].

There are several methods for reconstructing anterior urethral strictures, including flaps, free grafts, the excision of the stricture, and end-to-end anastomosis. While the excision of the stricture and primary end-to-end anastomosis is considered the gold standard with a high success rate of 90-95%, it is most suitable for bulbar urethral strictures of ≤ 2 cm in length [3]. However, for patients with long strictures (> 2 cm), end-to-end urethroplasty is not ideal due to the risk of chordee formation in the postoperative period [4]. In such cases, a substitution urethroplasty is a preferred approach,

where the stricture is opened along its entire length, and a patch of a suitable material is inserted to restore the normal caliber of the urethra [5].

The choice of material for substitution urethroplasty remains controversial, with options including split and full-thickness skin grafts from various sources such as the scrotum, penis, extragenital areas, bladder mucosa, and buccal mucosa [6]. Buccal mucosal graft (BMG) has emerged as an ideal substitute for urethral reconstruction due to its ease of harvest, favorable surgical handling characteristics, absence of hair, compatibility in a wet environment, and its ability to promote early graft survival and growth [7]. The use of buccal mucosa in urethral reconstruction dates back to the late 19th century when Professor Sapezhko performed the first operations on humans in 1894 [8]. Since then it has gained popularity and has been successfully employed in procedures such as hypospadias repair [9].

When performing augmentation urethroplasty using buccal mucosal grafts, there are three potential sites for graft placement: dorsally, ventrally, or dorsolaterally. However, there is currently no consensus on the preferred technique [10]. Dorsal onlay graft urethroplasty offers advantages such as graft fixation on a well vascularized surface, potentially improving neovascularization and reducing graft shrinkage, while also avoiding sacculation [11]. However, this technique may pose risks to erectile function and the bulbar arteries during proximal dissection from the corpora [12]. In contrast, dorsolateral urethroplasty with a free graft allows for unilateral urethral mobilization, preserving the lateral vascular supply and minimizing ischemia without the risk of chordee development.

The ventral approach, on the other hand, is easier, quicker, less aggressive, and more versatile compared to the dorsal technique. It provides direct access to the urethral lumen, allowing for clear visualization of the stricture and the preservation of as much of the urethral plate as possible during the urethral opening. However, the ventral approach carries a risk of graft weakening, urethral sacculation, or fistula formation [13].

In Bangladesh, different techniques of buccal mucosal graft urethroplasty are performed in multiple centres. However, there is a lack of studies specifically comparing the outcomes of dorsolateral and ventral onlay buccal mucosal graft urethroplasty for long-segment bulbar urethral strictures. Therefore, this study aims to evaluate and compare the overall outcomes of these two techniques, including surgical success rates, patterns of stricture recurrence, and complications, to provide valuable insights into the efficacy of each approach.

OBJECTIVES

General Objective:
- The general objective of this study is to compare the overall outcomes of dorsolateral and ventral onlay buccal mucosal graft urethroplasty in the management of long-segment bulbar urethral stricture.

Specific Objectives:
- To determine and compare the success rates of dorsolateral and ventral onlay buccal mucosal graft urethroplasty in the treatment of long-segment bulbar urethral stricture.
- To evaluate the incidence of complications associated with the surgical procedures, including wound hematoma, wound infection and graft necrosis, urethrocutaneous fistula, urethral diverticulum, and erectile dysfunction.
- To assess the changes in International Prostate Symptom Score (IPSS) before and after dorsolateral and ventral onlay buccal mucosal graft urethroplasty.
- To evaluate the impact on quality of life (QOL) using IPSS-QOL scores before and after dorsolateral and ventral onlay buccal mucosal graft urethroplasty.
- To measure the peak urinary flow rate (Qmax) before and after dorsolateral and ventral onlay buccal mucosal graft urethroplasty and compare the results between the two techniques.
- To determine the size and length of the stricture urethra using retrograde urethrogram and voiding cystourethrogram before and after dorsolateral and ventral onlay buccal mucosal graft urethroplasty.
- To observe post-operative restricture by urethrocystoscopy.

METHODS

This prospective, quasi-experimental study was carried out among patients with long-segment bulbar urethral stricture who were admitted into the Department of Urology of Dhaka Medical College Hospital, from July 2018 to September 2019. A total of 50 patients were selected by purposive sampling technique for the study according to the inclusion and exclusion criteria.

Data Collection
The clinical history of the patients, physical examination findings and relevant investigations before and after surgery during follow-up were recorded in a structured questionnaire which addressed all the variables of interest. Data were recorded and compared between the two groups. The results were presented in tables and charts.

Statistical Analysis

Data were processed manually and analyzed with the help of SPSS 22.0 (Statistical Package for social sciences) and Microsoft Excel. Quantitative data were expressed as mean and standard deviation and comparisons were done by "t" test. Qualitative data were expressed as frequency and percentage comparisons were carried out by chi-square (χ^2) test. A probability value (p) of less than 0.05 was considered to indicate statistical significance. The summarized findings were then presented in the form of tables and charts.

Ethical considerations

Before the commencement of the study, the respective authority approved the research protocol. Proper permission was taken from the department and institution concerned for the study. All the patients included in this study were informed about the nature, risks and benefits of the study. No data were collected without the permission of the patient. Participation in this research was fully voluntary. The respondents remained entirely free to withdraw their participation at any stage or any time of the study. Informed written consent was taken from each patient. Confidentiality was assured and anonymity was maintained. No participants were identified in any report or publication of the study.

RESULTS

The present study was conducted to compare the outcome between dorsolateral and ventral onlay buccal mucosal graft urethroplasty for long-segment bulbar urethral stricture. The recurrence of stricture was evaluated and compared between the two groups. Post-operative complications between the groups were also levelled as outcome variables and were compared between the two groups. Demographic variables i.e. age of the patients and baseline variables (length of stricture, IPSS, IPSS- QOL, Qmax) were also compared to minimize bias. A total of 50 patients with long-segment bulbar urethral stricture were included in this study according to the selection criteria. Patients were divided into two groups, Group A (25 cases)- Dorsolateral onlay buccal mucosal graft urethroplasty and Group B (25 cases)- Ventral onlay buccal mucosal graft urethroplasty. All patients attended at follow-up (there was no dropout) and were followed up for 06 months. The overall outcomes of the two groups were evaluated and compared.

Table 1: Distribution of age among patients in the study groups

Age (Years)	Group A (n = 25)	Group B (n = 25)	*P*-value
Range	28 - 60	23 - 60	
Mean ± SD	45.28 ± 10.19	46.88 ± 11.37	0.602ns

Table 2: Distribution of length of stricture among patients in the study groups

Length of stricture (cm)	Group		*P*-value
	Group-A (n=25)	Group-B (n=25)	
Mean ± SD	**3.62 ± 0.46**	**3.42 ± 0.54**	**0.165ns**

Table 3: Pre & Post-operative Assessment in two groups

Assessment Method	Assessment Time	Group-A (n=25)	Group B (n=25)	*P*-value
IPSS	Pre-operative	20.96 ± 2.44	20.68 ± 1.74	0.642ns
IPSS	Post-operative 1st Follow up (3 months)	4.64 ± 3.03	5.16 ± 4.14	0.614ns
IPSS	Post-operative 2nd Follow up (6 months)	5.68 ± 3.95	5.96 ± 4.69	0.820ns
IPSS - QOL	Pre-operative	4.84 ± 0.67	4.72 ± 0.61	0.511ns
IPSS - QOL	Post-operative 1st Follow up (3 months)	1.40 ± 0.76	1.60 ± 1.11	0.460ns
IPSS - QOL	Post-operative 2nd Follow up (6 months)	1.76 ± 1.01	1.80 ± 1.29	0.903ns
Qmax	Pre-operative	6.72 ± 1.99	7.04 ± 2.29	0.6004ns
Qmax	Post-operative 1st Follow up (3 months)	18.30 ± 2.25	18.75 ± 2.94	0.5462ns
Qmax	Post-operative 2nd Follow up (6 months)	17.19 ± 2.91	17.47 ± 2.85	0.7326ns

Table 4: Pre & Post-operative Assessment in the same group

Group	Assessment Method	Pre-operative (Mean ± SD)	Post-operative (3 months) (Mean ± SD)	Post-operative (6 months) (Mean ± SD)	*P*-value
Group-A (n=25)	IPSS	20.96 ± 2.44	4.64 ± 3.03	-	< 0.0001s
Group B (n=25)	IPSS	20.68 ± 1.74	5.16 ± 4.14	-	< 0.0001s
Group-A (n=25)	IPSS	20.96 ± 2.44	-	5.68 ± 3.95	< 0.0001s
Group B (n=25)	IPSS	20.68 ± 1.74	-	5.96 ± 4.69	< 0.0001s
Group-A (n=25)	IPSS - QOL	4.84 ± 0.67	1.40 ± 0.76	-	< 0.0001s
Group B (n=25)	IPSS - QOL	4.72 ± 0.61	1.60 ± 1.11	-	< 0.0001s
Group-A (n=25)	IPSS - QOL	4.84 ± 0.67	-	1.76 ± 1.01	< 0.0001s
Group B (n=25)	IPSS - QOL	4.72 ± 0.61	-	1.80 ± 1.29	< 0.0001s

Group	Assessment Method	Pre-operative (Mean ± SD)	Post-operative (3 months) (Mean ± SD)	Post-operative (6 months) (Mean ± SD)	*P*-value
Group-A (n=25)	Qmax	6.72 ± 1.99	18.30 ± 2.25	-	< 0.0001s
Group B (n=25)	Qmax	7.04 ± 2.29	18.75 ± 2.94	-	< 0.0001s
Group-A (n=25)	Qmax	6.72 ± 1.99	-	17.19 ± 2.91	< 0.0001s
Group B (n=25)	Qmax	7.04 ± 2.29	-	17.47 ± 2.85	< 0.0001s

Table 5: Status of Success rates at Follow-up by Uroflowmetry

Follow-up	Group A (n = 25)	Group B (n = 25)	*P*-value
1st follow-up	22 (88%)	21 (84%)	0.683ns
2nd follow-up	21 (84%)	20 (80%)	0.712ns

* Qmax ≥ 15ml/sec

Table 6: Status of Restricture rates at Follow-up

Assessment Method	Follow-up	Group A (n = 25)	Group B (n = 25)	*P*-value
RGU + VCUG	1st follow-up	3 (12%)	3 (12%)	1.00ns
	2nd follow-up	3 (12%)	4 (16%)	0.683ns
Urethroscopy	At follow-up	3 (12%)	4 (16%)	0.683ns

Table 7: Post-operative Complications in Study Subjects

Complications	Group A (n = 25)	Group B (n = 25)	*P*-value
Wound hematoma	1 (4%)	1 (4%)	1.00ns
Wound infection	2 (8%)	1 (4%)	0.470ns
Urethrocutaneous fistula	0 (0%)	0 (0%)	-
Urethral diverticulum	0 (0%)	2 (8%)	-
Erectile dysfunction	0 (0%)	0 (0%)	-
Restricture	3 (12%)	4 (16%)	0.683ns

Note: "ns" denotes not significant (p > 0.05).

Table 8: Comparison of Success and Restricture Rates between Group A and Group B

Variable	Number of Patients	Percentage
Success	Group A: 22	88%
	Group B: 21	84%
Restricture	Group A: 3	12%
	Group B: 4	16%
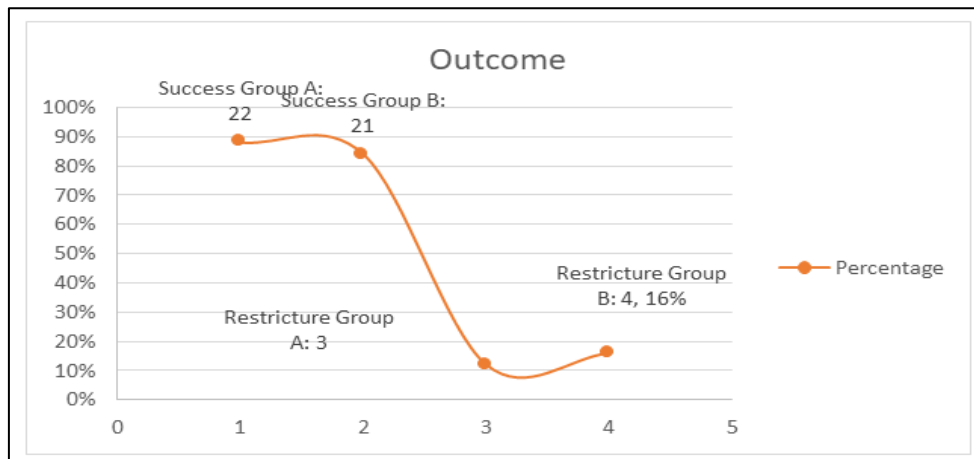
Figure 1: The ratio of Success and Restricture Rates in Groups A and B.

DISCUSSION

This prospective, quasi-experimental study was conducted at Dhaka Medical College Hospital to evaluate the outcomes of dorsolateral and ventral onlay buccal mucosal graft (BMG) urethroplasty for treating long-segment bulbar urethral strictures. A total of 50 patients were selected and divided into two groups: Group A (dorsolateral onlay BMG) and Group B (ventral onlay BMG). After a 6-months follow-up, 25 patients from each group were evaluated. The study ensured comparability between the groups by analyzing

demographic and baseline characteristics. The findings of this study will contribute to the discussion and help in concluding the effectiveness of the two techniques in treating bulbar urethral strictures.

In this study, the age range of patients in Group A was 28 to 60 years, while in Group B it was 23 to 60 years. The mean age ± standard deviation (SD) for Group A was 45.28 ± 10.19 years, and for Group B it was 46.88 ± 11.37 years. Age distribution was comparable between the two groups (p-value 0.602), similar findings were reported in other studies [14]. The preoperative length of stricture, measured by retrograde urethrogram and voiding cystourethrogram, ranged from 3 to 4 cm in Group A and 2.5 to 4 cm in Group B. The mean length ± SD of the stricture in Group A was 3.62 ± 0.46 cm, and in Group B it was 3.42 ± 0.54 cm, with no statistically significant difference (p > 0.05). Similar observations were reported [7] regarding the length of stricture. Additionally, the preoperative mean International Prostate Symptom Score (IPSS) was 20.96 ± 2.44 in Group A and 20.68 ± 1.74 in Group B, showing no significant difference (p > 0.05) [15].

In this study, both Group A and Group B showed improvement in mean International Prostate Symptom Score (IPSS) after surgery. At the first follow-up (3 months postoperatively), the mean IPSS was 4.64 ± 3.03 in Group A and 5.16 ± 4.14 in Group B, with no statistically significant difference between the two groups (p > 0.05). However, comparing the preoperative and postoperative mean IPSS within each group, there was a statistically significant difference (p < 0.05). At the second follow-up (6 months postoperatively), the mean IPSS was 5.68 ± 3.95 in Group A and 5.96 ± 4.69 in Group B, with no statistically significant difference between the groups (p > 0.05). Comparing the preoperative and postoperative mean IPSS within each group, a statistically significant difference was observed (p < 0.05). Similar findings were reported in the study by Singh and Mishra [15].

Regarding the IPSS-Quality of Life (QOL) score, there was no statistically significant difference between Group A and Group B in the preoperative assessment (p > 0.05). Both groups showed improvement in mean IPSS-QOL after surgery. At the first follow-up (3 months), there was no statistically significant difference between the two groups (p > 0.05), but a statistically significant difference was observed within each group when comparing the preoperative and postoperative mean IPSS-QOL scores (p < 0.05). At the second follow-up (6 months), there was no statistically significant difference between the groups (p > 0.05), but a statistically significant difference was observed within each group when comparing the preoperative and postoperative mean IPSS-QOL scores (p < 0.05).

In this study, the preoperative mean Qmax (peak urinary flow rate) was 6.72 ± 1.99 ml/sec in Group A and 7.04 ± 2.29 ml/sec in Group B, with no statistically significant difference between the groups (p > 0.05). Similar findings were reported [10]. After 3 months of follow-up, the mean Qmax was 18.30 ± 2.25 ml/sec in Group A and 18.75 ± 2.94 ml/sec in Group B, with no statistically significant difference between the groups (p > 0.05). Comparing the preoperative and postoperative mean Qmax within each group, there was a statistically significant difference (p < 0.05). Similar findings were reported. At the 6-month follow-up, the mean Qmax was 17.19 ± 2.91 ml/sec in Group A and 17.47 ± 2.85 ml/sec in Group B, with no statistically significant difference between the groups (p > 0.05). Comparing the preoperative and postoperative mean Qmax within each group, there was a statistically significant difference (p < 0.05) [15].

Regarding the success rate based on uroflowmetry criteria, in Group A, the success rate (Qmax ≥ 15 ml/sec) was 88% at the 1st follow-up and 84% at the 2nd follow-up. In Group B, the success rate was 84% at the 1st follow-up and 80% at the 2nd follow-up. The success rates were not statistically significant between the two groups at either follow-up (p > 0.05). Overall, the results of this study indicate significant improvement in Qmax and comparable success rates between Group A and Group B, as assessed by uroflowmetry criteria. These findings align with previous studies and suggest the effectiveness of both techniques in improving urinary flow in patients with bulbar urethral strictures.

In this study, postoperative complications were observed in both Group A and Group B. Wound hematoma occurred in 4% of cases in both groups, while wound infection occurred in 8% of cases in Group A and 4% in Group B. No cases of urethrocutaneous fistula or erectile dysfunction were observed in either group. The urethral diverticulum was seen in 8% of cases in Group B but not in Group A. Restricture occurred in 12% of cases in Group A and 16% in Group B. These results were not statistically significant between the two groups (p > 0.05).

In terms of follow-up evaluations, uroflowmetry, retrograde urethrogram (RGU), and voiding cystourethrogram (VCUG) was performed. At the 1st follow-up, 21 patients in both groups showed improvement in uroflowmetry and normal RGU/VCUG results. One patient in Group A had a stricture on RGU/VCUG despite uroflowmetry improvement, and one patient in each group had no success in uroflowmetry but had normal RGU/VCUG results. At the 2nd follow-up, all patients with uroflowmetry improvement showed normal RGU/VCUG results, while one patient in each group had no success in uroflowmetry but normal

RGU/VCUG results. The differences in stricture rates between the groups were not statistically significant (p > 0.05) at both follow-ups [15].

Post-operative urethroscopy was performed in patients with Qmax < 15 ml/sec on uroflowmetry or stricture on RGU/VCUG. Abnormal urethral findings (stricture) were observed in 12% of cases in Group A and 16% in Group B, with no statistically significant difference between the groups (p > 0.05). In Group A, the strictures were primarily located at the proximal anastomotic site. Optical internal urethrotomy (OIU) followed by urethral dilatation was performed to manage the strictures. Similar findings were reported [10].

In this study, the success rates were 88 % in dorsolateral and 84% in ventral onlay buccal mucosal graft urethroplasty which is comparable with the previous studies. Though the success rate is higher in dorsolateral BMG urethroplasty statistically no significant difference was observed. On the other hand, the complications were higher in ventral onlay BMG urethroplasty but statistically were not significant.

CONCLUSION

The present study concluded that short-term outcomes of both dorsolateral onlay and ventral onlay buccal mucosal graft urethroplasty for treatment of long-segment bulbar urethral stricture are good in comparison to overall outcomes and complications. Both techniques are equally effective with low complication rates.

Limitations
The limitations of this study were:
- It was done on a small group of patients.
- Non-randomized sample.
- May be biased.
- The study period was short.
- A short period of follow-up.
- Operations were performed by different surgeons.

Recommendations
According to the findings of the present study following recommendations are put forward for consideration by the relevant authority.
- Dorsolateral and ventral onlay buccal mucosal graft urethroplasty have comparable outcomes and complications rate for the treatment of long-segment bulbar urethral strictures.
- A well-controlled randomized study should be done.
- The study should be done on a large sample size.
- The study should be done with a long period of follow-up.

REFERENCES
1. Mundy, A. R., & Andrich, D. E. (2011). Urethral strictures. *BJU international*, *107*(1), 6-26.
2. Hillary, C. J., Osman, N. I., & Chapple, C. R. (2014). Current trends in urethral stricture management. *Asian journal of Urology*, *1*(1), 46-54.
3. Jezior, J. R., & Schlossberg, S. M. (2002). Excision and primary anastomosis for anterior urethral stricture. *Urologic Clinics*, *29*(2), 373-380.
4. Gupta, N. P., Ansari, M. S., Dogra, P. N., & Tandon, S. (2004). Dorsal buccal mucosal graft urethroplasty by a ventral sagittal urethrotomy and minimal-access perineal approach for anterior urethral stricture. *BJU international*, *93*(9), 1287-1290.
5. Andrich, D. E., Leach, C. J., & Mundy, A. R. (2001). The Barbagli procedure gives the best results for patch urethroplasty of the bulbar urethra. *BJU international*, *88*(4), 385-389.
6. Bhargava, S., & Chapple, C. R. (2004). Buccal mucosal urethroplasty: is it the new gold standard?. *BJU international*, *93*(9), 1191-1193.
7. Kaggwa, S., Galukande, M., Dabanja, H., & Luweesi, H. (2014). Outcomes of dorsal and ventral buccal graft urethroplasty at a tertiary hospital in Uganda. *International Scholarly Research Notices*, *2014*.
8. Korneyev, I., Ilyin, D., Schultheiss, D., & Chapple, C. (2012). The first oral mucosal graft urethroplasty was carried out in the 19th century: the pioneering experience of Kirill Sapezhko (1857–1928). *European urology*, *62*(4), 624-627.
9. Venkatesan, K., Blakely, S., & Nikolavsky, D. (2015). Surgical repair of bulbar urethral strictures: advantages of ventral, dorsal, and lateral approaches and when to choose them. *Advances in Urology*, *2015*.
10. Pathak, H. R., Jain, T. P., Bhujbal, S. A., Meshram, K. R., Gadekar, C., & Parab, S. (2017). Does site of buccal mucosa graft for bulbar urethra stricture affect outcome? A comparative analysis of ventral, dorso-lateral and dorsal buccal mucosa graft augmentation urethroplasty. *Turkish Journal of Urology*, *43*(3), 350.
11. ISELIN, C. E., & WEBSTER, G. D. (1999). Dorsal onlay graft urethroplasty for repair of bulbar urethral stricture. *The Journal of urology*, *161*(3), 815-818.
12. Barbagli, G., Palminteri, E., Guazzoni, G., Montorsi, F., Turini, D., & Lazzeri, M. (2005). Bulbar urethroplasty using buccal mucosa grafts placed on the ventral, dorsal or lateral surface of the urethra: are results affected by the surgical technique?. *The Journal of urology*, *174*(3), 955-958.
13. Palminteri, E., Berdondini, E., & Di Pierro, G. B. (2013). The advantages of the ventral approach to bulbar urethroplasty. *Arab Journal of Urology*, *11*(4), 350-354.
14. Hosseini, J., Kaviani, A., Hosseini, M., Mazloomfard, M. M., & Razi, A. (2011). Dorsal versus ventral oral mucosal graft urethroplasty. *Urology Journal*, *8*(1), 48.
15. Vasudeva, P., Nanda, B., Kumar, A., Kumar, N., Singh, H., & Kumar, R. (2015). Dorsal versus ventral onlay buccal mucosal graft urethroplasty for long-segment bulbar urethral stricture: A prospective randomized study. *International Journal of Urology*, *22*(10), 967-971.