DOI: 10.4081/aiua.2025.13695

ORIGINAL PAPER

Buccal mucosal graft for onlay ureteroplasty in the management of proximal ureteral stricture. Single centre, prospective trial

Ahmed Salah Nasef, Ibrahim Alaa Eldin Tagrida, Mohamed Fawzy Salman, Adel Elatreisy, Sabry Mahmoud Khaled

Urology Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

Summary ***Objectives: To evaluate the outcomes of oral buccal mucosa graft (BMG) ureteroplasty in managing recurrent long-segment proximal ureteric strictures and recurrent uretero-pelvic junction obstruction (UPJO).***
Methods: A single-centre prospective study included patients with recurrent long-segment proximal ureteric strictures and recurrent UPJO treated with open onlay BMG ureteroplasty from January 2022 to September 2024. Patient demographics, intraoperative and postoperative characteristics, and the percentage of stricture-free status at the last visit were documented. Complication rates were categorized according to the modified Clavien-Dindo grading system.
Results: The study included 21 patients, 11 males (52.4%) and 10 females (47.6%), with a mean age ± SD of 45.8 ± 13.7 years. Regarding the stricture etiology, Ten patients (47.6%) had previously undergone complicated endoscopic stone surgeries, seven patients (33.3%) had a history of open surgery for stone disease, while the remaining four (19%) had undergone previously failed pyeloplasty for congenital UPJO. The mean operative time was 145 minutes, the mean stricture length ± SD was 3.94 ± 1.4 cm, and the mean harvested BMG length ± SD was 7.6 ± 1.1 cm. Six patients (28.6%) developed postoperative complications of Clavien II and III grade. The follow-up duration ranged from 9 to 24 months, with a mean duration of 16.3 months. At the last follow-up visit, 18 out of 21 patients (85.7%) were stricture-free.
Conclusions: Buccal Mucosa Graft for onlay ureteroplasty represents an effective surgical intervention for managing recurrent, long-segment proximal ureteric strictures and recurrent cases of ureteropelvic junction obstruction.

KEY WORDS: Stricture; Ureter; Buccal Mucosa, proximal.

Submitted 6 February 2025; Accepted 6 February 2025

INTRODUCTION

Surgical management of long proximal ureteral strictures presents significant challenges in clinical practice. Surgical options, such as ileal ureter replacement and renal autotransplantation, can be considered for addressing these conditions. However, both procedures are associated with complexities and a substantial risk of morbidity (1). In 1999, *Naude* (2) introduced an alternative and innovative technique for treating ureteric strictures by utilizing *buccal mucosa grafts* (BMG) in conjunction with omental wrapping. Implementing onlay BMG during ureteral reconstruction eliminates the necessity for extensive ureterolysis, reducing disruption to the peri-ureteral blood supply. Furthermore, the BMG can be customized to accommodate the dimensions of the ureteral defect, ensuring a tension-free anastomosis (3).

Although BMG ureteroplasty for long-segment ureteral strictures was developed long ago, evidence is still restricted to case series in the literature.

The current study aims to evaluate outcomes of onlay BMG ureteroplasty for recurrent, long-segment proximal ureteric strictures and recurrent *uretero-pelvic junction obstruction* (UPJO).

PATIENTS AND METHODS

Study design and patient selection

The present study is a prospective trial conducted at the *Urology Department, Faculty of Medicine, Al-Azhar University in Cairo, Egypt*, from January 2022 to September 2024.

Following approval from the local institutional review board, the study was duly registered on *ClinicalTrials.gov*, with a registration ID of NCT05928364.

The cohort comprised patients with recurrent long proximal and middle ureteric strictures and recurrent UPJO not amenable to primary anastomosis due to stricture length or extensive fibrosis.

Before surgical intervention, all patients underwent comprehensive medical history assessments, physical examinations, and standard laboratory investigations.

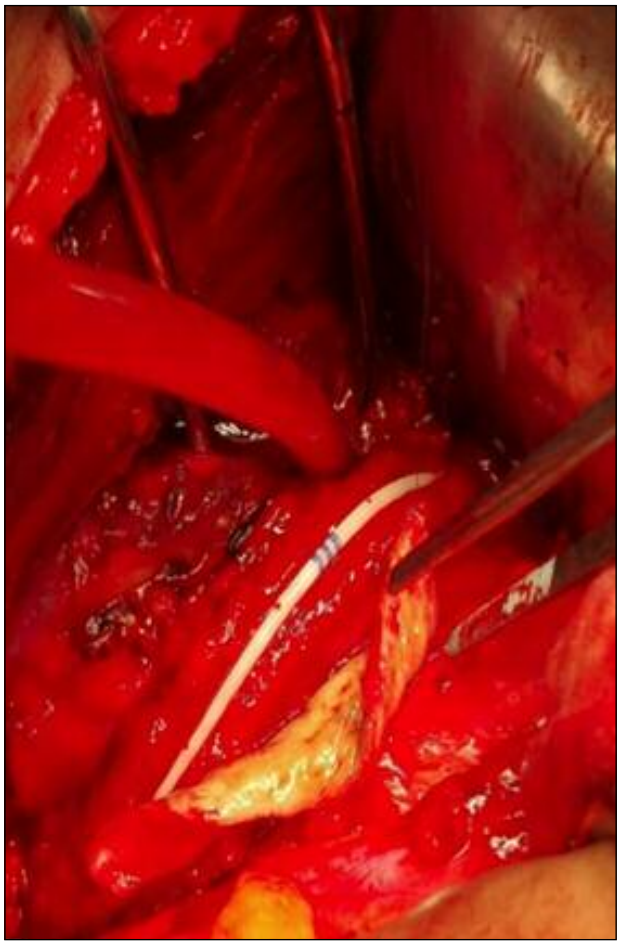
For preoperative imaging, abdominal ultrasound and renal isotope scans were conducted for all participants. Antegrade pyelography was performed in cases with a fixed *percutaneous nephrostomy* (PCN) tube. *Computed Tomography* (CT) urogram was requested when clinically indicated.

All enrolled patients underwent open ureteroplasty utilizing onlay BMG and omental wrapping.

Operative technique

Under general anesthesia, retrograde ureteropyelography was performed for all cases to assess the exact stricture

Figure 1.
Opened ureter in the site of stricture, buccal mucosa graft was sutured to the ureteral defect with a double-J ureteric stent.



length, and combined antegrade and retrograde ureteropeylography were used in patients with fixed PCN. Patients were placed in the lateral lumbar position, and the incision was performed to access the affected site of the ureter.
The diseased ureteral segment was identified and longitudinally incised from the lateral side. After incising the stricture segment, we kept it as a plate, and the exact length of the defect was measured. The BMG was harvested from the inner cheek after identification of the Stensen duct. Each graft had a varying length that followed the size of the ureteral defect. The harvested mucosal graft was laid on the incised ureters as an onlay graft (Figure 1) and sutured with vicryl 4/0 with antegrade 6 Fr *double-J* (DJ) ureteric stent. The omentum was then mobilized and wrapped around the reconstructed site of the ureter.

Follow up
Patients were monitored for blood tests and drain output during the early postoperative period. As part of their treatment regimen, they received anti-inflammatory and antibacterial therapy and were discharged after the drain was removed. The Foley catheter was removed once the drain output was nil for 48 hours. The drain was also removed if there was no output for 24 hours following the removal of the Foley catheter.
For patients with a fixed PCN, it was closed for 48 hours once the drain output was nihil and removed if there was no pain or fever. The DJ ureteral stent was scheduled for cystoscopy and was removed approximately six to eight weeks postoperatively. The hydronephrosis grade was assessed according to the *Society of Fetal Urology* (SFU) classification, and renal function was evaluated with a renal isotope scan 3 to 6 months after surgery.

Outcomes
The analysis will encompass patient demographics, intraoperative data, perioperative complications as classified by the modified Clavien-Dindo grading system (5), duration of follow-up, and the percentage of patients remaining free of strictures at the final assessment.
A good postoperative outcome was considered being asymptomatic, the absence of hydronephrosis or grade 1, a patent ureter on contrast study after removal of the ureteric stent (Figures 2-4), and a non-obstructed curve in the diuretic renogram.

Statistical analysis
Statistical analysis was conducted using SPSS statistical software version 29.0 (*IBM, Chicago, USA*). Continuous data are presented as means and standard deviations. Nominal data are reported in terms of counts and per-

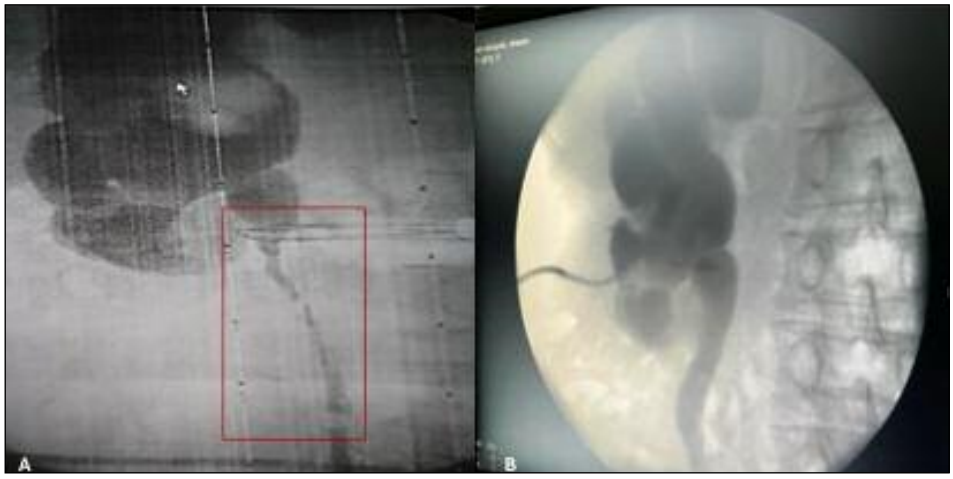


Figure 2.
A: Preoperative retrograde uretero-pyelography revealed recurrent long-segment stricture of the proximal right ureter.
B: Post onlay buccal mucosa graft ureteroplasty with antegrade nephrostogram showing patent right ureter.

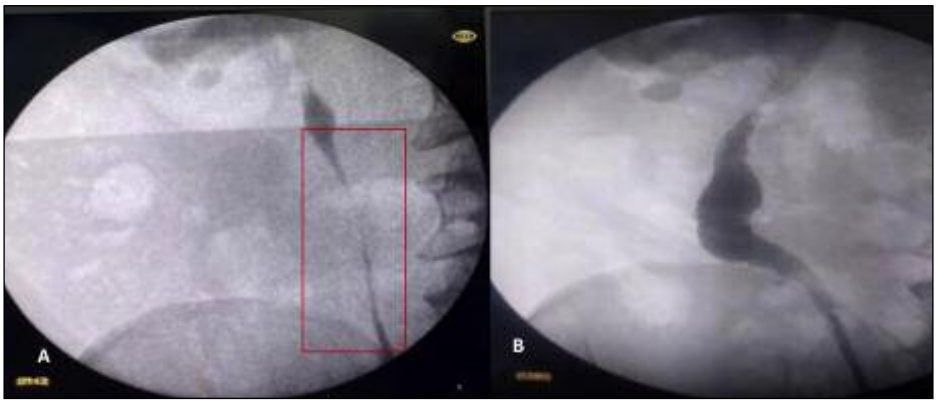


Figure 3.
A: Preoperative retrograde uretero-pyelography revealed a 3 cm recurrent stricture of the proximal right ureter.
B: Post buccal mucosa graft onlay ureteroplasty with RGP showing patent right ureter and wide graft area.

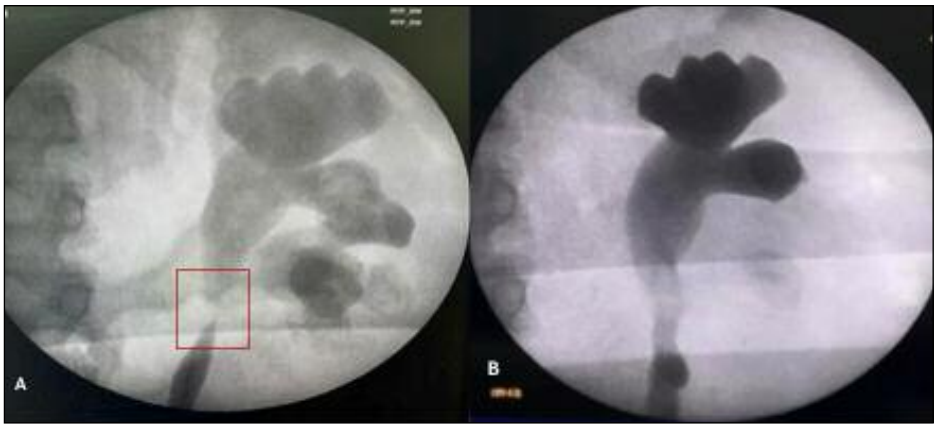


Figure 4.
A: Preoperative retrograde pyelography (RGP) revealed a 2 cm recurrent stricture of the proximal left ureter and failed previous four times ureteroplasty procedures.
B: Post onlay buccal mucosa graft ureteroplasty with RGP showing patent left ureter and wide graft area.

centages. Depending on the data type, the paired-sample t-test was utilized to compare preoperative and postoperative parameters. Differences were considered statistically significant at a threshold of $p < 0.05$.

Results

Twenty-one patients were included, comprising 11 males (52.4%) and 10 females (47.6%). The mean age of the cohort was 45.8 years. Eleven (52.4%) were found to have DJ stents, five (23.8%) had fixed *percutaneous nephrostomy* (PCN) tubes, and the remaining five presented solely with loin pain without any fixed catheters or tubes.

Regarding the etiology of the stricture, ten patients (47.6%) had complicated endoscopic ureteric stone surgeries, including four patients (19%) who underwent semirigid *ureteroscopy* (URS), and six patients (28.6%) who underwent retrograde intrarenal surgery. Seven patients (33.3%) had a history of open surgery for stone disease, while the remaining four (19%) had undergone pyeloplasty for UPJO. The mean stricture length ± SD was 3.94 ± 1.4 cm, and the mean harvested BMG length ± SD was 7.6 ± 1.1 cm. Patients' demographic data are demonstrated in Table 1.

The operative time ranged from 105 to 205 minutes, with a mean duration of 145.71. *Estimated blood loss* (EBL) during surgery varied between 50 and 300 ml, with an average of 157.14 ml (Table 2). The average *length of hospital stay* (LOS) was 4.28 days.

Table 1.
Demographic data of the study cohort.

Parameter	Value
Age, mean ± SD	45.76 ± 13.7
Sex, N (%)	
Male	11 (52.4)
Female	10 (47.6)
BMI, mean ± SD	30 ± 3.8
Stricture Location, N (%)	
UPJ	4 (19%)
Proximal	14 (66.7%)
Middle	3 (14.3%)
Laterality, N (%)	
Right	12 (57.1%)
Left	9 (42.9%)
Stricture length (cm), mean ± SD, (range)	3.94 ± 1.4 (2-6.5)
Etiology of the ureteric stricture, N (%)	
Complicated Ureteral stone surgery by RIRS using Laser	6 (28.6%)
Complicated Ureteral stone surgery by URS	4 (19%)
Iatrogenic during open surgery	7 (33.3%)
Congenital UPJO	4 (19%)
Previous open ureteroplasty procedures for the same stricture pathology, N (%)	
One time	9 (42.6%)
Two times	4 (19.1%)
Three times	6 (28.6%)
Four times	1 (4.8%)
Five times	1 (4.8%)
Preoperative urinary drain, N (%)	
Double-J ureteric stent	11 (52.4%)
Nephrostomy	5 (23.8%)
No diversion of urine	5 (23.8%)

SD: Standard deviation; BMI: Body mass index; UPJ: Ureteropelvic junction; RIRS: Retrograde intrarenal surgery; URS: Ureteroscopy; UPJO: Ureteropelvic junction obstruction.

Table 2.
Operative and postoperative characteristics of the study cohort.

Parameter	Value
BMG length (cm), mean ± SD, (range)	7.6 ± 1.1 (5.2-10)
Operative time (min), mean (range)	145.71 (105-205)
Estimated blood loss (ml), mean (range)	157.14 (50-300)
Length of hospital stay (days), mean (range)	4.28 (4-5)
Follow-up duration (months), mean (range)	16.3 (9-24)
Stricture free at last visit, N (%)	18 (85.7 %)
Complication rate according to the modified Clavien-Dindo grading system, N (%)	
Total	6 (28.6%)
Grade II	4 (19%)
Grade IIIa	1 (4.8%)
Grade IIIb	1 (4.8%)

BMG: Buccal mucosa graft.

Table 3.
Comparison between preoperative and postoperative renogram findings and split renal function in the study cohort.

	Preoperative	Postoperative	P-value
Serum creatinine, Mean ± SD	1.31 ± 0.41	1.13 ± 0.26	0.19
GFR, ml/min	36.1 ± 11.28	38.65 ± 12.19	0.48
Split renal function, %	44.53 ± 23.52	47.4 ± 22.83	0.69
SFU grade of hydronephrosis, N (%)			
No HN	0	13 (61.9%)	
Grade 1	0	5 (23.8%)	
Grade 2	14 (66.7%)	0	< 0.001
Grade 3	6 (28.6%)	3 (14.3%)	
Grade 4	1 (4.7%)	0	

SD: Satndared deviation, GFR: Glomerular filteration rate; SFU: Society of Fetal Urology.

No intraoperative complications were observed. However, six patients (28.6%) developed postoperative complications. Two patients experienced urinary tract infections, requiring additional antibiotics (Grade II), and two patients developed wound infections that needed further systemic and local antibiotic treatment (Grade II). One patient developed leakage at the anastomosis site due to migration of DJ stent and was managed with percutaneous nephrostomy tube drainage (Grade IIIa complication). Another patient developed an incisional hernia at the surgical site, which was later surgically repaired (Grade IIIb). There was no complication related to the graft harvested site.

As regards to post ureteroplasty ipsilateral renal function compared to preoperative values, the mean *glomerular filtration rate* (GFR) improved from 36 to 38.7 ml/min, and the *split renal function* (SRF) improved from 44.5% to 47.4% with insignificant p-value as depicted in Table 3.

The follow-up duration ranged from 9 to 24 months, with a mean duration of 16.3 months. At the last follow-up visit, 18 out of 21 patients (85.7%) were stricture-free, while three (14.3%) had failed ureteroplasty and were kept on permanent DJ-ureteric stents to be exchanged annually.

Discussion

Proximal long ureteric strictures are complex and challenging to treat in reconstructive urology. Such complex cases require major urologic procedures to treat, including ileal ureter replacement and renal autotransplantation. Onlay BMG ureteroplasty is a less morbid operative technique to treat these conditions (6).

Intestinal interposition carries risks such as bowel anastomosis leakage, impaired bowel movement, urinary tract obstruction, and recurrent UTIs. Prolonged urine exposure to ileal mucosa may also lead to metabolic acidosis (7).

Kidney autotransplantation for ureteric strictures is a complex procedure; complication rates range from 33% to 46%, with a transplantation failure rate of about 11%. Common complications include issues with vascular anastomosis, such as thrombosis and hemorrhages (8).

Alternative surgical options for proximal ureteric strictures include the utilization of appendiceal onlay or tubularized bladder flaps. However, there are notable drawbacks associated with appendiceal interposition, particularly regarding the availability of the appendix and its significant variability in length, which may result in a 10-20% incidence of insufficiency. Furthermore, a transperitoneal approach is required for the implementation of appendiceal interposition. In contrast to bladder flaps or transposition techniques, BMG ureteroplasty preserves the natural vesicoureteral anti-reflux mechanism (9).

The EAU guidelines recommend BMG as an option for long-segment ureteral stricture, especially after a previous failed reconstruction, with an average overall success rate of 90%, but experience is limited (10).

The buccal mucosa is readily accessible for harvesting, exhibits lower susceptibility to immune responses, and can withstand urinary tract pathogens. While buccal mucosa grafting is extensively employed in reconstructive urethral surgery, BMG ureteroplasty is also gaining popularity, particularly in cases where achieving a tension-free anastomosis proves challenging through ureteroureterostomy. This technique is especially beneficial for patients experiencing recurrent ureteral strictures who have previously undergone unsuccessful ureteroplasty characterized by peri-ureteral scarring and inadequate ureteral vascularization (11).

Our study included 21 patients, 17 with recurrent long segment upper ureteral stricture and 4 with prior failed repair for UPJO treated with on lay BMG ureteroplasty. We reported a high success rate of 85.7%. No intraoperative complications were observed.

Heijkoop and Kahokehr carried out a systematic literature review of surgical outcomes in 72 patients with ureter strictures who underwent BMG ureteroplasty (including 34 open and 38 robotic) from 15 articles. The overall success rate was reported as 91.6%, and the rate of complications, with Clavien grades ≥ 3, was 5% (12). Our results are comparable to the results of these trials.

In the present study, six patients (28.6%) experienced minor postoperative complications classified as Clavien grades II and III, with no instances of complications rated at Clavien grade ≥ 3. This indicates a low morbidity rate associated with this procedure, particularly in comparison to the complications associated with alternative treatment options for this condition, such as ileal transposition.

Using the omentum to wrap the grafted area gives the confidence that the augmented area is more supported and postoperative leakage may be minimized. Engelmann and his colleagues performed 14 cases of ureteroplasty with BMG without omental wrap, and 13 cases (92.9%) were stricture-free; their findings indicate that the perirenal and retroperitoneal fat surrounding the BMG is an adequate substitute for this mechanism. The omission of omental wrapping facilitates a strictly extraperitoneal approach, which spares the intestines and decreases the risk of impaired bowel function or ileus (9).

In all cases, we utilized the omentum to encase the grafted region; however, the observed success rate was 87.5%, slightly lower than that reported in previous studies. All cases in the current study involved recurrent strictures that had undergone failed surgical interventions up to four to five times in certain instances. The presence of severe fibrosis in several cases contributed to these failures. Nonetheless, our findings indicate a commendable success rate.

Cases of recurrent UPJOs after prior failed pyeloplasty are another challenging condition due to increased perireteral and peri pelvic scarring and fibrosis in the previous surgical area. Most studies in the literature describe the utilization of a dismembered (transecting) pyeloplasty in cases of recurrent UPJO setting (13-15). BMG ureteroplasty avoids complete transection of the ureter, which may help avoid devascularization of the ureteral blood supply and reduces the need for significant ureterolysis in such cases.

The published data regarding the use of BMG ureteroplasty in managing recurrent UPJOs are limited (16). Our study included four patients with secondary UPJO. The four cases were non-obstructed at the last follow-up (100% success rate). A report of 10 cases of seccondary UPJO repaired via robotic BMG ureteroplasty showed an 80 % success rate (8 out of 10 cases) with a low complication rate (16).

In summary, we present the findings of the first prospective study assessing the outcomes of BMG ureteroplasty with omental wrap in cases of recurrent long-segment ureteric strictures and recurrent *ureteropelvic junction obstruction* (UPJO). Our results indicate a success rate of 85.7% and a postoperative complication rate of 28.6%, primarily involving low Clavien grades II and III.

Study limitations

The present study acknowledges several limitations. Firstly, it is not a comparative analysis; the procedures used open surgical techniques. Notably, current practices in BMG ureteroplasty increasingly incorporate laparoscopic and robotic methodologies. Furthermore, a critical need exists for direct prospective randomized studies featuring a substantial sample size to compare BMG ureteroplasty with alternative treatment options for long-segment ureteral strictures.

Conclusions

Our study indicates that onlay Buccal Mucosa Graft ureteroplasty represents an effective and safe surgical intervention for managing recurrent, long-segment ureteral strictures and recurrent cases of ureteropelvic junction obstruction.

References

1. Yang K, Fan S, Li Z, et al. Lingual mucosa graft ureteroplasty for ureteral stricture: a narrative review of the current literature. Ann Palliat Med. 2021; 10:4840-4845.

2. Naude JH. Buccal mucosal grafts in the treatment of ureteric lesions. BJU Int. 1999; 83:751-754.

3. Lee Z, Keehn AY, Sterling ME, et al. A review of buccal mucosa graft ureteroplasty. Cur Urol Rep. 2018; 19:1-6.

4. Yang CH, Lin YS, Weng WC, et al. Validation of robotic-assisted ureteroplasty with buccal mucosa graft for stricture at the proximal and middle ureters: the first comparative study. J Robot Surg. 2022; 16:1009-17.

5. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004; 240:205-213.

6. Sahay SC, Kesarwani P, Sharma G, and Tiwari A. Buccal mucosal graft ureteroplasty: The new normal in ureteric reconstructive surgery - Our initial experience with the laparoscopic and robotic approaches. J Minim Access Surg. 2024:10-4103.

7. Kocot A, Kalogirou C, Vergho D, and Riedmiller H. Long-term results of ileal ureteric replacement: a 25-year single-centre experience. BJU Int. 2017; 120:273-279.

8. Ruiz M, Hevia V, Fabuel JJ, et al. Kidney autotransplantation: long-term outcomes and complications. Experience in a tertiary hospital and literature review. Int Urol Nephrol. 2017; 49:1929-1935.

9. Engelmann SU, Yang Y, Pickl C, et al. Ureteroplasty with buccal mucosa graft without omental wrap: an effective method to treat ureteral strictures. World J Urol. 2024; 42:116.

10. EAU Guidelines. Edn. presented at the EAU Annual Congress Milan March 2023. pp 17-19. ISBN 978-94-92671-19-6.

11. Guliev BG, Komyakov B, Avazkhanov Z, et al. Laparoscopic ven-

Declarations

Ethical approval and consent for participate: *This study was conducted by the principles outlined in the Declaration of Helsinki. Approval was obtained from the local institutional review board of the Urology Department at the Faculty of Medicine, Al-Azhar University, located in Cairo, Egypt. All participants provided their informed consent by signing the necessary forms. The methods employed adhered strictly to the relevant guidelines and regulatory standards.*

Availability of data and material: *Available from the corresponding author on a reasonable request.*

Competing interests: *There are no conflicts of interest involving any of the authors in relation to the subject matter discussed in this article.*

Funding: *No funding was received.*

Authors' contributions: *A.S.N and I.A.T. conceptualized the article; M.F.S. wrote the initial manuscript; and A.E and S.M.K. reviewed and edited the main manuscript.*

Acknowledgments: *Not applicable.*

tral onlay ureteroplasty with buccal mucosa graft for complex proximal ureteral stricture. Int Braz J Urol. 2023; 49:619-627.

12. Heijkoop B, Kahokehr AA. Buccal mucosal ureteroplasty for the management of ureteric strictures: A systematic review of the literature. Int J Urol. 2021; 28:189-195.

13. Sundaram CP, Grubb RL, Rehman J, et al. Laparoscopic pyeloplasty for secondary ureteropelvic junction obstruction. J Urol. 2003; 169:2037-2040.

14. Hammady A, Elbadry MS, Rashed EN, et al. Laparoscopic repyeloplasty after failed open repair of ureteropelvic junction obstruction: a case-matched multi-institutional study. Scand J Urol. 2017; 51:402-406.

15. Atug F, Burgess SV, Castle EP, Thomas R. Role of robotics in the management of secondary ureteropelvic junction obstruction. Int J Clin Pract. 2006; 60:9-11.

16. Lee M, Nagoda E, Strauss D, et al. Role of buccal mucosa graft ureteroplasty in the surgical management of pyeloplasty failure. Asian J Urol. 2024; 11:373-376.

Correspondence

Ahmed Salah Nasef
drahmedmero@gmail.com

Ibrahim Alaa Eldin Tagrida
itagreda@yahoo.com

Mohamed Fawzy Salman (Corresponding Author)
prof_mohamed_fawzy@yahoo.com

Adel Elatreisy
adel.elatreisy@azhar.edu.eg

Sabry Mahmoud Khaled
sabri.moussa@azhar.edu.eg

Lecturer of Urology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt