Orginal Article

Maximum Urine Flow Rate [Qmax] after one year of Buccal Mucosal Graft [BMG] Urethroplasty

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Article History

Recived: 28 May,2024
Accepted: 12 July, 2024
Published: 31 July, 2024

Funding Sources: None

Conflict of Interest: None

Online Access

DOI:

https://doi.org/10.61122/jkistmc297

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Citation: karki K, Bhusal NP, Baral B, Tiwari M. Maximum Urine Flow Rate [Qmax] after one year of Buccal Mucosal Graft [BMG] Urethroplasty. J. KIST Med. Col. 6(12):29-34.

Introduction: Urethral stricture disease is a debilitating condition that can result in lifelong morbidity if not properly managed. This study aims to quantify the success rate of urethroplasty performed at KIST Medical College, using maximum urine flow rate measured by uroflowmetry as the primary outcome.

Methods: This prospective observational study was conducted at KIST Medical College Teaching Hospital, including all urethroplasties performed from August 2016 to August 2022. Medical records were reviewed for all cases meeting the inclusion criteria. Out of 72 patients, 63 responded to follow-up calls and attended outpatient department visits. Success was defined as no need for further intervention (e.g., dilation or optical urethrotomy) and maintaining a flow rate greater than 15 ml/s during follow-up. All patients underwent one-stage buccal mucosal graft urethroplasty, with the urethral catheter removed four weeks postoperatively and suprapubic drainage removed the next day after normal urination. Follow-up included clinical history, symptom reporting, urinalysis and culture, periodic uroflowmetry, ultrasonography, and cystourethrography at 1, 3, and 6 months and annually thereafter.

Results: Of the 63 patients eligible for the study, the mean age was 41.5 years (range: 14-72 years), with a median age of 40 years. The mean follow-up period was 38 months (range: 12-60 months). Trauma was the most common cause of stricture (23 patients, 36.5%), followed by lichen sclerosis (16 patients, 25.4%) and post-TURP strictures (12 patients, 19.0%). The success rate of urethroplasty was 83.15%. Fifteen patients reported dribbling urine, and four had a urinary tract infection in the last six months. Forty-eight patients were sexually active; six reported an inability to achieve satisfactory penile hardness during erection, and nine had reduced ejaculate volume. Stricture length and follow-up duration were inversely associated with the procedure's success rate, showing statistical significance.

Conclusion: Buccal mucosal graft urethroplasty is a reliable technique. Using a uroflow meter to measure maximum urine flow rate is effective for monitoring urethral stricture recurrence during follow-up.

Keywords: *Buccal mucosal graft, Urethroplasty, Uroflowmetry*

Introduction

Urethral stricture disease is one of the most debilitating conditions to have.[1] Depending on the etiology, site, and severity of the stricture, different techniques of stricture repair have been devised.[2,3] The choice of buccal mucosa has been the ideal graft for substitution urethroplasty. [4] This buccal mucosa graft can be placed dorsally, ventrally, dorsolaterally, or as a dorsal inlay, depending on the anatomy of the stricture.Until now, the short-term and medium-term success rates of buccal mucosal graft (BMG)

urethroplasty have been excellent. However, there has been no uniformity in quantifying the success rate. The success of urethroplasty can be assessed based on the patient's history, uroflowmetry, ultrasonography to find post-void residual urine or direct visualization with a cystoscope.[6] We aim to quantify the success rate of urethroplasty performed at KIST Medical College based on the maximum urine flow rate measured during the uroflowmetry examination.

Methods

This prospective observational study was carried out at KIST Medical College Teaching Hospital, encompassing all urethroplasties performed from August 2016 to August 2022. Ethical approval was secured from the institutional review board (IRB), and informed consent was obtained from all participants. The surgeries were exclusively conducted by a single surgeon, Karki K.

Inclusion Criteria:

- Use of Buccal Mucosal Graft: All urethroplasties where buccal mucosal graft (BMG) was utilized.
- First surgery: Only primary surgeries were included.
- Male patient: The study focused solely on male patients.
- Follow-up: Patients who had a minimum follow-up period of one-year post-surgery.

Exclusion Criteria:

- Redo surgeries: Patients undergoing repeat surgeries were excluded.
- Non-Buccal Mucosal Grafts: Any urethroplasty involving grafts other than buccal mucosa was excluded.

Surgical Techniques

The choice of surgical technique was determined by the site and length of the urethral stricture and the availability of the buccal mucosal graft. The specific procedures were as follows:[2,7]

Proximal Bulbar Strictures: For strictures confined to the proximal bulbar region, a ventral onlay BMG urethroplasty was performed.

Distal Urethral Strictures: For strictures in the distal urethral region, a dorsal onlay BMG urethroplasty was utilized.

Pan-Urethral Strictures: For these extensive strictures, the Kulkarni technique, which involves a dorsolateral onlay approach, was employed.

Graft Harvesting: All buccal mucosal grafts were primarily harvested from the cheek. In instances where the cheek mucosa was insufficient, additional mucosa was obtained from the lip or the undersurface of the tongue. Post-harvesting, meticulous hemostasis was ensured, and the mucosal surface was left open to heal naturally.[8]

The study aimed to evaluate the outcomes of these surgical techniques in managing urethral strictures, with a focus on the efficacy and complications associated with the use of buccal mucosal grafts in different anatomical locations of the urethra.

The diagnostic work-up began with a patient history and physical examination, followed by uroflowmetry, a retrograde urethrogram and micturition cystourethrogram (RGU+MCUG), and urethroscopy. After these procedures, a catheter was placed for four weeks. Subsequently, the Foley catheter was removed from the urethral, followed by the removal of suprapubic catheter.

The functional outcome of the procedure was assessed through patient history, physical examination, and uroflowmetry. In uroflowmetry, the maximum flow rate (Qmax), voided volume, and post-void residual volume were recorded.[6,9]

All files meeting the inclusion criteria were retrieved from the medical records section. Patients were contacted for follow-up in the urology outpatient department (OPD) via phone. Out of 72 patients, 63 responded to the phone call and attended the follow-up in the OPD. Informed consent was obtained, and a questionnaire was completed.

Success was defined as requiring no further intervention, such as dilation or optical urethrotomy (OU), and maintaining a flow rate greater than 15 ml/s during the follow-up period.

Data entry was performed using SPSS version 16 (California, Inc.). Continuous variables were recorded as medians and means, while categorical data were recorded as frequencies and proportions. For parametric data, the Student's t-test and Chi-square test were used. For non-parametric data, the Mann-Whitney test was applied. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 72 cases of buccal mucosal graft urethroplasty were performed. Sixty-three patients met the inclusion criteria and were included in the analysis. The mean age of the patients was 41.5 years (range: 14-72 years), with a median age of 40 years. The mean follow-up period was 38 months (range: 12-60 months). Table 1 presents the demographic characteristics of the patients and the causes of their strictures. Trauma was the most common cause of stricture, affecting 23 patients (36.5%), followed by lichen sclerosis in 16 patients (25.4%), and post-TURP strictures in 12 patients (19.0%).

Table 1: Clinical characteristic of patient treated with buccal mucosal graft urethroplasty [n=63]

Mean age years[range]	41.5 [14-72]
Median age years [range]	40[14 -72]
Follow up months [Mean]	38 [12-60]
Follow up months [Median]	42 [12-60]
Location of stricture [%]	
Bulbar	24 [38.09%]
Panurethral	16 [25.39%]
Penile	11 [17.46%]
Membranous	12 [19.04%]
Length of stricture [cm]	5.35 [3-14]
Etiology [%]	
Trauma	23 [36.5%]
Post TURP	12 [19.04%]
Inflammatory	5 [7.93%]
Lichen Sclerosis	16 [25.39%]
Idiopathic	7 [11.11%]
Type of Procedure [%]	
Dorsal onlay	22[34.92%]
Ventral onlay	17 [26.98%]
Lateral onlay	24 [38.09%]

Table 2 provides detailed information on the outcomes and long-term complications following urethroplasty. Outcomes were assessed using uroflowmetry and ultrasonography. The mean average urine flow rate was 12.5 ml/s. Eleven patients[17.46%] patients had a urine flow rate of less than <15ml/s and 4 presented to the outpatient department with complaints of fever and urinary tract infections. These patients underwent cystourethroscopy and urethrotomy and were asymptomatic following these procedures. The mean postvoid residual volume was 43 ml, with 15 patients having a postvoid residual volume greater than 100 ml. At a median follow-up of 38 months, the success rate was 83.15%. Fifteen patients reported dribbling of urine, and four patients had a urinary tract infection in the last six months. Of the 63 patients, 48 were sexually active. Six patients reported an inability to achieve desirable penile hardness during erection, and 9 patients had reduced ejaculate volume. Two patients experienced penile curvature during erection.

Table 2: Outcome and long-term complication of patients [n=63]

Uroflowmetry	
Q-max	12.5ml/s [6-20]
Voided volume[ml]	220 [180-540]
Dribbling of urine	15
Patients with urine flow <15ml/s	11 [17.46%]
UTI in last 6 months	4
Erectile dysfunction	6
Ejaculatory dysfunction	9
Post-void residual urine [ml] range	43 ml [0- 150ml]

Table 3 compares cases of success and failure. Eleven patients (17.5%) experienced recurrence at a median follow-up of 40 months. Most of these patients responded well to optical internal urethrotomy. Three patients opted for clean intermittent self-catheterization (CISC) and refused to re-do surgery. When comparing patients with recurrence-free survival to those with recurrence, the length of the stricture and the follow-up period were significantly longer in the recurrence group.

Table 3: Comparative analysis of outcome

	Success [n=52]	recurrence[n=11]	recurrence[n=11]
Mean age[years]	34.3	36.5	0.12 £
Median age [years]	35	38	0.34 €
Median Stricture length [cm]	4	7	0.02 €
Mean Stricture length [cm]	4.25	8.12	0.01 £
Location			0.06
Panurethral	13	3	
Penile	10	1	
Bulbar / Bulbo-membranous	29	7	
Etiology			0.14 ¥
%Lichen Sclerosis	13	3	
%Trauma	19	4	
%Idiopathic	6	1	
%Post-TURP	10	2	
%Inflammatory	5	0	
Mean Period of follow-up[months]	22	37	0.001 £
Median Period of follow-up[months]	24	40	0.002€
£ Mann–Whitney U	€ Student t test	¥ Chi-square	

Discussion

Urethral stricture disease is one of the most debilitating conditions for patients. The management of urethral strictures depends on the site, the length of the stricture, and the degree of fibrosis. Strictures longer than 2 cm typically require augmentation with a graft or flap. The buccal mucosa is currently considered the best substitute for augmentation due to its subcutaneous tissue, rich blood supply, and resistance to infection. These attributes confer advantages such as good graft take, reduced frequency of ballooning, and minimal graft shrinkage. [10,11,12]
Various parameters are used to measure the success rate of urethroplasty, including the length of the stricture, the degree of fibrosis, and the follow-up duration. In our study, the success rate was comparable to that of the Barbagli et al [13] study but lower than that of the Kluth et al group[14]. Our study included patients with stricture lengths ranging from 3 cm to 14 cm and different etiologies. The follow-up period ranged from 13 to 42 months. The overall success rate may have been influenced by the inclusion of a few challenging cases and due to the heterogeneity of the sample.

Regarding the technique, there was no significant difference in success rates between dorsal onlay and ventral onlay urethroplasty. [15] However, Han et al study showed that stricture length was associated with failure rates. [16] Similarly, in our study, among the cases of urethroplasty performed for pan urethral stricture, recurrence was observed in patients with a mean stricture length of 5.4 cm. The recurrence might be attributed to the extensive area that needed supplementation.

After urethroplasty, patients were followed up every six months. During each follow-up, patients were clinically assessed and underwent uroflowmetry and measurement of postvoid residual urine. Uroflowmetry is a useful tool for quantifying urine flow rates.[17] In our study, the mean flow rate was 12.5ml/s range [6-20] ml/s. Patients with a flow rate of less than 15 ml/s were further evaluated with urethroscopy. [18] However, relying solely on flow rate is not advisable as it can be influenced by factors such as detrusor function, prostate health, and neurological status. [19] In patients with low flow rates, urethral calibration was performed to ensure patency, expecting the patients to pass urine until the size reached 16 Fr.[20]

During urethroscopy, we found re-stenosis at the anastomosis of the buccal mucosa with the urethra, either at the proximal or distal end. This may be due to scar contraction during healing. Additionally, the proximal part of the stricture, which appears distended preoperatively, can shrink post-surgery. In our study, patients who underwent optical internal urethrotomy followed by regular dilatation for a few months showed good outcomes without further dilatation. [21]

Dribbling of urine was observed in 15 patients in our study, predominantly in those who underwent ventral onlay repair. This might be due to urine collection in the posterior urethra or impairment of the constricting action of the bulbospongiosus muscle after it has been divided, resulting in dribbling.[22,23]

Self-reported complaints included erectile dysfunction in six patients and ejaculatory dysfunction in nine patients. These findings are not entirely reliable as they were not confirmed by validated questionnaires. Accurate data can only be obtained by comparing preoperative and postoperative ejaculatory status. All cases of ejaculatory dysfunction were observed in patients where the bulbospongiosus muscle had been divided, highlighting its importance.[24,25]

The strength of our study lies in the long-term follow-up of urethroplasty using buccal mucosa grafts. However, the different etiologies and techniques applied make the group heterogeneous, complicating conclusions about success rates and complications. Our study's limitations include a small sample size and the lack of validated questionnaires to quantify erectile and ejaculatory dysfunction, which would make the study more relevant.

Conclusion

The use of a buccal mucosa graft for urethroplasty is a time-tested technique. It has had excellent success rates in short-term and medium-term periods. The use of a uroflowmeter to assess the maximum flow rate is a good method for the screening recurrence of urethral stricture in the follow-up period.

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