RESEARCH ARTICLE

Short-term outcomes of urethroplasty: Experience from a specialized center: A retrospective descriptive cohort study

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Abstract

Objective: To assess the outcome of urethroplasty, the rate of recurrence, and post-operative complications in a high-volume tertiary care centre.

Method: The retrospective, descriptive study was conducted at the Pakistan Kidney and Liver Institute and Research Centre, Lahore, Pakistan, and comprised data of male patients who had urethroplasty because of urethral stricture disease between September 2018 and September 2024. Demographics, clinical and surgical history as well as outcomes were noted. Data was analysed using SPSS 27.

Results: Of the 22 male patients with mean age 35.2±11.5 years and mean body mass index 24.84 ± 4.60kg/m^2, 16(72.7%) had urethral strictures that were traumatic, 12(54.5%) had anterior strictures and 10(45.5%) had posterior strictures. Anastomotic urethroplasty was performed in 10(45.5%) cases and buccal mucosal graft replacement in 9(40.9%). The mean surgical time was 163.87 ± 48.16 minutes. There was 1(4.5%) case of recurrence. Two (9.1%) patients had bleeding and 5(22.7%) had fever as immediate post-surgery complication. Six (27.3%) reported experiencing painful ejaculation, while 17(77.3%) were able to void normally. The median blood loss was 50mL (interquartile range: 20-130mL), and the median hospital stay was 2 days (interquartile range: 1-3 days). All 22(100%) patients had erectile dysfunction prior to surgery, and 2(9.1%) exhibited improvement post-surgery. As part of 30-day complications, recurrent constriction occurred in 2(9.1%) patients and urinary tract infection in 2(9.1%).

Conclusion: Urethral strictures could be effectively treated by urethroplasty. However, even with positive urine results, erectile dysfunction is a problem that needs more research.

Keywords: Kulkarni technique, Buccal mucosal graft, Urethroplasty, Urethral stricture, Surgical results, Complications.

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Introduction

Urethral strictures narrow as a result of fibrosis and scarring in urethral stricture disease (USD), which is a common and difficult urological illness that frequently results from trauma, infection, iatrogenic injury or inflammation.[1-4] It causes symptoms like reduced urine stream, incomplete voiding, urinary tract infections (UTIs) and, in extreme situations, urinary retention, all of which have a major negative impact on quality of life.[5] Although there are a number of treatment options, including dilation and internal urethrotomy, these are frequently linked to high recurrence rates.[6,7] With excellent success rates and minimal long-term recurrence, urethroplasty, especially involving replacement or augmentation techniques, remains the gold standard for long-lasting and definitive therapy.[8-10] Depending on the stricture's location, length and cause, different surgical techniques are available, and, among them, buccal mucosal grafts are becoming more and more popular because of their attractive histological characteristics and superior results.[11,12] Even with improvements in surgical methods, issues including infection, recurrent strictures and erectile dysfunction (ED) remain.[13-15]

The current study was planned to assess the outcome of urethroplasty, the rate of recurrence, and postoperative complications in a high-volume tertiary care centre.

Materials and Methods

The retrospective, descriptive study was conducted at the Pakistan Kidney and Liver Institute and Research Centre (PKLI&RC), Lahore, Pakistan, and comprised patient data between September 2018 and September 2024. The PKLI&RC performs 18-25 urethral stricture surgeries annually, but only complex, recurrent or long-segment strictures undergo urethroplasty. Having reconstructive urologists and an established multidisciplinary team provides a representative and specialised environment for assessing urethroplasty outcomes.

After approval from the institutional ethics review board,

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data was retrieved using non-probability consecutive sampling strategy. Male USD patients who had urethroplasty were included. Patients with anterior or posterior urethral stricture based on traumatic, iatrogenic, or inflammatory aetiologies who had urethral stricture confirmed by such imaging studies as retrograde urethrography or cystoscopy were included if complete clinical, preoperative, per-operative and postoperative data was available. A three-month follow-up was completed by every patient. Those excluded were patients with urethral stricture superimposed with malignancy, lichen sclerosus, or previous pelvic irradiation. Similarly, patients with neurogenic bladder disease, severe uncontrolled comorbid conditions which could render patients at high risk of compromised surgical outcome due to recovery from surgery or could affect urine function, or patients with recurrent and uncontrolled UTI at the time of surgery were excluded.

The primary outcomes of interest were the success rate of urethroplasty, recurrence of urethral strictures, and the incidence and severity of postoperative complications. Secondary objectives included the assessment of changes in erectile and fertility functions, as well as the evaluation of perioperative variables, such as length of hospital stay (LOS) and postoperative pain.

Data were collected using a standardised proforma by trained research personnel. Patients who had undergone urethroplasty were identified through a systematic search using International Classification of Diseases, 10th Revision (ICD-10) procedure codes related to USD and reconstructive urethral surgery (N35.1 and N35.2). The search was supplemented by key word screening of operative notes and discharge diagnoses, such as "urethroplasty," "anastomotic repair," "substitution urethroplasty" and "buccal mucosal graft", and cross-verification with operative logs. Demographic variables consisted of age, body mass index (BMI) and occupation. Clinical history variables included documented comorbidities, previous urological and non-urological surgeries, and present medications. Assessment variables included those from retrograde urethrogram (RUG), micturating cystourethrogram (MCUG) and cystoscopic examination. Stricture variables included those related to the anatomical position, cause, and length of strictures. Operative variables included urethroplasty procedure undertaken, which included anastomotic repair, substitution urethroplasty using buccal mucosa graft, and Badenoch procedure,[16] along with other operative details. Postoperative variables comprised LSO, early and late complications, follow-up imaging findings, evidence of stricture recurrence, assessment of urinary stream quality, and postoperative erectile and fertility outcomes.

Success was defined as the absence of stricture recurrence, determined by normal uroflowmetry (maximum urinary flow rate [Qmax] ≥15 mL/s) absence of radiological narrowing on RUG, and no requirement for additional intervention during follow-up, in accordance with European Association of Urology (EAU) guidelines.[16] Functional outcomes were assessed separately from surgical success, and defined as normal voiding, based on patient-reported absence of voiding difficulty, hesitancy or bothersome lower urinary tract symptoms (LUTS), irrespective of radiological findings.[17] Clinical status was further assessed using the American Society of Anesthesiologists (ASA)[18] physical status classification and the Eastern Cooperative Oncology Group (ECOG)[19] performance status.

All urethroplasties were performed by consultant urologists using standardised techniques. Most anterior urethral strictures were managed using a dorsal onlay buccal mucosal graft approach based on principles described by Kulkarni[20] but without penile invagination, tailored to stricture length and location. The procedure included mobilisation and dissection of the urethra, dorsal incision of the stricture segment with unilateral urethral mobilisation, harvesting of buccal mucosal grafts, quilting and anastomosis of the graft to the dorsal urethral surface.

Posterior urethral strictures were typically managed with excision and anastomotic urethroplasty. Complex and long-segment strictures were treated with substitution urethroplasty techniques. Procedures performed less frequently included urethrocutaneous fistula repair and Badenoch[16] pull-through urethroplasty (Figure 1).

Data were analysed using SPSS version 27. Descriptive

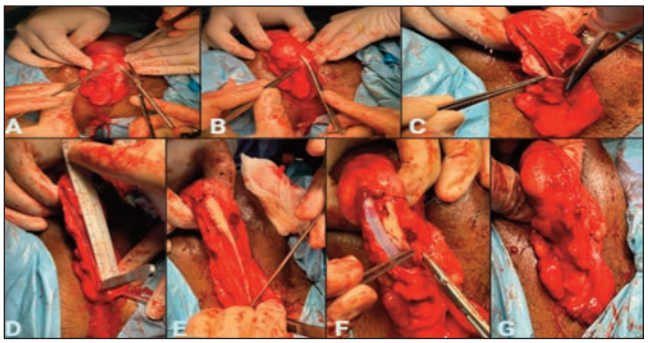

Figure-1: Intraoperative steps of dorsal onlay buccal mucosal graft urethroplasty based on Kulkarni principles (without penile invagination). A: Mobilisation of the urethra; B: Unilateral urethral dissection; C: Dorsal incision of the stricture segment: D: Preparation of the dorsal urethral bed; E: Placement of the buccal mucosal graft on the dorsal urethral surface; F: Quilting of the graft to the corpora cavernosa and anastomosis to the urethral margins; G: Completed dorsal onlay graft reconstruction.

statistics were employed to summarise baseline, surgical, and postoperative data. Categorical variables are presented as frequencies and percentages, while continuous variables are presented as mean±standard deviation (SD) or median with interquartile range (IQR), as appropriate.

As this was a retrospective study, no formal a priori sample size calculation was performed. Given the limited sample size, a post-hoc power analysis was conducted for the primary outcome (urethroplasty success rate) using a previously published reference proportion of 93.5%.[21] Statistical power for a one-sample proportion was estimated using standard normal approximation methods as described in the literature.[21] The estimated post-hoc power was approximately 72%, reflecting the ability of the study to detect a difference relative to previously published data.

Results

Of the 22 male patients with mean age 35.2 ± 11.5 years and mean BMI 24.84 ± 4.60kg/m^2, 8(36.4%) were engaged in labour-intensive occupations, followed by formal sector employees 7(31.8%), students 3(13.6%), businessmen 3(13.6%) and chef 1(4.5%). Optical urethrotomy was the most frequent prior procedure 5(22.7%), followed by previous urethroplasty 4(18.2%) and urethral dilatation 3(13.6%). Overall 6(27.3%) patients had undergone other major surgical procedures, including renal transplantation 2(9.1%) and isolated cases of nephrectomy, liver transplantation, hip replacement, pelvic fracture fixation, urethrocutaneous fistula repair, and suprapubic cystostomy (Table 1).

Trauma was the predominant aetiology, identified in 16(72.7%) patients. The median ASA score was 1 (IQR: 1-2), and most patients had an ECOG performance status of 0. RUG was performed in 14(63.6%) patients and demonstrated varied stricture patterns. Bulbo-membranous strictures were the most common radiological finding 4(18.2%), with equal distribution of strictures shorter and longer than 2cm. Complete prostatic urethral involvement was noted in 2(9.1%) patients.

Flexible cystoscopy was performed preoperatively as an outpatient procedure in 17(77.3%) cases. Among these, complete urethral disruption was identified at the bulbar urethra in 3(13.6%) and at the posterior urethra in 2(9.1%). No cases of pan-urethral strictures were observed. Overall, strictures involved the anterior urethra in 12(54.5%) and

Table-1: Baseline demographic and clinical characteristics (n=22).

Characteristic	Value / n (%)
Mean Age (years)	35.2±11.5; Median: 31.5 (IQR: 25.8–43.0)
Mean BMI (kg/m^2)	24.8±4.6; Median: 24.0 (IQR: 20.2–27.9)
Occupation	
Labour-intensive	8 (36.4)
Formal Sector	7 (31.8)
Student/Businessman	6 (27.2)
Chef	1(4.5)
Surgical History	
Optical Urethrotomy	5 (22.7)
Previous Urethroplasty	4 (18.2)
Urethral Dilatation	3 (13.6)
Renal Transplant	2 (9.1)
*Other Procedures	6 (27.3)
Aetiology	
Trauma	16 (72.7)
Idiopathic/Inflammatory	3 (13.6)
Other	3 (13.6)
ASA Score	Median: 1 (IQR: 1–2)

*Other procedures: surgical fixation for pelvic fracture, urethrocutaneous fistula repair, pelvic fixation with intramedullary nail, bilateral pyelolithotomies, urethrocystoscopy and suprapubic cystostomy (1[4.5%] case each); BMI: Body mass index, IQR: Interquartile range, ASA: American Society of Anaesthesiologists.

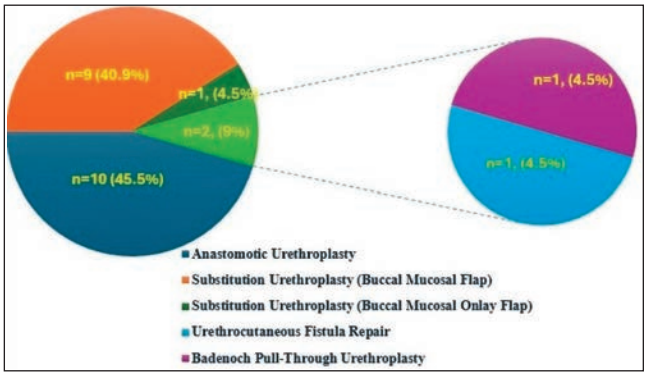

Figure-2: Surgical techniques used for urethroplasty.

Table-2: Surgical outcomes and follow-up at 3 months.

Parameter	Value / n (%)
Surgical Technique	
Excision & Primary Anastomosis	10 (45.5)
Substitution Urethroplasty	9 (40.9)
Other	3 (13.6)
Operative Time (min)	Mean: 163.87 ± 48.16
Blood Loss (ml)	Median: 60 (IQR: 40–100)
Hospital Stay (days)	Median: 2 (IQR: 1–3)
Follow-Up Duration (months)	3 (all patients)
Early Complications	
Fever	5 (22.7)
Bleeding	2 (9.1)
Functional Outcomes	
Normal Voiding	17 (77.3)
Good Flow Rate	17 (77.3)
Painful Ejaculation	6 (27.3)
Stricture Recurrence	1 (4.5)
Erectile Function (Lost/Persisted)	20 (90.9)
Fertility (Retained/Regained)	19 (86.4)

IQR: Interquartile range.

Table-3: Comparative analysis of current findings with those reported by selected key studies on urethroplasty.

Study	Key Features	Patient Demographics	Geographical Location	Study Duration	Sample Size (n)	Aetiology	Stricture Site	Surgical Technique	Outcomes / Complications	Comparison with Current Study
Hussain et al. (2013)[23]	Delayed end-to-end anastomosis for post-traumatic posterior strictures ≤2 cm	Young males	Department of Urology and Renal Transplantation, Quaid-e-Azam Medical College/Bahawal Victoria Hospital, Bahawalpur, Pakistan	2009–2011	26	Trauma	Posterior	End-to-end urethroplasty	87.5% success, 17.5% recurrence, 5% ED	Our study had broader etiologies and stricture sites; recurrence lower (4.5% vs. 17.5%); fewer cases of ED likely due to trauma-predominant, shorter strictures and uniform technique
Siu & Latini (2008)[24]	13-year retrospective review	Adult men, mean age 45.2 years (range 17.1–86.6)	Not specified	1993–2006	91	Mixed	Bulbar (55%), Penile (30%)	Anastomotic & augmented	Recurrence, infection, catheter issues	Similar surgical techniques, but our study showed fewer perioperative complications, possibly due to improved infection control and perioperative optimization
Kay et al. (2021)[25]	Multicenter predictors of recurrence & complications	Median age 58, higher BMI	Dell Seton Medical Center at the University of Texas, Austin, USA	2016–2020	108	Iatrogenic (31%)	Anterior predominant	Multiple techniques	22% recurrence; BMI and stricture length ≥5 cm predictors	Our recurrence was lower (4.5% vs. 22%) with younger patients (median 31.5), lower BMI, and trauma-predominant strictures
Lacy et al. (2018)[26]	NSQIP database, 30-day complications	Nationwide dataset	Academic and community hospitals, USA and Canada	2007–2015	555	Mixed	Anterior	Anastomotic & substitution	8.5% complication rate	Our study had no perioperative complications or readmissions; uniform ASA and ECOG scores may explain favorable outcomes
Rourke et al. (2020)[27]	PROs from 357 patients; 6-month follow-up	Median age 49.7	Canada	2011–2018	357	Mixed	Anterior predominant	Various including BMG	95.9% stricture-free, 80% satisfaction	Our study focused on early outcomes and severe cases; comparable short-term success, but lacking long-term PRO data
Current Study (2024)	Retrospective series from specialized center	Median age 31.5, mean BMI 24.8	PKLI & RC, Lahore, Pakistan	2018–2024	22	Trauma 72.7%, Idiopathic 4.5%, Others 22.8%	Anterior (54.5%), Posterior (45.5%)	End-to-end (50%), Substitution BMG (45.5%), Pull-through (4.5%)	4.5% recurrence, 9.1% UTI, 9.1% fever, 4.5% ED; no intraoperative or perioperative complications	Demonstrated lower recurrence and complication rates compared to several larger series; younger, trauma-predominant, lower-BMI cohort with uniform surgical expertise may account for favorable outcome

Footnote: BMI, body mass index; ED, erectile dysfunction; UTI, urinary tract infection; ASA, American Society of Anesthesiologists physical status classification; ECOG, Eastern Cooperative Oncology Group performance status; PROs, patient-reported outcomes; NSQIP, National Surgical Quality Improvement Program; BMG, buccal mucosal graft.

the posterior urethra in 10(45.5%) patients.

Preoperative urine cultures were positive in 7(31.8%) patients, and surgery was deferred until appropriate antibiotic treatment achieved sterile urine. Baseline laboratory values were within acceptable ranges (Table 1).

All procedures were performed via an open surgical approach under general anaesthesia (GA). Excision and primary anastomosis was the most commonly employed technique 10(45.5%), followed by substitution urethroplasty using a buccal mucosal graft 9(40.9%). Badenoch pull-through surgery was performed on 1(4.5%) patient (Figure 2).

The median estimated blood loss was 60mL (IQR: 40-100mL), and the average surgery time was 163.87 ± 48.16 minutes. In 19(86.4%) cases, a Lone Star retractor (CooperSurgical, Trumbull, CT, USA) was used. There were no documented intraoperative problems. Median LOS was 2 days (IQR: 1-3 days). Every patient experienced mild postoperative pain. Fever in 5(22.7%) patients and bleeding in 2(9.1%) were among the early problems upon admission. Complications at the 30-day follow-up included catheter blockage in 1(4.5%) patients, new-onset ED in 1(4.5%), recurrent urethral constriction in 2(9.1%), and UTI in 2(9.1%). There was 1(4.5%) patient who satisfied the requirements for intervention due to recurrence. No further intervention was needed for 14(63.6%) patients.

At the three-month follow-up, 17(77.3%) patients had normal voiding and adequate flow rate,

while 1(4.5%) showed signs of stricture recurrence. Overall, 20(90.9%) patients had chronic ED and 19(86.4%) had preserved or recovered fertility (Table 2).

Discussion

The current study shows that urethroplasty performed in a specialised tertiary care referral facility has good short-term results, which is indicative of both cautious patient selection and efficient surgical management. The low incidence of recurrence and postoperative complications in the cohort indicates urethroplasty to be the best option in complicated USD cases. With considerable variation in the number of stricture locations, aetiologies and previous surgical procedures, the study sample was heterogeneous (Table 1). The predominant aetiology of the strictures was trauma, and this could be the underlying factor of the successful results obtained, since the success rates of anterior strictures, depending on aetiology, are highest for traumatic strictures,[22] particularly if referred to specialised institutions.

Higher recurrence rates in post-traumatic posterior strictures were reported by Hussain et al.[22] compared to the current sample, possibly because of the younger patients with lower BMIs, and uniform surgical skills.

The current study's complication rates were lower than those seen in national databases and large retrospective series,[23-26] which is probably due to variations in patient functional state and perioperative optimisation (Table 3).

Overall, functional results were positive; but early follow-up showed limited recovery of sexual function. This finding is in line with research showing that erectile recovery after urethroplasty is frequently delayed and may continue to improve over a period of 6 months.[26] The current study's short follow-up period limited the ability to draw firm conclusions about long-term sexual effects, and emphasises the necessity of longer surveillance.

Comprehensive clinical characterisation, inclusion of anterior and posterior strictures, and consistent surgical management by skilled reconstructive urologists are among the study's merits. However, it is important to recognise a few restrictions. The evaluation of long-term recurrence and patient-reported outcomes is limited by the small sample size and comparatively brief follow-up. In addition, the absence of standardised patient-reported outcome measures (PROMs) obstructs the measurement of enhanced quality of life following surgical procedures. In order to more fully define functional durability, predictors of recurrence, and the best individualised treatment in urethral stricture disease, prospective studies with prolonged follow-up are recommended.

Conclusion

With low rates of recurrence and acceptable morbidity, urethroplasty was found to be a reliable and successful surgery for urethral stricture. In challenging conditions, customised methods, like the Kulkarni method, hold promise. The urine functions are normally satisfactory, but ED post-surgery requires further research.

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Author Contribution:

NBN & SI: Concept, design, supervision of data collection and critical review.
AUR, NZ & SM: Design, supervision, critical review and clinical interpretation.
SA & MA: Literature review, data collection, coordination, editing, revision and critical review.
SI: Statistical analysis, interpretation of results and final approval.