



Use of buccal mucosa graft in robotic-assisted ureteroplasty: experience of a multidisciplinary group in Mexico

Uso de injerto de mucosa bucal en ureteroplastia robótica: experiencia de un grupo multidisciplinario en México

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Abstract

Introduction: Complex ureteral strictures are challenging, particularly after failed surgery. Buccal mucosa graft ureteroplasty combined with robotic assistance may facilitate precise dissection, preserve periureteral blood supply and minimize manipulation. This paper describes the first experience in ureteral reconstruction with BMG with robotic surgery in a referral center in Mexico.

Materials and methods: Retrospective analysis of 5 patients who underwent robotic BMG ureteroplasty from July 2023 to July 2025. Patients had upper or mid-ureteral strictures > 3cm and were not candidates for tension free end-to-end repair. Every intervention was performed by the same team, following a standardized protocol including: use of Indocyanine Green (Intravenous or intraluminal) to identify stricture and vascularization, simultaneous ureteroscopy evaluation and mucosal graft harvesting by a second team. Technique selection- augmented anastomotic ureteroplasty (AAU) vs onlay was based on segment characteristics (luminal obliteration vs narrowing) The follow-up included ultrasound at the 6th week and follow-up on the 6th and 12th months.

Results: Median age was 45 years (36-62 range), female predominance (60 %). Stricture location was ureteropelvic junction in 3 patients (n=3, 60 %), proximal ureter (20 %) and mid-ureter (20 %). 3 patients (60 %) had history of reconstructive surgery. All patients underwent previous ureteral rest. The stricture length was 3.2cm (3-3.5cm range). AAU was performed in (20 %) patients while onlay technique was used in 3 (60 %). We presented 2 early postoperative complications (40 %), Clavien-Dindo I (post-hematoma and urinary tract infection), no major complications. The mean follow-up was 18 months (4-24 range), with no clinical or radiologic recurrence.

Conclusions: Robotic assisted buccal mucosal graft ureteroplasty is an effective and safe technique for ureteral strictures >3cm. Our early results show a 100 % success rate with only mild complications according to the findings on international literature. Larger multicenter cohorts with longer follow-up are warranted to confirm durability and identify predictors of success.

Keywords:

Robot-assisted ureteroplasty,
Buccal mucosa graf,
Reconstructive urology,
Onlay ureteroplasty

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Resumen

Introducción: Las estenosis ureterales complejas conllevan un reto quirúrgico, especialmente en aquellos pacientes con procedimientos quirúrgicos fallidos previos. El injerto de mucosa oral (IMO) ha demostrado ser una opción eficaz en estenosis largas en segmentos proximales, mientras que la cirugía robótica brinda ventajas técnicas que favorecen una disección precisa, preservación de la vascularización, evitar manipulación excesiva y una reconstrucción óptima. Este estudio presenta nuestra experiencia en reconstrucción ureteral con IMO con plataforma robótica.

Material y métodos: Estudio observacional con análisis retrospectivo y descriptivo de cinco pacientes sometidos a ureteroplastia con IMO asistida por robot entre julio de 2023 y julio de 2025. Se incluyeron pacientes con estenosis de uréter proximal y medio, longitud > 3 cm no factible para realizar ureteroplastia término-terminal. Todos los procedimientos fueron realizados por el mismo equipo quirúrgico siguiendo un protocolo estandarizado que incluyó: identificación de la estenosis mediante verde indocianina (intravenoso o intraluminal) y visualización endoscópica, obtención del injerto de mucosa por un segundo equipo. Se decidía realizar una ureteroplastia por aumento (AAU) o colocación onlay del injerto de mucosa según las características del segmento afectado (obliteración luminal o estenosis). El seguimiento postoperatorio consistió en ultrasonido a las 6 semanas y controles a los 6 y 12 meses.

Resultados: La mediana de edad fue de 45 años (rango 36–62), con predominio femenino (60 %). La localización más frecuente de estenosis fue la unión ureteropélvica (3 casos, 60 %), seguida de uréter proximal (20 %) y medio (20 %). Tres pacientes (60 %) tenía antecedente de cirugía reconstructiva previa y todos tuvieron reposo ureteral previo. La longitud promedio del segmentoestenótico fue 3.2 cm (rango 3–3.5). Se realizó en 2 pacientes (40 %) técnica AAU y 3 (60 %) técnica onlay. Las complicaciones postoperatorias fueron dos eventos tempranos (40 %), Clavien–Dindo I (hematoma de puerto e infección de vías urinarias bajas), sin complicaciones mayores. La media de seguimiento fue de 18 meses (rango 4–24), sin recurrencia de estenosis durante el periodo de seguimiento (evaluación radiológica y estatus clínico).

Conclusiones: La ureteroplastia con injerto de mucosa oral asistida por robot es una técnica factible, segura y reproducible para el tratamiento de estenosis ureterales > 3 cm. Nuestros resultados iniciales muestran una tasa de éxito del 100 % y únicamente complicaciones menores, en concordancia con lo reportado en series internacionales. Este trabajo constituye el primer reporte en México y abre la posibilidad de incorporar esta técnica como alternativa reconstructiva en casos seleccionados brindando las ventajas de la plataforma robótica. No obstante, se requieren cohortes multicéntricas con mayor número de pacientes y seguimiento prolongado para confirmar la durabilidad de la reconstrucción y definir factores predictores de éxito o falla.

Palabras clave:

Ureteroplastia asistida por robot, injerto de mucosa bucal, urología reconstructiva, ureteroplastia de superposición

Introduction

Complex ureteral stricture and Ureteropelvic junction obstruction represent an important challenge in patients with previous failed surgical treatments, due to segmented vascularization of the ureter, which comes from multiple branches that run in the adventitia of the ureter, this devascularization compromises healing and

promotes fibrosis with subsequent recurrence of stricture.^(1–3) In this context, the choice of reconstructive procedure must consider the location, stricture length, etiology and patient expectations.

Of the surgical reconstructive options, substitution techniques using bowel segments (e.g.,

ileum), renal autotransplantation, and grafting have been described. Among these, the buccal mucosa graft has gained particular relevance because it lacks hair follicles, demonstrates relative resistance to infection, and maintains good viability in moist environments.⁽⁴⁻⁶⁾ Since its first reported use in humans by Naudé in 1999, BMG has been primarily employed for proximal and mid-ureteral strictures using two main approaches: onlay ureteroplasty and augmented anastomotic ureteroplasty, both associated with high success rates in medium-term follow-up series.⁽⁴⁻⁷⁾

In 2015, Zhao *et al.* published the first series of four cases of complex ureteral strictures managed with BMG using a robotic approach.^(8,9) The introduction of robotic surgery expanded the potential of reconstructive surgery, providing enhanced three-dimensional visualization and articulated instrumentation, enabling more precise suturing and meticulous dissection of tissue planes—critical factors in preserving the vascular supply of the reconstructed segment and hermetic environment of the ureter.^(10,11) Following the initial reports of robot-assisted BMG reconstruction and the subsequent multicenter experiences, promising and reproducible outcomes have been documented for almost a decade.^(8,9,11)

Building on this foundation, we present our institutional experience with robot-assisted ureteral reconstruction using BMG in five cases of complex (proximal/mid) ureteral strictures. To our knowledge, this is the first report in Mexico with this technique. Our aim is to detail the surgical approach and short-term perioperative outcomes, providing evidence of feasibility and safety in our setting, establishing a basis for comparison with international series.

Methods

A retrospective review of 5 consecutive cases from patients undergoing robotic assisted BMG ureteroplasty between July 2023 - July 2025 was made. All surgical interventions were performed by the same robotic surgery experienced reconstructive team (one team for robotic procedure and another for graft harvest)

Patient selection

Patients with evidence of ureteropelvic junction stricture, proximal or mid-ureter stricture, length > 3cm, unable to undergo a no tension end-to-end anastomosis, this was confirmed on retrograde pyelography, CT scan with excretory phase and 3D reconstruction model. Exclusion criteria: patients with distal ureter stricture in which alternative reconstructive procedures were offered. Data was obtained from clinical files, strict confidentiality was enhanced and followed. Written informed consent was obtained from all patients prior to surgery. All patients underwent a period of at least 4 weeks with ureteral rest (only nephrostomy) before the surgery to diminish ureteral and periureteral inflammation.

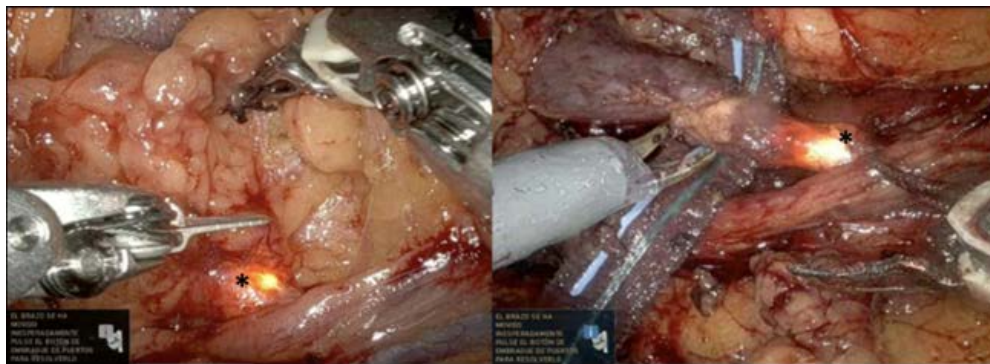
Surgical technique

The procedure began with the patient in the lithotomy position using Allen-type leg supports, to perform ureteral catheterization on the affected side and place a guidewire that would allow simultaneous access with a flexible ureteroscope. Subsequently, the patient was positioned in a 60° lateral decubitus position, with the affected side facing upward and the leg extended to facilitate the introduction of the flexible ureteroscope.

A standard arrangement of four robotic trochars was used on the da Vinci® X and Xi robotic Surgical Systems (Intuitive Surgical, Sunnyvale, CA, USA) platforms: the optic trocar was placed in a supraumbilical position 2 cm above, and three robotic arms (R1, R2, R4) were positioned in triangulation, along with a 5 mm assistant trochar. The instruments used in the ports included monopolar scissors, needle drivers, Pott scissors, Maryland bipolar and ProGrasp Forceps to perform the procedure.

Stricture identification: We used Indocyanine green (ICG) near-infrared fluorescence and flexible ureteroscopy in all the procedures. During the initial dissection of the ureter with minimal touch of it, mostly using periureteral tissue for mobilizing it, careful hemostasis was performed while a second team prepared for retrograde flexible ureteroscopy (Figure 1).

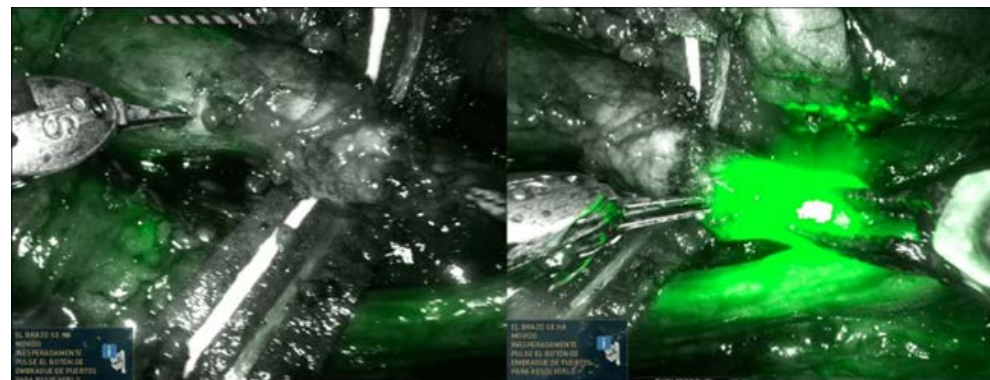
Figure 1.



Intraoperative view from the robotic platform using a flexible ureteroscope. The ureter is visualized at the stenotic site, with the lumen identified (*)

At this time, the combination of intraoperative ureteroscopy and indocyanine green administration (intravenous or intraluminal), allowed precise identification of length and luminal status of the stricture site (Figure 2).

Figure 2.



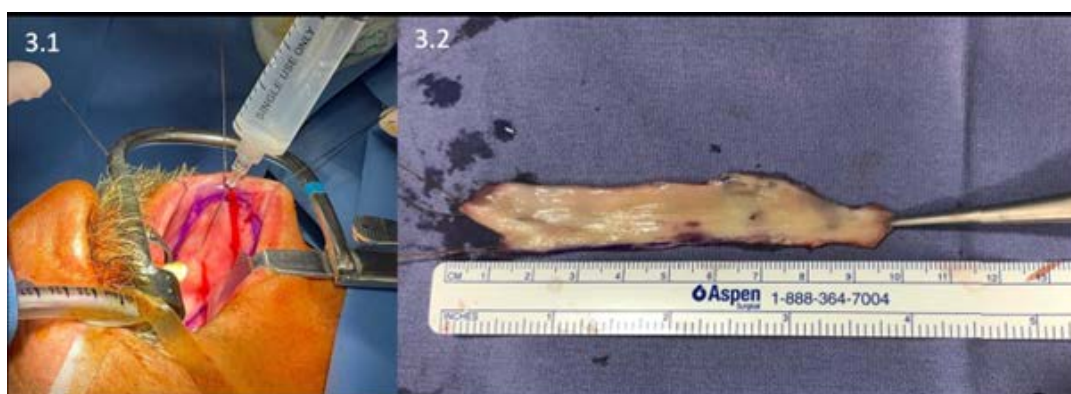
Firefly near-infrared fluorescence (NIRF) on the da Vinci Xi platform demonstrating indocyanine-green uptake in the ureteral lumen (*) and absent uptake at the stenotic segment (+).

The choice of intravenously administrate ICG was made to identify ureteral viability cases of extense fibrosis around the ureter that could compromise ureter blood supply, whether intraluminal administration through nephrostomy and ureteroscope was used when we had luminal obliteration to, allowing us identify the site and length of stricture intraoperatively. The affected segment was dissected in a limited and precise manner, aiming to preserve the peripheral vascularization and minimize the risk of ischemic complications in the anastomosis area. Throughout the procedure, we continued the use of the Tilepro function in the DaVinci console for the surgeon supervise the endoscopic image obtained with the flexible ureteroscope (Storz®, Karl Storz SE & Co. KG, Tuttlingen, Germany).

Harvest of buccal mucosal graft

Working simultaneously in the same operating room: the first team prepared the ureteral bed while the second team harvested the BMG from the oral cavity. This strategy optimized surgical times without compromising patient safety. For graft harvesting, oral-tracheal intubation was made with lateralization of the endotracheal tube contrary to the site of harvest. Traction sutures with 2-0 silk were placed, and a mucosal graft measuring 1.5 cm in width and length according to the stricture was outlined, taking care to preserve the integrity of Stensen's duct (located opposite the second upper molar). After infiltration with saline solution for hydrodissection, the graft was dissected and extracted preserving the buccinator muscle. Finally, residual submucosal tissue was removed to prepare the graft (Figure 3).

Figure 3.



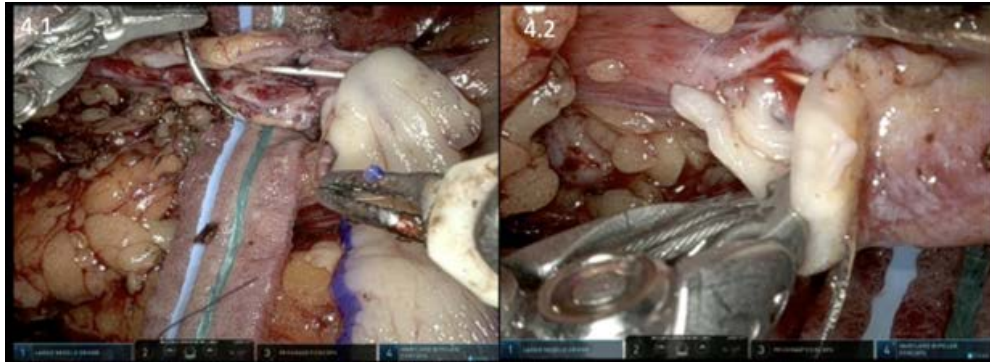
3.1 Intraoral exposure with traction, performing hydrodissection to facilitate dissection. 3.2 The graft is prepared by removing the submucosa to obtain a thin, smooth, pliable graft, which is then tailored for inset

Ureteral anastomosis

With the stricture segment exposed, in an onlay repair, a longitudinal incision was made on the anterior surface of the ureter, fully opening the lumen. The BMG was positioned parallel to the ureter

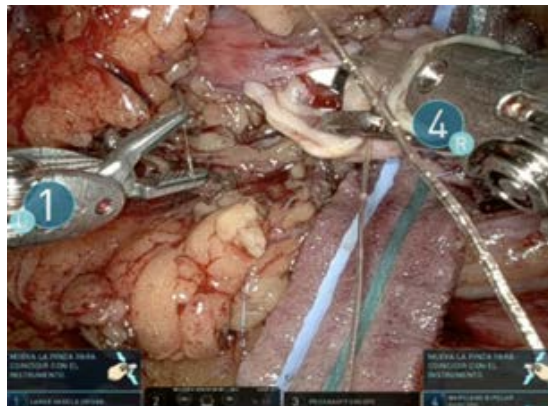
and secured with continuous absorbable suture (Stratafix®TM 3-0), first on the posterior border and then on the anterior border, ensuring a free passage for the ureteral stent. The anastomosis was completed by tying the suture ends (Figures 4 and 5).

Figure 4.



4.1 Graft fixation at the distal ureter to initiate the posterior wall anastomosis. 4.2 Proximal advancement of the guidewire is confirmed, and the graft is tailored with the urothelium oriented toward the lumen.

Figure 5.



Placement of a 6-Fr double-J ureteral stent, followed by completion of the graft anastomosis.

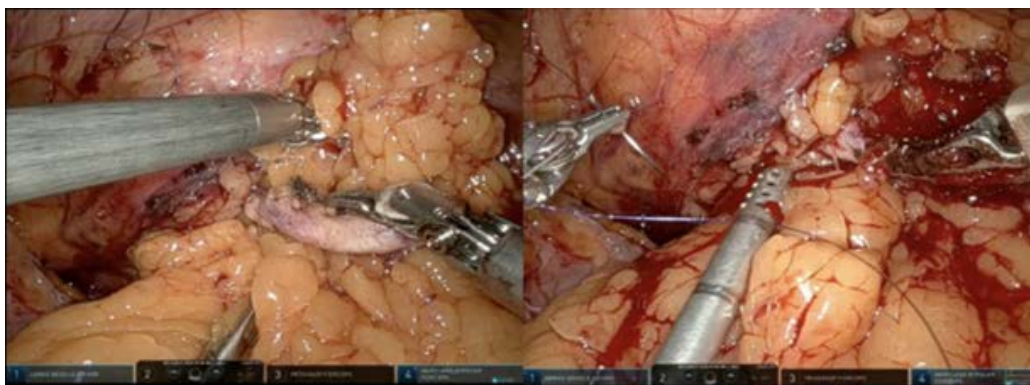
In cases of anastomotic augmented ureteroplasty, once the obliterated segment of the ureter was exposed and incised, 3 interrupted sutures of 4-0 monocryl were put to augment the ureteral lumen and subsequently the graft was positioned onlay for anastomotic closure. Subsequently, the patency of the anastomosis was verified by performing hydrodistension with the flexible ureteroscope and direct visualization.

Omental flap and closure

At the end of the anastomosis, omental flaps were interposed and anchored to the periureteral tissue to ensure fixation and promote vascularization of the graft. In cases performed at the ureteropelvic junction, additional reinforcement with omental coverage was also used (Figure 6). Subse-

quently, hemostasis was verified, the surgical ports were inspected, a 15 Fr Blake drain was placed directed to the surgical site, and the ports were closed conventionally.

Figure 6.



Placement of omentum at the anastomotic site, covering the ureter 360 degrees if possible.

Postoperative follow-up

Patients were discharged between 24 and 48 hours after the procedure, with prophylactic antibiotics and standard care. The ureteral stent was removed after 6 weeks and if a nephrostomy was present, it was removed 1-2 weeks afterward. Follow-up included an ultrasound one month after catheter removal and serial check-ups at 6 and 12 months, monitoring for the absence of hydronephrosis and asymptomatic status as criteria for clinical success. We decided on this follow-up protocol, using the same protocol as the group of Chao *et al.*⁽¹⁰⁾, who recommend that in these patients the most important factor for success is absence of symptoms and ultrasound image without hydronephrosis. In case there's doubt about ureteral patency, they recommend a renal scan with MAG3.

Results

Five patients with complex ureteral stricture were included, these patients underwent robot-assisted BMG reconstructive surgery, one of them with DaVinci® X system and 4 Xi (Intuitive Surgical, Sunnyvale, CA). Median age was 45 yo (36-62 yr range), women predominance was observed (3 women; 2 men). 3 out of 5 cases had an etiology of lithiasis (due to impacted ureteral stones and post-endopyelolithotomy + multiple renal stone extraction surgeries) and 1 due to pyeloplasty stricture caused by an aberrant vessel. In all cases, the stricture was located on the left ureter. 3 patients had a history of a previous reconstructive surgery classifying them as complex and highly selective cases for this technique. The most frequent location of the stricture was the ureteropelvic junction (n=3), proximal ureter (n=1) and mid-ureter (n=1). Median stricture length was 3.2cm (3-3.5cm range), extensive enough to rule out tension-free end-to-end anastomosis (Table 1-2).

Table 1. Demographic and preoperative characteristics with complex ureteral strictures N=5

	Result
Age Avarage $\pm$ SD*	45 $\pm$ 10.1 (36–62)
Sex, n (%)	
Male	2
Female	3
Laterality, n (%)	
Left	5
Solitary kidney	1
History of previous reconstructive surgery, n (%)	3
Location of stricture, n (%)	
Ureteropelvic junction	UUP: 3
Proximal ureter	Tercio sup.: 1
Midureter	Tercio medio: 1
Median stricture length, cm (range)	3.2 (3–3.5)
*Standar deviation	

Table 2. Surgical characteristics and surgical outcomes

	n= 5
Robotic system	
DaVinci X Robot	1
DaVinci Xi Robot	4
Técnica Quirúrgica	
Onlay Anterior	2
AAU	3
Ureteral Reconstruction with Oral Mucosal Graft	5
Graft Reinforcement with Omentum	5
Surgical Time (min)	175 (156–190)
Clavien–Dindo Complications	
CD I	2
Follow up (months)	18 (4-24)
Success rate	5

AAU: Augmented anastomosis Ureteroplasty, CD: Clavien–Dindo

Of the perioperative characteristics of the patients, 3 patients had preoperative nephrostomy drainage, which was maintained for up to 2 weeks after the removal of the ureteral stent. This allowed us to perform an ultrasonographic screening prior to removal and ensure the safe withdrawal of the diversion confirming the asymptomatic status of the patient.

In terms of post-operative complications, 2 early events were documented: a robotic trocar-site hematoma and a lower urinary tract infection. Both events occurred within the first postoperative week and were classified as Clavien-Dindo grade I. No major complications or need for reintervention were recorded during the 90-day postoperative period.

All patients remained stricture free during follow-up; median follow-up was 18 months (4-24 months range).

Discussion

To our knowledge, this is the first report in Mexico that documents the use of Robot-assisted OMG for the reconstruction of complex ureteral strictures. Our findings suggest that it is a feasible, safe and effective technique in lesions longer than 3 cm, even in patients with medical history of failed reconstructive attempts, thereby expanding the available alternatives within the national surgical arsenal.

The complexity of this surgery lies in the fact that both the graft harvesting as well as the anastomosis require high technical precision. This challenge is heightened by the segmental vascular supply of the ureter which is dependent on multiple branches that run within the adventitia; when compromised, the risk of ischemia, dehiscence, or restenosis increases.⁽¹⁻³⁾ In our series we prioritize a minimal and exact dissection, supported by the intraoperative use of indocyanine green (administered intravenously or intraluminally), which allows optimal preservation of ureteral perfusion to the maximum and therefore reducing these risks.

When comparing international evidence, our results show a 100 % success rate within the follow-up median time of 18 months, which is consistent with the data in larger multicenter series reporting success rates of 87-92 %.^(8,9) In those cohorts, major complications were described in approximately 8 % of cases (Clavien-Dindo grade III), requiring intervention.⁽⁹⁾ In contrast, our experience included only two minor complications, both grade I (port-site hematoma and lower urinary tract infection), without the need of reinterventions. Likewise, the mean stricture length in our series (3.2 cm) was similar to that reported by Chao *et al.*, in which no differences in outcomes were observed between strictures longer or shorter than 3 cm.⁽⁸⁾ These findings support the applicability of robot-assisted OMG reconstructive surgery in carefully selected patients with extensive strictures.

Nonetheless, we acknowledge important limitations in our study including the small sample size and relatively short follow-up period. Given that recurrences typically occur at a mean of 10–12 months long-term follow-up will be essential to confirm the durability of these results.^(8,9)

Among the strengths of our study, the technical consistency is highlighted, as all procedures were performed by the same reconstructive team, and the systematic approach to the surgical steps, including graft harvesting, anastomosis and the omental reinforcement. Such consistency decreases the surgical variability and facilitates interpretation of the outcomes. These initial findings pave the way for the establishment of an emerging field of minimally invasive ureteral reconstruction in Mexico.

Conclusion

This work represents the first report from Mexico on the use of robot-assisted buccal mucosal graft for the management of complex ureteral strictures. The results, with a 100 % success rate and no major complications, demonstrate that this approach is a viable and reproducible option in selected cases. Its implementation opens new reconstructive possibilities in our field and lays the groundwork for future multicentric research. However, to consolidate the evidence, large multicentric cohorts as well as prospective studies are needed to identify predictors of success and validate the reproducibility of the technique across different surgical contexts.

Conflicts of interest

The authors declare no conflicts of interest

Funding

This research received no external funding.

Ethical considerations

The study was approved by the Ethics and Research Committee of the *Hospital Universitario "Dr. José Eleuterio González", Universidad Autónoma de Nuevo León*, and conducted in accordance with the Declaration of Helsinki.

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