Original Article

Labial mucosal grafting onlay ureteroplasty without omental wrap for ureteral stricture with occlusion: initial results

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Background: The treatment of complex ureteral stricture has always been a hot and difficult topic in urology. The aim of our study is to investigate the feasibility and clinical efficacy of labial mucosal graft (LMG) onlay ureteroplasty without omental wrap for ureteral stricture with occlusion and present our initial experience.

Methods: We retrospectively reviewed perioperative and follow-up data of 12 patients admitted to The First Affiliated Hospital of Chongqing Medical University who underwent the LMG ureteroplasty with ureteral occlusion from April 2022 to September 2023. After stricture and occluded segments were incised longitudinally, the LMG was used to expand the ureteral lumen without omental wrap.

Results: All patients had successful surgery with no intraoperative complications. The median length of ureteral stricture was 3.5 cm (range, 3–5 cm), the median length of the occlusion was 1.5 cm (range, 1–2 cm), the median length of the LMGs is 4.5 cm (range, 4–6 cm). Ureteroscopy confirmed that the reconstructed ureteral lumen was unobstructed except for one patient with thin film-like ureteral stricture. Only one patient had slight contracture at the graft site, which did not affect movement of lip and appearance. No persistent and obvious discomfort was observed at the graft site in the remaining patients.

Conclusions: Our experience suggests that LMG onlay ureteroplasty without omentum wrap appears to be a feasible and safe option for reconstruction of ureteral occlusion.

Keywords: Labial mucosa; ureteral stricture with occlusion; onlay ureteroplasty; initial results; modified ureteroplasty

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Introduction

Ureteral stricture is a condition characterized by the narrowing of the lumen of the ureter due to a variety of reasons (1). Prolonged obstruction of ureter can lead to hydronephrosis and even renal failure (2). The common causes include congenital abnormalities, iatrogenic injury from surgery, ureterolithiasis, post radiation therapy, retroperitoneal fibrosis, trauma, infection, and endometriosis (3,4). With the increasing prevalence of urological endoscopic surgeries, secondary ureteral stricture has gradually increased, and the incidence of ureteral stricture has also increased (1).

There are many methods for the treatment of ureteral stricture, including ureteral reimplantation with psoas hitch, Boari flaps, ureteroureterostomy, renal autotransplantation, ileal interposition graft and so on (5). Among them, ureteral reimplantation with psoas hitch, Boari flaps, ureteroureterostomy have become the standard surgical procedures for distal ureteral stricture, but long proximal or middle ureteral stricture is still a challenge for urological

surgeons (6,7). The traditional standard treatment strategies are ileal ureteral replacement and autotransplantation, but these surgery can lead to serious complications such as metabolic acidosis, ileal obstruction, anastomotic leakage and complications related to vascular anastomosis, which limits their clinical application (8-10).

In recent years, alternative graft materials such as buccal mucosa and lingual mucosa have been successfully utilized in ureteroplasty for long ureteral stricture and gained encouraging outcomes (3,5,7,11-21). However, the complications in donor site cannot be ignored. Complications such as perioral numbness, persistent difficulty opening the mouth, and potential parotid duct injury may occur when buccal mucosa is harvested (22,23). For tongue mucosa sampling, complications such as mild to moderate tongue fine motor impairment, numbness in the donor site, and abnormal taste may occur. Previous studies have reported the successful use of labial mucosa in urethroplasty, with success rates comparable to those of buccal and lingual mucosa, but reports of complications at the site of sampling are scarce and conflicting (24-33). To our knowledge, the use of labial mucosa in ureteroplasty has not been extensively reported in the literature (34). And there is no report on the use of labial mucosa in ureteral stricture with occlusion. Given that labial mucosa has histological characteristics of oral mucosa (OMG) and its successful use in urethroplasty, we consider labial mucosa to be one of the potential graft options for ureteroplasty as well.

Ureteral occlusion, a severe manifestation of ureteral stricture, where the ureter is completely blocked and can result in severe impairment of kidney function if it is not addressed promptly. In previous studies, augmented anastomotic ureteroplasty was chosen for ureteral occlusion (20,21). However, in clinical practice, cases of ureteral occlusion are likely to have severe adhesions and edema around the diseased ureter. Augmented anastomotic ureteroplasty may increase the difficulty of the operation, increase the amount of surgical bleeding, and cause secondary damage to the ureter. In addition, to promote blood supply to the reconstructed ureter, the omentum is wrapped in prior studies. Its necessity deserves further exploration.

To address these challenges, we proposed a modified reconstruction procedure using labial mucosal grafting (LMG) onlay ureteroplasty without omental wrap. This technique aims to reconstruct occluded and stenotic ureters with a focus on minimizing surgical complexity. We herein describe our initial experience in LMG ureteroplasty (LMGU). We hope that our findings will contribute to the development of less invasive and more effective treatment strategies for ureteral stricture. We present this article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-24-266/rc).

Highlight box

Key findings

- Labial mucosa may be an alternative to graft selection.
- For patients with ureteral occlusion, onlay ureteroplasty is expected to become an effective treatment method.
- Grafts can survival without omentum wrapping.

What is known and what is new?

- Buccal mucosa and lingual mucosa have been successfully utilized in ureteroplasty. Anastomotic ureteroplasty has been used in previous studies for reconstruction of ureteral occlusion, and the reconstructed ureter is usually covered with omentum.
- Our study suggests that labial mucosal graft (LMG) onlay ureteroplasty without omental wrap can ensure graft survive and relieve ureteral stricture and occlusion.

What is the implication, and what should change now?

- Our experience suggests that LMG onlay ureteroplasty without omentum wrapping appears to be a feasible and safe option for reconstruction of ureteral occlusion.
- Further expanded clinical trials are needed to confirm the efficacy of LMG onlay ureteroplasty without omentum wrap in ureteral occlusion.

Methods

A retrospective review of patients who underwent LMGU at The First Affiliated Hospital of Chongqing Medical University between April 2022 and September 2023 was conducted. All surgeries were performed by the same surgeon. The indication for this surgery was benign proximal or mid-ureteral stricture with occlusion, which was not suitable for resection and end-to-end anastomosis due to the length of the stricture (>2 cm) or extensive periureteral fibrosis, not suitable for pyeloplasty, preliminary reconstructive surgeries. Malignant ureteral stricture and complete absence of a segment ureter were excluded from this study. The ureteral stricture with occlusion was diagnosed by ureteroscopy and computerized tomography urography (CTU) before surgery. A total of 12 patients were included in this study, of which 1 patient underwent open surgery, 7 patients underwent laparoscopic surgery and

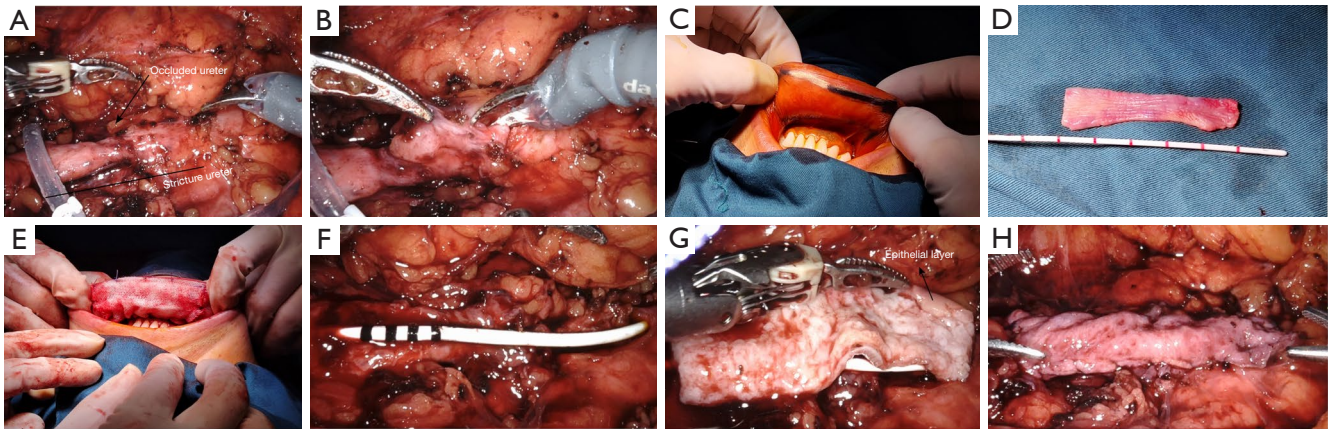

Figure 1 Robot-assisted laparoscopic labial mucosal graft ureteroplasty. (A) Dissect the ureteral stricture with occlusion; (B) incision on the stricture segment of the ureter along the longitudinal axis; (C) mark the labial mucosa to be harvested; (D) the harvested labial mucosa; (E) oil gauze covers the harvesting site; (F) a 6 Fr ureteral stent was inserted into ureter; (G,H) anastomosis of ureteral mucosa and labial mucosa.

4 patients underwent robot-assisted laparoscopic surgery. The choice of surgical approach was primarily based on the surgeon's surgical experience and the patients' economic status, with the latter being the most significant factor due to the higher costs associated with laparoscopic and robotic-assisted procedures. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of The First Affiliated Hospital of Chongqing Medical University (No. K2023-420) and individual consent for this retrospective analysis was waived.

Preoperative preparation

Nephrostomy was performed on the patient 4–6 weeks prior to surgery to relieve obstruction symptoms, relax the ureter, and relieve perinephric, ureteral edema and inflammation. Antegrade and retrograde urography were performed one month later to accurately locate the location and length of ureteral occlusion. 10% povidone-iodine was used to clean the mouth 2 days before surgery. Routine preoperative preparations were performed. CTU was performed to identify the anatomy surrounding the diseased ureter.

Surgical technique

Patient position

After general anesthesia with nasal tracheal intubation, the patient was placed in a lateral decubitus position with a 60° angle with the affected side facing upward.

Incision of ureteral stricture and occlusion

After mobilizing the colon, the ureter was identified and mobilized with a pre-placed ureteral catheter. Then the segment of stricture was exposed completely with healthy ureter 2 cm superior and inferior to the stricture also exposed (*Figure 1A*). With the guide of dilatation of ureter and ureteral catheter, the ureter was incised ventrally along the entire length of the stricture and occlusion (*Figure 1B*). The occluded segment of the ureter was longitudinally incised and used as part of the ureteral wall reconstruction.

LMG harvesting

The site of the harvesting graft on the lower lip was marked after measuring the length of ureteral stricture intraoperatively (*Figure 1C,1D*). To facilitate graft harvesting and minimize bleeding, diluted epinephrine (1:100,000) was injected submucosally. Then the graft was shaped to an appropriate size after removing the submucosal tissue. The donor site was covered with oil gauze by 4-0 Vicryl (*Figure 1E*). Moisten the excised labial mucosa with normal saline and trim excess fibrous and fatty tissue.

Robot-assisted laparoscopic or laparoscopic ureteroplasty

Under the guidance of a guide wire, a double-J (DJ) stent was inserted into the ureter (*Figure 1F*). We used a onlay technique to reconstruct the ureter, which placed

the graft in the diseased ureter as a ventral covering, with the epithelial surface facing the ureteral lumen for ureteroplasty (*Figure 1G*). The suturing was performed in a tension-free manner without omentum wrap (*Figure 1H*). For reconstructed ureteral segments close to the kidneys, perinephric fat was used for coverage if available. In cases where perirenal fat coverage is not possible, only periureteral, which is the retroperitoneal fat near the ureter, was used for wrapping. Fibrin sealant was then applied to the reconstructed ureter. A drainage tube was placed in the surgical gap, and all incisions were closed in layers.

Open surgery

The procedures of open surgery are similar to laparoscopic ureteroplasty.

Perioperative care and postoperative follow-up

When intestinal function is restored, the patient can begin oral intake nutrition and rinse the mouth with 10% povidone-iodine twice a day. The time to remove the drainage tube is when the output of the drainage tube is less than 50 mL/d and there is no concern about urine extravasation. Since we have introduced several surgical innovations, including the use of labial mucosa, onlay ureteroplasty and ureteroplasty without omentum wrap in our study, the DJ stent was removed 8 weeks postoperatively to ensure complete healing of the reconstructed ureter. There may be minor changes in the method of evaluation of postoperative follow-up based on patient history and surgeon preference. Ureterography, ureteroscopy or CTU should be completed 10–12 weeks after surgery to confirm the ureteral drainage. Of these, all patients underwent ureteroscopy to confirm graft survival and patency of the reconstructed ureteral lumen. We have defined patency as the unobstructed passage of a 9.8 Fr ureteroscope through the reconstructed segment of the ureter. If the relevant examination results indicate that the ureteral drainage is unobstructed, the nephrostomy tube will be removed. The patient was followed regularly thereafter. If there is no change in the condition, the follow-up interval will be appropriately lengthened. During the follow-up period, symptom assessment, ultrasound examination, radiological examination, etc. were flexibly used to evaluate the patient's improvement of ureteral stricture and occlusion. Ultrasound examination played a crucial role in our follow-up protocol, providing regular monitoring of hydronephrosis. CTU as an important method of quantifying the degree of hydronephrosis completed during long-term follow-up. The criteria for successful surgery are that the graft survival and improvement of occlusion and stricture confirmed by urography, ureteroscopy or CTU. During long-term follow-up, the patient's hydronephrosis on the affected side did not worsen, and the patient did not complain of low back pain and other discomforts.

Statistical analysis

Descriptive analysis was carried out in this study. Categorical variables were expressed as percentages. Continuous variables were presented as the median. SPSS software was used for statistical analysis.

Results

Of the 12 patients included in the study, nine patients had proximal ureteral occlusion, two patients had middle ureteral occlusion, and one patient had both proximal and distal ureteral occlusion (*Table 1*, Figure S1A-S1C). For patients with multiple segments ureteral occlusion, LMGU was performed for proximal ureteral occlusion, and ureterovesical reimplantation was performed for distal ureteral occlusion. In our study, patients were followed up for a maximum of 26 months, with a median follow-up time of 14 months (*Table 2*). The median length of proximal or middle ureteral stricture was 3.5 cm (range, 3–5 cm). The median length of proximal or middle ureteral occlusion was 1.5 cm (range, 1–2 cm) (*Table 2*). As shown in *Table 2*, the robotic-assisted laparoscopic surgery group had a shorter operative time and less blood loss compared to the laparoscopic surgery group in our study, which may be related to the more precise and larger field of view of robot-assisted laparoscopic surgery.

No complications occurred intraoperatively in any patient. Low-grade complications (Clavien-Dindo I) were observed in 2 patients (17%), both of whom presented with postoperative fever, with the maximum temperature not exceeding 38 ℃. The symptoms were relieved within one day after physical hypothermia. We thought this might be related to the inflammatory reaction caused by surgery. The oil gauze at the patient's oral cavity dropped automatically 2 weeks after surgery, and all patients' lip mucosa was completely healed without bleeding (*Figure 2A*). No serious complications occurred at the donor site (*Figure 2B*, *Table 2*). Five patients developed lower lip numbness in the

Table 1 Baseline data of patients

Parameters	Outcomes
Age (years)	48 [26–63]
BMI (kg/m^2)	24 [18–31]
Gender	
Male	10 [83]
Female	2 [17]
Location	
Proximal	9 [75]
Middle	2 [17]
Multiple segments	1 [8]
Laterality	
Left	4 [33]
Right	8 [67]
Etiology	
Urological endoscopic lesions	11 [92]
Unknown	1 [8]
Prior ureteral reconstruction	1 [8]
Length the stricture (cm)	3.5 [3–5]
Length the occlusion (cm)	1.5 [1–2]

Data are presented as median [range] or n [%]. BMI, body mass index.

Table 2 Summary of perioperative data

Parameters	Outcomes
Length the LMG (cm)	4.5 [4–6]
Width the LMG (cm)	1.3 [1–1.5]
Type of surgical procedure	
Open	1 [8]
Laparoscopic ureteroplasty	7 [58]
Robotic-assisted laparoscopic	4 [33]
Operation time (min)	
Open	260
Laparoscopic ureteroplasty	275 [235–440]
Robotic-assisted laparoscopic	220 [195–235]
Total	260 [195–440]
Estimated blood loss (mL)	
Open	100
Laparoscopic ureteroplasty	100 [50–200]
Robotic-assisted laparoscopic	75 [50–200]
Total	100 [50–200]
Length of stay (days)	11 [11–17]
Surgical complications (Clavien-Dindo)	
No	10 [83]
I	2 [17]
II or above	0
Complications at the grafting site (after 3 months)	
Numb	0
Contracture	1 [8]
Numb and contracture	0
Follow-up (months)	14 [11–26]
Occlusion free after surgery	12 [100]
Stricture free after surgery	11 [92]

Data are presented as median [range] or n [%]. LMG, labial mucosal graft

short term, with recovery of sensation during 3–6 months follow-up. One patient had slight contracture and numbness of the lower lip. Contracture did not affect daily life and eating, nor did it affect appearance. Gradual improvements were achieved during long-term follow-up (*Table 2*).

All the patients had removed the DJ stents 2 months after surgery without flank pain, fever or ureteral fistula. 2–4 weeks after removing the DJ stent, all the patients completed the ureterography or CTU and ureteroscopy. The ureteral obstruction was relieved in all 12 patients. Except for one patient postoperative ureterography showed poor drainage, no hydrops or worsening of stenosis was found during follow-up in the remaining patients (*Table 2*). For case with poor ureteral drainage, ureteroscopy revealed that a membranous fibrous ring formed at the anastomosis between the labial mucosa and the ureteral mucosa, which can be easily broken through (Figure S1D). The ureteroscopy also showed that all the all grafts were alive and healing well, including the case with postoperative stricture (*Figure 3*, Figure S1D, *Table 2*). For the patient with thin film-like ureteral stricture, we placed the ureteral stent once more, which has now been removed, and no worsening of hydronephrosis was noted during subsequent

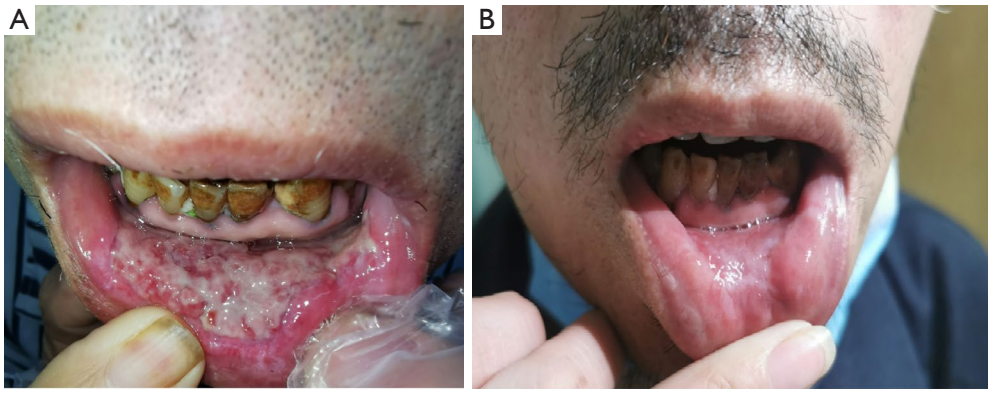

Figure 2 Postoperative photos of the lip donor site. (A) The donor site 2 weeks after surgery; (B) the donor site 1 month after surgery.

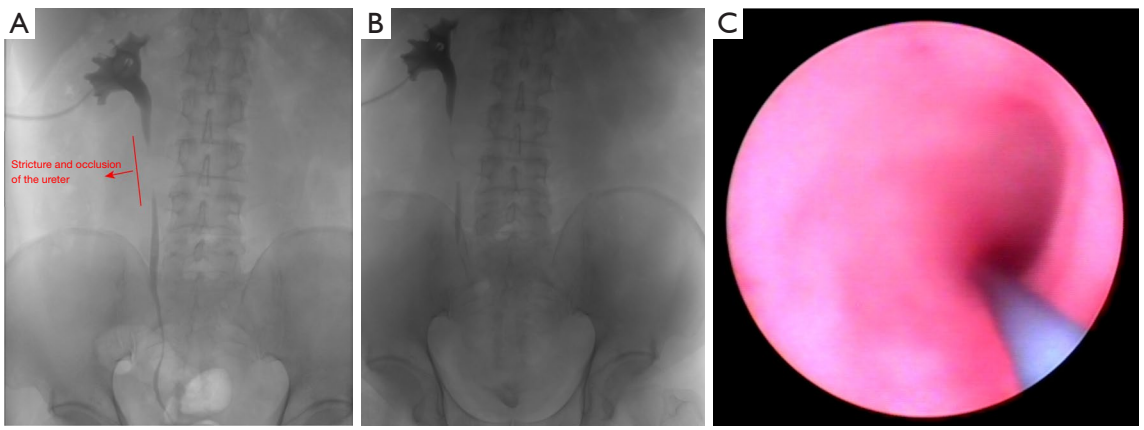

Figure 3 Data from a patient with proximal ureteral stricture and occlusion. (A) Preoperative ureterography showed proximal ureteral occlusion; (B) ureterography 2 months after surgery showed smooth drainage and reduced hydronephrosis; (C) ureteroscopy 3 months after surgery showed that the labial mucosa survived well and the mucosal surface was red.

6-month-long follow-up period.

Discussion

OMG is easy to access and has properties such as being resistant to infection, compatible with moist environments, and hairless. In addition, the OMG has the histological characteristics of thick epithelium, thin lamina propria, and rich capillary plexus, which is conducive to the establishment of new blood supply for patch tissue (7,35). Therefore, OMG is widely recognized as an ideal graft for urinary tract reconstruction (17,18,20). Although the effectiveness of the operations with buccal or lingual mucosa has been proved from the current literature, there are still some problems. As mentioned before, there is a possibility of complications occurring at the buccal mucosal donor site thereby affecting the patient's quality of life. Although the lingual mucosa is easier to obtain than buccal mucosa, the risk of complications is lower, and complications are relatively mild, the intraoperative sampling is still relatively complicated and the incision needs suturing. Therefore, we consider whether labial mucosa can be used for replacement. In addition to having histological characteristics similar to those of the buccal and lingual mucosa, the labial mucosa is easier to harvest and therefore can be easily mastered by the urologist. Moreover, labial mucosa has no special functions, is far away from salivary glands, so the risk of related complications is theoretically lower. Current reports on labial mucosa have focused on urethral reconstruction, and its validity has been largely accepted in urethroplasty. The only study also showed that LMGU has a success rate comparable to other OMG. However,

reports of complications at the labial mucosa harvesting site are controversial. Previous research observed that the main complications at the donor site are pain, contracture and numbness (32,33). These symptoms are generally temporary and resolve within a variable period post-harvest, as reported in the existing literature. However, the comparison of complication rates among the labial, buccal, and lingual mucosal donor sites has yielded inconsistent findings. Some studies suggest no significant difference in complication rates across these sites, while others indicate a potentially higher rate of complications with labial mucosal harvest (24,26,27,29-31). This discrepancy underscores the need for further investigation into the safety and efficacy of labial mucosa as an alternative graft source. In our study, only one patient had mild contracture of the lower lip, but it did not affect patient's eating and appearance, and no obvious movement disorder was observed in the lower lip. Moreover, patients did not experience pain at the harvesting site during the postoperative course, but only complained of numbness, which was relieved during the six-month postoperative follow-up. The low incidence of contracture in our study may be related to moist environment of the wound, rational harvesting of graft, and absence of wound suturing, which can promote faster epithelialization and potentially reducing scarring (36). Moreover, the wound in the mouth barely affects the patient's ability to eat. Patients can start eating small amounts of fluids after observing gastrointestinal peristalsis, and gradually increase the amount of food, usually returning to a normal amount of liquid diet on the second postoperative day. Therefore, we consider that the labial mucosa has certain advantages and is an alternative graft for ureteroplasty.

Different from previous studies, we used the onlay technique to expand the ureteral occlusion segment instead of augmented anastomotic ureteroplasty (20,21). Our result demonstrates the effectiveness of this approach. Postoperative ureteroscopy confirmed that the transplanted labial mucosa in all patients was alive, without anastomotic necrosis, urinary fistula, and the diameter of the transplant site was similar to that of the normal ureter, which could be easily passed by ureteroscopy. For case with postoperative stricture, our ureteroscopy revealed that fibrous proliferation formed a membranous structure at the anastomosis between the OMG and the ureter, resulting in poor drainage. Relief of ureteral stricture was also achieved in this case after one ureteral stent replacement. Compared with other cases, this case had the longest length of stricture and occlusion, and was also combined with lower ureteral stricture and occlusion. Therefore, this case seems to be more prone to ureteral fibrosis, which may be one of the reasons for the postoperative ureteral stricture in this patient. In addition, considering that there may be problems such as contracture after transplantation, the width of the graft can be slightly larger to ensure that the reconstructed lumen is large enough to fully drain urine.

Onlay ureteroplasty is an important innovation in our study to managing ureteral occlusion. It is well known that cases of ureteral occlusion are often associated with severe adhesions, whereas onlay ureteroplasty does not require resection of the occluded segment, which means that this method does not require complete dissection of the ureter and mobilization of the kidneys. Specifically, onlay ureteroplasty only requires the ventral side of the ureter to be freed, so that blood supply on the ureteral surface is preserved to the greatest extent, which is beneficial to the survival of the postoperative graft and the prevention of stricture. Secondly, the onlay technique of longitudinal incision dissects the occluded segment uses it as part of the ureteral wall, which helps to expand the ureteral lumen and achieve tension-free ureteral anastomosis. It is worth mentioning that for some cases in which ureteral inflammation and edema are obvious and surrounding fibrosis is severe, making dissection of the ureter difficult and risky, this method can shorten the operation time and avoid secondary damage to the ureter, which can reduce the possibility of perioperative complications and improve the success rate of surgery. Therefore, we believe that this surgery is feasible in the reconstruction of ureteral stricture and occlusion and provides new ideas and practical evidence for the treatment of ureteral occlusion.

Adequate blood supply is key to successful surgery. In previous studies, it is generally considered that omentum wrapping is crucial, because researchers consider that it has a positive effect on the healing of the anastomosis, helps provide blood supply to the graft (3,20,21). However, we found that the graft can still survive even without using omentum to wrap it. Engelmann *et al.* also recently reported the results of their study of buccal mucosal graft ureteroplasty without omentum wrapping, which only used retroperitoneal or perirenal fat to cover the graft, showing good postoperative mucosal survive (17). We consider that this may be related to preserving the surface blood supply of the ureter as much as possible, blood supply from periureteral or perirenal fat and using fibrin sealant. As mentioned before, considering that the blood supply source of the proximal ureter is mostly located on

the medial side of the ureter, our dissection was limited to the ventral and lateral sides of the ureter which helps to preserve the vital blood supply to the ureteral surface. Besides, the surrounding perirenal or retroperitoneal fat can also provide certain coverage. Moreover fibrin sealant have been reported to promote the formation of granulation tissue, which may also promote the establishment of local blood supply (37). Our results demonstrate the feasibility of not using omentum wrapping and are expected to be extended to longer segments of ureteroplasty. In clinical practice, not using omentum wrapping avoids the impact on the intestines, promotes recovery of bowel function and reduces the operation time. Enteral nutrition can be started once gastrointestinal peristalsis has been observed after the operation to promote postoperative recovery. In addition, patients who recover well after surgery can shorten the length of hospital stay, which can save patients' medical expenses and is more conducive to the reallocation of medical resources. The median length of hospital stay was 11 days in our cohort, which is longer than typically reported due to the unique healthcare context of our country and the implementation of innovative surgical techniques that required extended monitoring for safety. However, the final observations showed that all patients did not experience any serious complications.

In summary, from the results of these 12 patients, we can draw the following conclusions: (I) Like buccal and lingual mucosa, ureteroplasty with LMG is effective in our patients. (II) No serious perioperative complications such as urine leakage occurred, which proved the LMGs could survive after the surgery. (III) For patients with ureteral occlusion, onlay ureteroplasty is expected to become an effective treatment method. (IV) Grafts can survive without omentum wrapping. The effectiveness of this method in longer segment reconstruction needs further study. (V) The mucosa of the donor site recovered well and there were no serious complications. Labial mucosa may be an alternative to graft selection.

The main limitations of this study are the small sample size, short follow-up period, relatively short ureteral stricture segment, as well as its retrospective nature. After our preliminary study has proven the potential clinical value of this procedure, future prospective studies can be carried out to include more patients and observe for a longer period of time to further prove the clinical value of the labial mucosa. Furthermore, we lack further comparative studies with other ureteral reconstruction methods.

Conclusions

The labial mucosa may be an alternative option of buccal mucosa and lingual mucosa. Moreover, onlay ureteroplasty without omentum wrap is expected to become a surgical option that will benefit patients more. Our results will provide urologists with more choice in handling complicated ureteral stricture.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-24-266/rc

Data Sharing Statement: Available at https://tau.amegroups.com/article/view/10.21037/tau-24-266/dss

Peer Review File: Available at https://tau.amegroups.com/article/view/10.21037/tau-24-266/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-24-266/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of The First Affiliated Hospital of Chongqing Medical University (No. K2023-420) and individual consent for this retrospective analysis was waived.

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