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Efficacy of revision urethroplasty in the treatment of recurrent urethral strictures at a tertiary hospital (Kenyatta National Hospital–KNH), in Nairobi Kenya: 2015-2018

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ABSTRACT

Background: Urethral strictures cause malfunction of the urethra. Urethroplasty is a cost-effective treatment option. Its success rate is greater than 90% where excision and primary anastomosis(EPA) is performed and 80-85% following substitution urethroplasty. Definitive treatment for recurrent urethral strictures after urethroplasty is not defined. Repeat urethroplasty is a viable option with unknown efficacy.

Method: Retrospective analysis of patients who underwent revision urethroplasty for unsuccessful urethroplasty at KNH from 2015 to 2018 was performed. Patients' age, demographic data, stricture length, location, aetiology, comorbidities and type of urethroplasty was evaluated from records with complete data. Male patients aged 13 to 80years were evaluated. Comparison of urethroplasty outcome between two patient cohorts was made: Fresh urethroplasty patients versus failed urethroplasty who underwent revision so as to determine efficacy of the later. Principal outcome measure was urethral patency, while Subsidiary outcome measures were associated complications. Outcomes were compared using statistical package SPSS version 23.0.

Result: 235 patients who met inclusion criteria underwent urethroplasty, 71.5% (n=168) had a successful outcome, while28.5% (n=67) failed and were subjected to revision urethroplasty. Another 58% were successful upon revision but experienced significant morbidity. Majority of urethral strictures were bulbomembranous. Trauma was the leading cause of urethral strictures followed by idiopathic strictures. EPA was the commonest surgery while Tissue transfer featured prominently in revision urethroplasty. A significant correlation was evident between stricture length, prior surgery, and procedure choice and urethroplasty outcome.

Conclusion: Revision urethroplasty is feasible after failed urethroplasty but less efficacious. Stricture length, number of prior surgeries and procedure choice affected outcome.EPA and Tissue Transfer techniques are essential surgical armamentarium in revision setting.

Keywords: Urethral strictures, recurrent urethral strictures, fresh urethroplasty, revision urethroplasty, redo urethroplasty.

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INTRODUCTION

Urethral stricture is a progressive spongiofibrosis of the corpus spongiosum that often leads to malfunction of the urethra. It is associated with life-long morbidity and socioeconomic consequences. Open urethroplasty is the main stay treatment with excision and primary anastomosis the gold standard.

Although primary urethroplasty has a success rate of approximately 90%, salvage repairs fare dismally, registering a success rate of roughly 80% or worse.[1,2] Additional treatment for recurrent urethral strictures may be warranted in 14-42% of cases.[1] The definitive treatment approach for recurrent urethral strictures after failed urethroplasty is largely unknown. Redo urethroplasty though feasible has unestablished efficacy.[3] Substitution urethroplasty procedures are inferior to anastomotic procedures, posting success rates as low as 50 %.[4] Many primary urethroplasty failures can be salvaged with a second or subsequent open reconstructive procedure.[2] Patients who undergo redo urethroplasty are likely to require tissue transfer and may experience significant morbidity.[3] Previous open repair has been shown to be an independent risk factor for subsequent salvage urethroplasty failure.[5-7] Surgical sequence of procedure may play a role in influencing outcome.[8]

Excision and primary anastomotic (EPA) failure result from inadequate distal urethral mobilization and or inadequate excision of fibrotic tissue culminating in anastomosis performed under tension. Inappropriate choice of repair technique may also contribute to urethroplasty failure. An excisional repair would be preferred over a flap or graft for example, for a short focally severe bulbar urethral stricture. Other factors determining type of reconstruction are stricture location and severity.[3]

The main stay treatment modality for recurrent penile urethral strictures remains a flap procedure

from penile shaft skin. Strictures ideal for EPA are those in the proximal bulbar urethra as these allow maximal use of the elastic properties of the distal bulbar urethra to bridge the gap created following excision of scar tissue. For mid or distal bulbar structures longer than 3cm, tissue transfer (with buccal mucosa or penile skin) is advisable. Inadequate excision of scar tissue in primary open urethroplasty of posterior urethra is the cause of procedure failure.$_2$

Repeated endoscopic procedures and dilatations are burdensome, unpleasant and often compromise subsequent urethroplasty success.[2,5,6] Comorbid conditions such as Diabetes Mellitus, hypertension, malnutrition, spinal cord injuries, tobacco abuse, and others may also adversely influence tissue healing and contribute to failure.[2,5] De Novo Urethral cancer is a rare but devastating cause of urethroplasty failure hence the need to perform urethral biopsy to rule out malignancy in refractory and advanced stricture cases.[2]

Anterior urethroplasty can fail due to inadequate extension of the urethrotomies into normal healthy urethra on both ends of the stricture during graft or flap procedures. A common area for failure of BMG urethroplasties is at the distal end of the repair. Here the recurrent stricture is often easy to manage by minimally invasive techniques due to low stricture density. More complex stricture recurrences after tissue substitution surgery are often due to poor vascular and structural support of grafted tissues or flap ischaemia, infection or coexistent microvascular disease.

Failure of posterior urethroplasty is often the result of inadequate resection of scar tissue on the proximal aspect of the urethral distruction defect.[2,10] Difficult exposure of the proximal urethral segment often occurs in conjunction with traumatic pubic bone distruction within the retropubic space. Risk factors for stricture recurrence and complications where BMG urethroplasty is performed include patient's age at the time of surgery, anatomical site of the urethral stricture, length of stricture and aetiology.[11]

Long- term postoperative follow-up for urethroplasty is necessary because of occurrence of late failure especially following substitution urethroplasty. Evaluation of procedure failure is both clinical and radiological. Patients with stricture recurrence present with a poor urinary stream or a split stream. The AUA_SI, coupled with urinary flow rates is an effective screening tool in patients who previously underwent urethral reconstructive surgery.[12,13] Clinical assessment by urethral palpation may show significant induration due to spongiofibrosis in the area of failed prior repair.

Symptom assessment by AUA-SI in the long-term follow-up of substitution urethroplasty together with Urethroscopy and or RUG is nearly 100% sensitive in confirming stricture recurrence. Periodic RUG or Urethroscopy is advisable within the first 6 months after repair then annually as most failures occur soon after surgery. High-quality updated imaging prior to salvage repair is prudent, as the length and location of stricture may have changed significantly following previous procedures. Oblique views are crucial to precisely delineate stricture length or defect.[2]

If recurrent stricture is suspected on the basis of clinical findings and imaging, flexible cystourethroscopy is performed to confirm the length and severity of recurrence. If a 15-french scope passes into the bladder without resistance the patient may be safely observed without further surgical intervention. Flexible endoscopy may be combined with radiographic imaging in cases that fail to adequately demonstrate the entire urethra. The main objective of this study was to compare and contrast a cohort of revision urethroplasty patients with fresh urethroplasty by interrogating principal and subsidiary outcome measures.

METHOD

Study procedures

Patients aged 13-80 years were selected on basis of availability of complete data. Patients who had prior instrumentation within the previous 3 months as well as those with urethral stenoses or contractures arising from previous prostatectomy and radiotherapy related strictures were excluded from study. Also excluded were patients with strictures post-kidney transplant or hypospadia surgery and those on steroid therapy. Urethroplasty surgeries performed by other surgeons had their files excluded from analysis.

Data included patients' demographic details such as age, occupation, social habits, morbidity status, investigations and type of surgery performed. The number of previous surgeries prior to revision was noted. On average, patients were followed up for 6 months to 36 months. During follow-up period, patients were interviewed using a standard questionnaire, AUA-SI and or uroflowmetry. Cystoscopy or MCU was reserved for symptomatic patients and those with flow rates below 12-15mls per second. Urethroplasty, whether fresh or repeat was noted as well as its outcome. Procedure-related complications and number of previously failed urethroplasties plus time from surgery to urethroplasty failure was also noted. Fresh urethroplasty outcome was used as the control and repeat urethroplasty as

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the experimental group. Both study cohorts were compared and contrasted with regard to baseline parameters. First time urethroplasty failures that underwent revision were also compared with those that underwent revision more than once but failed. All patients had MCU, AUA-SI and or a flow rate prior to surgery. The stricture length was determined by the radiologist on MCU and confirmed intra-operatively.

Outcome measures

The principal outcome measure was urethral patency; determined by cystoscopy, urethrography, AUA-SI, flow rate, post-void residual urine (PRU) and Patient reported outcome measures (PROM) where feasible.

Subsidiary outcome measures included erectile dysfunction(ED), dribbling, urinary incontinence, scrotal pain, urinary tract infection (UTI) and chordee. These later measures were largely subjective.

Success was defined as unobstructed voiding as reported by the patient, flow rate above 12-15 mls per second and or AUA-SI below 8 points, PRU less than 100mls on abdominal ultrasound scan, freedom from instrumentation or absence of need for further surgical intervention.

Data management and analysis

Data obtained by two research assistants pre-trained by the investigators using a standard questionnaire was entered and stored in a computer excel program. Statistical comparison between the fresh urethroplasty group and those who underwent revision urethroplasty was done with aid of SPSS version 23.0.Statistical power of 95%, $p<0.05$ was set as significant.Chi-square,Fisher exact test for categorical data or t test were used where appropriate.

Ethical consideration

Clearance was sought and obtained from the Kenyatta National Hospital (K.N.H)/University of Nairobi (U.O.N) Ethics and Research Committee, to conduct a retrospective study that involved perusal of medical records of all patients who were treated for urethral strictures during the study period. Those who met the selection criteria were appropriately selected.

RESULTS

From 235 patients who qualified for this study, 168 had a successful fresh urethroplasty, but 67 patients failed in their first urethroplasty and were subjected to revisional procedures. Consequent to this, revision urethroplasty yielded 58% success rate. The time to recurrence ranged from 2 weeks to 24 months. As shown in Table 1 and Figure 1, the difference in the outcome in favour of fresh urethroplasty among the two study cohorts was statistically significant (71.5% Vs 58%; P=0.039). From Table 2, the average stricture length was 2.8 cm for successful urethroplasties (n=168) and 4.1 cm for first-time urethroplasty failures (n=67). The differences in stricture length among the two groups was statistically significant (4.1cm vs. 2.8cm, $p< 0.001$). Figure 2 illustrates the percentage difference in stricture length above and below 4 cm in both cohorts. From Figure 2, majority of patients had stricture lengths below 4 cm in both cohorts. The discrepancy in stricture length above or below 4 cm was greater in the fresh urethroplasty set (75% vs 25%) compared to the redo-urethroplasty cohort (59.7% vs 40.3%). There was a statistically significant difference in the principal outcome measure when stricture lengths above and below 4 cm were compared. Table 3, shows mean stricture length per each anatomical region and type of surgery performed in the respective location. The overall mean stricture length was 3.2 cm and the regional mean varied from 2.0 cm to 12.4 cm. The commonest stricture location was bulbar and least common was panurethral in both cohorts. Panurethral strictures had the longest average length (12.4 cm), compared to Penile, Bulbar and Membranous with 4.2 cm, 2.7 cm and 2.0 cm respectively. The variation in the regional mean stricture length was statistically significant ($p<0.001$).

Table 2 outlines the principal outcome of the study cohorts in relationship to patients' age, social habits, different urethral stricture parameters and types of surgeries performed. The mean age was 40.4 years (SD 16.6), ranging from 13 to 80 years. The

Table 1 Comparison of Patency rates between fresh urethroplasty and revision urethroplasty.

Variable	Urethroplasty		p-value
	Fresh n (%)	Revision n (%)	
Urethral patency			
Successful	168 (71.5)	39 (58.2)	0.039
Failed	67 (28.5)	28 (41.8)	

Table 2 Comparison of baseline stricture parameters, patient age, surgery type, social habits between fresh and revision cases of urethroplasty

Variable	Fresh (n=168) n (%)	Revision (n=67) n (%)	p-value
Age in years			
Mean (SD)	41.0 (16.4)	38.6 (16.8)	0.315
Category, n (%)			
<40	92 (54.8)	41 (61.2)	0.369
40+	76 (45.2)	26 (38.8)	
Length of stricture in cm			
Mean (SD)	2.8 (2.6)	4.1 (3.0)	0.001
Category, n (%)			
<4 cm	126 (75.0)	40 (59.7)	0.020
4+ cm	42 (25.0)	27 (40.3)	
Location			
Bulbar	101 (60.1)	36 (53.7)	0.370
Membranous	38 (22.6)	17 (25.4)	0.653
Panurethra	6 (3.6)	4 (6.0)	0.477
Penile	23 (13.7)	10 (14.9)	0.806
Etiology			
Iatrogenic	29 (17.3)	10 (14.9)	0.664
Idiopathic	18 (10.7)	10 (14.9)	0.368
Infection	18 (10.7)	6 (9.0)	0.688
Trauma	102 (60.7)	40 (59.7)	0.886
BXO	1 (0.6)	1 (1.5)	0.490
Type of surgery			
BMG	55 (32.7)	24 (35.8)	0.652
EPA	98 (58.3)	25 (37.3)	0.004
Meatoplasty	1 (0.6)	0	1.000
Mikulcz-Heineke	0	1 (1.5)	0.285
Prepuce graft	1 (0.6)	0	1.000
Staged/Flap	13 (7.7)	17 (25.4)	<0.001
Using alcohol/smoking			
Yes	39 (23.2)	21 (31.3)	0.197
No	129 (76.8)	46 (68.7)	
Smoking			
Yes	20 (11.9)	12 (17.9)	0.226
No	148 (88.1)	55 (82.1)	
Alcohol			
Yes	37 (22.0)	17 (25.4)	0.582
No	131 (78.0)	50 (74.9)	

average age was 41 years and 38.6 years for fresh and repeat urethroplasties respectively. There was no large variation in the patients' age amongst the two cohorts. Majority of patients were below 40 years of age in both study groups, but this observed difference in age was not statistically significant.

From Table 2 and Figure 3, EPA (58.3% vs. 37.3%) was the most commonly performed surgical procedure in both fresh and redo urethroplasty. There was a slight increment in the BMG procedures (35.8% vs. 32.7%) in the revision cohort. BMG was commonly performed in the

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Table 3 Type of surgery/mean stricture length compared with anatomical region of urethra

	Bulbar	Membranous	Panurethra	Penile	p-value
Mean length of stricture in cm	2.7	2.0	12.4	4.2	<0.001
Type of surgery					
BMG	47 (34.3)	2 (3.6)	10 (100.0)	20 (60.6)	<0.001
EPA	72 (52.6)	50 (90.9)	0	1 (3.0)	
Meatoplasty	0	0	0	1 (3.0)	
Mikulcz-Heineke	1 (0.7)	0	0	0	
Prepuce graft	0	1 (1.8)	0	0	
Staged/Flap	17 (12.4)	2 (3.6)	0	11 (33.3)	

Table 4 Comparison of number of prior surgeries, morbidity and complications between successful and failed revision urethroplasty

Variable	Successful (n=39)	Failed (n=28)	p-value
Number of prior surgeries			
Median (IQR)	1 (1-2)	3 (2-4)	<0.001
Number (%)			
1	23 (59.0)	2 (7.1)	<0.001
2	8 (20.5)	10 (35.7)	
3	4 (10.3)	7 (25.0)	
4	3 (7.7)	8 (28.6)	
5	1 (2.6)	1 (3.6)	
Occurrence of complications			
Yes	14 (35.9)	28 (100.0)	<0.001
No	25 (64.1)	0	
Presence of comorbidity			
Yes	3 (7.7)	3 (10.7)	0.688
No	36 (92.3)	25 (89.3)	

Table 5 Occurrence of complications and comorbidities in fresh and revision cases

Variable	Fresh (n=168) n (%)	Revision (n=67) n (%)	p-value
Complications	35 (20.8)	42 (62.7)	<0.001
Chordee	0	2 (3.0)	0.080
Donor site scar	0	1 (1.5)	0.285
Dribbling	3 (1.8)	13 (19.4)	<0.001
ED	8 (4.8)	8 (11.9)	0.080
Fistula	2 (1.2)	6 (9.0)	0.008
UTI	5 (3.0)	5 (7.5)	0.153
Incontinence	4 (2.4)	14 (20.9)	<0.001
Scrotal pain	1 (0.6)	0	1.000
Orchitis	1 (0.6)	1 (1.5)	0.490
Wound sepsis	14 (8.3)	5 (7.5)	0.825

Table 5 Continued

Variable	Fresh (n=168) n (%)	Revision (n=67) n (%)	p-value
Comorbidities	32 (19.0)	6 (9.0)	0.058
Asthma	1 (0.6)	1 (1.5)	0.490
Brain tumor	1 (0.6)	0	1.000
Epilepsy	1 (0.6)	0	1.000
Diabetes	1 (0.6)	1 (1.5)	0.490
Hypertension	18 (10.7)	3 (4.5)	0.130
Arthritis	1 (0.6)	0	1.000
Renal tumor	1 (0.6)	0	1.000
CVA	2 (1.2)	0	1.000
Epistaxis	1 (0.6)	0	1.000
HIV	6 (3.6)	1 (1.5)	0.676
PUD	1 (0.6)	0	1.000
Renal failure	1 (0.6)	0	1.000
TB	2 (1.2)	0	1.000

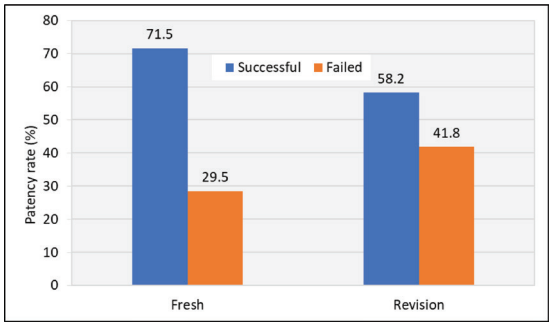

Figure 1 Urethral patency in fresh and revision urethroplasty

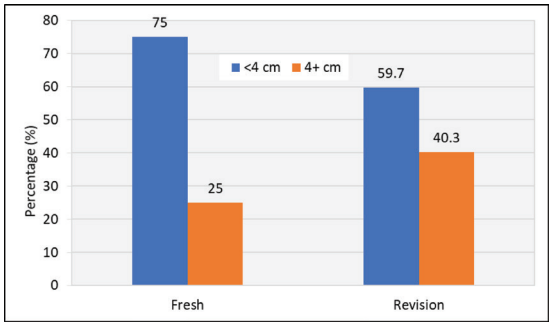

Figure 2 Length of stricture

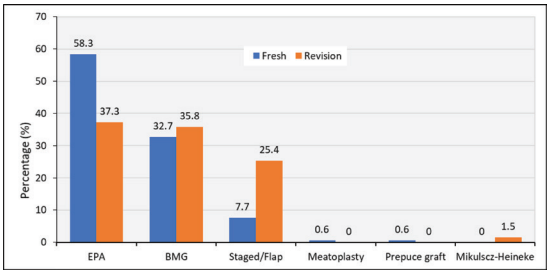

Figure 3 Comparison of type of surgery between fresh and revision urethroplasty

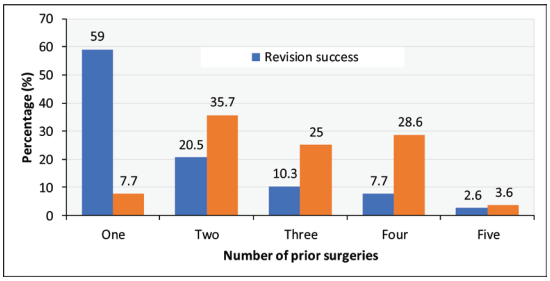

Figure 4 Prior surgeries in revision urethroplasty patients

in penile and panurethral strictures. Tissue transfer procedures (BMG and Staged/flap) were the main procedures performed in the penile urethra. Staged/flap procedures just like BMG, were also commonly performed in revision urethroplasty compared to fresh cohorts (25.4% vs. 7.7%). The procedures of EPA and Staged/flap showed a statistically significant correlation with the principal outcome measure in both study groups (EPA, P=0.004, Staged/flap, p<0.001). EPA was the procedure of choice in the bulbomembranous area.

Data from Table 2 shows that Trauma was the leading cause of urethral strictures followed by iatrogenic injuries of the urethra in both study groups.Trauma emanated from road Traffic accidents (RTA) with or without pelvic fracture causing urethral injury, fall from a height, straddle injury by motor cyclists, GSW to the pelvic area affecting the genitalia and assault. Iatrogenic injuries arose from urethral catheterization, endoscopy of the urethra during TURP, TURBT, routine cystoscopy,

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complex pelvic surgeries culminating in urethral injuries. Radiotherapy induced urethral strictures were not included in this study. BXO as a cause of urethral strictures was uncommon. There was no observed statistical significance between the principal outcome and stricture aetiology or location in both study cohorts. Majority of patients in both cohorts were non-smokers and non-alcoholics. Furthermore, there was no statistically significant association between either of these social habits or both and the principal outcome (Table 2).

In Table 4, a comparison is made between the number of prior surgeries, comorbidity and complications amongst the first time revision urethroplasty and a sub-cohort of two or more attempts at revision (Revision success vs. Revision Failure). There was a statistically significant correlation between the number of prior surgeries and failure rate following revision urethroplasty. There was a statistically significant difference in the complication rate but not in comorbidity amongst the two sub-cohorts of Revision urethroplasty.

Figure 4 compares the success rate of revision urethroplasty amongst the two sub-cohorts of revision urethroplasty with the number of prior surgeries. The success rate was inversely proportional to the number of prior surgeries.

Table 5 shows the occurrence of complications and comorbidities among fresh and revision cases. Comorbidities did not significantly affect the principal outcome of urethroplasties in both study groups. Overall, there was a statistically significant complication rate amongst the two study groups. Fistula formation, urinary incontinence and dribbling of urine were the complications that differed significantly amongst fresh and revision sets.

DISCUSSION

In this study, revision urethroplasty was less efficacious with 58.5% success rate contrary to studies elsewhere.[1,3] Rosenbaum et al. report a success rate of 83%, emanating from BMG revision urethroplasty.[14] Blaschko et al in an outcome analysis of 130 patients that underwent revision urethroplasty, established that 78% of patients were successfully treated.[15]

Breyer et al., Joseph et al., O'Riordan et al., Morey et al., in their respective studies established success rates of 79%, 80%, 86%, 90% respectively.[5,9,16,17] Joseph and O'Riordan studies were confounded by previously unsuccessful open procedures being evaluated in the same category with patients who had failed prior DVIU before urethroplasty.[16,17] It has been established that prior DVIU has overall negative impact on outcome of urethroplasty.[6,7,10] However, Barbagli et al. in a study of 93 patients, with bulbar urethral strictures who underwent urethroplasty with or without prior urethrotomy established that urethrotomy did not adversely affect outcome.[18]

In the present study, stricture length, number of prior surgeries and some of the surgeries performed (EPA, Staged/flap) affected the outcome. Quite a significant correlation existed between urethral length and outcome post urethroplasty, p value<0.001. More patients in the revision cohort had stricture length exceeding 4cm. Breyer and Wood affirmed that stricture length beyond 4 cm, may increase likelihood of urethroplasty failure.[5,19] Accordingly, Morey et al recommend a systematic decision making process for failed anterior urethroplasty based on stricture length, location and complexity.[9] From the foregoing results, patients age, stricture location and aetiology did not seem to have affected the outcome.However,in studies conducted elsewhere, several factors influence outcome of urethroplasty such as patient's age at surgery, dense stricture fibrosis, variation in stricture length, location, aetiology, type of surgery performed, surgeon's experience, number of previous surgeries and duration of follow-up.[5,11,19] Breyer et al. in a multivariate analysis of risk factors mitigating urethroplasty outcome, established that urethral length (>4cm), previous urethroplasty, unsuccessful endoscopic treatment, smoking and Diabetes mellitus may predict urethroplasty failure.[5]

Roehrborn et al. concur with the significant contribution made by urethral length, location and type of surgery in determining outcome of urethroplasty.[6] In this study, majority of urethral strictures were bulbomembranous in both cohorts. This finding was however not statistically significant. Levine et al. in a comparative analysis found a preponderance of bulbomembranous urethral strictures in both revision and urethroplasty naïve cohorts.[3] EPA was commonly performed in both study cohorts because majority of urethral strictures were bulbomembranous in location and therefore still amenable to the procedure. EPA is the most efficacious method of bulbar urethral reconstruction even in salvage repairs despite prior technique failure.[2] The bulbar location is a common site for traumatic and inflammatory urethral strictures.

The mean age was 40.4 years (SD16.6) out of 235 patients in the current study. This compares with a mean age of 42.7 years (n=112) derived from local studies.[20] Stein et al retrospectively interrogated data from 2,589 patients who

underwent urethroplasty surgery in USA, Italy and India, and established that the presenting age was 41.4 years.[21] This age bracket represents an economically viable segment of the society that is prone to accidental trauma especially in urban setting such as the Nairobi Metropolis where this study was conducted. In this study, trauma (60%) was the preponderant cause of urethral strictures. The last decade has seen astronomical growth in motor-cycle, car, minibus and bus transport industry in Kenya and the Nairobi Metropolis in particular. During the same period, sexually transmissible diseases that used to be more common than trauma in the aetiology of urethral strictures have been on the decline due to sufficient health education and readily available antibiotic-based therapy. Accidental trauma appears to have overtaken infection-related urethral strictures. The trend does not obtain if we interrogate the spectrum of stricture presentation in the rural setting or in towns away from Nairobi where infective causes appear to have an upper hand (20). From above results, the outcome of patients undergoing both revision and fresh urethroplasty significantly depended on EPA procedure and staged/ flap urethroplasty. Although EPA was the surgical procedure of choice in both study cohorts, a large number of patients undergoing revision urethroplasty still required tissue transfer. Use of tissue transfer, though not common in fresh urethroplasty was significantly common in the revision setting, reflecting the increasing complexity of stricture tissue due to progressive scarring and devascularization. Staged urethroplasty is an operation of resort in long anterior urethral strictures, evident in patients with BXO or failed urethroplasty.

Levine et al in their study of 476 patients who underwent initial urethroplasty, 49 had unsuccessful outcome and ultimately required tissue transfer.[3] BMG for substitution urethroplasty was more proportionately used in revision urethroplasty than in fresh cases. (35.8% vs 32.7%). This association was however not statistically significant. Although a significant number of patients who underwent redo urethroplasty benefitted from EPA (37.3%) tissue transfer is an essential surgical armamentarium in the treatment of patients with recurrent urethral strictures. A success rate of 25.6% associated with staged/flap urethroplasty in this study compares favorably with Jasionowska et al. systematic review which had a success rate ranging between 20-100 %.[6] BMG, the substitution material of choice realized a success rate of 33.3% in this study and therefore fell within the range of 18-100% evident in the systematic review.[1]

EPA procedures should be used in less extensive bulbar strictures in the revision setting, while tissue transfer should be used judiciously in similar setting.[3,9] Longer bulbar urethral strictures may require BMG urethroplasty. In longer strictures that may require more than one buccal graft tissue or in severe distal urethral strictures, flap surgery is a better alternative.[9] A systematic review of redo urethroplasty outcomes by Jasionowska et al identified varying trends of effectiveness for revision urethroplasty in different locations.[1] These studies, small and observational, found that bulbar located strictures had a success rate of 58-100%, and posterior 69-100% in recurrent strictures. In the present study, success rates of 54% and 25% for bulbar and posterior urethral strictures respectively, were below the expected range.

Patient's social habits and comorbidity did not significantly affect urethroplasty outcomes in both cohorts. Social habits included alcohol consumption and or cigarette smoking. Each social habit either alone or in combination was matched with either cohort, but no association emerged.

Levine et al. just like in the present study did not find a significant correlation between tobacco consumption,comorbid conditions and urethroplasty outcome in both study cohorts.[3] Breyer et al in a multivariate analysis of risk factors for long-term urethroplasty outcome, found a significant correlation between smoking and urethroplasty outcome. He established that smokers got worse outcome from tissue transfer urethroplasty.[5]

Sinha et al established that BMG urethroplasty had a significantly reduced success rate of 58.3% in active tobacco consumers compared with 94.4% in non-consumers.[22]

Overall, post-operative complications, especially dribbling, incontinence and fistula formation significantly affected a greater number of patients undergoing revision urethroplasty than they did for the fresh urethroplasty cohort (62.7% Vs. 20.8%, $p<0.001$). Fistula formation significantly affected both revision and fresh urethroplasty groups though more common in the revision cohort (9% Vs 1.2%, $p=0.008$). That, those patients with unsuccessful urethroplasties, have less healthy available local tissue for reconstruction with extensive scarring and precarious blood supply, predisposes them to fistula formation.[1,5,15] Moreover, multiplicity of surgeries may further cause tissue devascularization and scar formation. The frequency of post-micturation dribbling was significantly different in both study groups. More patients in the revision cohort had dribbling post urethroplasty than in the fresh cohort (19.4% vs 1.8%). This rate is similar to that reported in literature.[3,16] Sequestration of urine in the urethra postoperatively and reduced

perineal muscle tone can lead to post void dribbling. Posterior urethroplasty interferes with the function of external urethra sphincter leading to urinary incontinence.

Other complications did not significantly affect the outcome in both study groups. All the complications evident were mild to moderate and in keeping with grade 1 or 2 Clavien-Dindo classification and therefore amenable to conservative treatment. Erectile dysfunction (ED) occurred in 16 (6.8%) of patients from both cohorts. However, no alteration was found in new-onset or pre-existing ED in both groups. Post-operative ED was evident in all stricture aetiologies, locations and amongst patients undergoing different surgical procedures. From the above results, sexual function was not altered significantly post urethroplasty in both groups. These findings are similar to those of Levine et al. who found 5% adverse change in all patients undergoing urethroplasty in their series and affecting different aetiologies, stricture location and types of surgeries.[3] Dogra et al. in a prospective study established that ED may occur in up to 20% of patients but majority resolved in the first 6 months.[23] Erickson et al in a prospective analysis of 52 patients who underwent anterior urethroplasty found erectile dysfunction in nearly 40% of cases but these, like in the Dogra's series improved within 6 months.[24] The incidence of Urinary tract incontinence, UTI and orchitis was proportionately higher in the redo cohort compared to the fresh group. Chordee et al. and donor site scar were only seen in the revision group. Penile chordee in this series may be a factor of multiplicity of surgeries culminating in scar formation and penile shortening especially in the penile urethra.[3,19] The greater proportion of UTI evident in the revision group is in accord with other quoted rates of UTI in long-term follow-up in some series(3,19).The risk of UTI may arise due to detrusor dysfunction consequent to chronic urinary tract obstruction and or tissue substitution in the urethra(3).Overral,the complication rate arising from this study was low and in keeping with studies elsewhere.[16,17]

In the current study, there was no significant statistical difference in the comorbidity rate between fresh urethroplasty and repeat ones. In a multivariate analysis of long-term urethroplasty outcomes, Breyer et al confirmed that none of the examined Comorbid conditions impacted on the outcome of urethroplasty (5). Han et al in a retrospective review of 347 urethroplasty-naive patients who underwent urethroplasty by a single surgeon over a 10 year period and followed-up for at least 12 months, found no significant association between outcome and comorbidities (25).

Study limitation

The study has limitations inherent to a retrospective setting. Prospective evaluation of relevant parameters may help to refine and enhance reliability of results. A randomized trial comparing urethroplasty techniques and incorporating cost- effective analysis would be more informative. The selection of patients for revision was not limited to a particular anatomical location, length of stricture or by the number of times urethroplasty had been performed. Evaluation of principal outcome measures was to a large extent based on non -anatomical variables due to cost limitations associated with these tests. Duration of follow-up ranging between 6 and 36 months was insufficient as results are bound to change with time. Furthermore, inadequate documentation may have had an influence on the overall outcome.

CONCLUSION

Revision urethroplasty is feasible even after failed urethroplasty though less efficacious. Stricture length, number of prior surgery and procedure choice affect outcome.EPA and Tissue Transfer techniques are essential surgical armamentarium in the revision setting.

ETHICAL CLEARANCE

The study was approved by the Kenyatta National Hospital and University of Nairobi Ethics and Research Committee, Nairobi- KENYA (email: uonknh_erc@ uonbi.ac.ke website: http://www.erc.uonbi.ac.ke). Approval number (P446/06/2016).

CONFLICT OF INTEREST

The authors hereby confirm that they have no competing interest concerning this manuscript.

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COMMON ABBREVIATIONS.

EPA-Excision and Primary Anastomosis,
BMG-Buccal Mucosa Graft,
DVIU-Direct Vision Internal Urethrotomy,
BXO-Balanits Xerotica Obliterans,
ED-Erectile Dysfunction,
UTI-Urinary Tract Infection,
PROM-Patient Reported Outcome Measures,
TURP-Transurethral Resection of Prostate,

TURBT-Transurethral Resection Bladder Tumour,
AUA-SI-American Urological Association -Symptom Index,
PRU-Post-void Residual Urine,
MCU-Micturating Cystourethrogram,
GSW-Gun Shot Wound,
KNH-Kenyatta National Hospital,
SPSS-Statistical Package for Social Scientists,
RUG-Retrograde Urethrogram,
< Less than,> more than.

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