Original Article – Reconstructive Urology

Outcomes of Modified Lich–Gregoir Technique in the Management of Iatrogenic Distal Ureteral Injuries

İyatrojenik Distal Üreter Yaralanmalarının Tedavisinde Modifiye Lich–Gregoir Tekniğinin Sonuçları

Short Title: Modified Lich–Gregoir for Distal Ureter Injury (Distal Üreter Yaralanmalarında Modifiye Lich–Gregoir)

Süleyman Şahin[1], Metin Savun[1], Çağrı Şevik[1], Yunus Çolakoğlu[2], Ramazan Uğur[1], Halil Lutfi Canat[1]

[1]Department of Urology, Başakşehir Çam Sakura City Hospital, İstanbul, Türkiye
[2]Department of Urology, İstanbul Arel University, İstanbul, Türkiye

Cite as: Şahin S, Savun M, Şevik Ç, Çolakoğlu Y, Uğur R, Canat HL. Outcomes of Modified Lich–Gregoir Technique in the Management of Iatrogenic Distal Ureteral Injuries. Grand J Urol 2026, DOI: [Epub Ahead of Print]

Submission date: 12 January 2026 **Acceptance date:** 30 April 2026 **Online first: Publication date:**

Corresponding Author: Çağrı Şevik / Başakşehir Çam Sakura City Hospital, Department of Urology, İstanbul, Türkiye / cagri.sevik@hotmail.com / ORCID ID: 0000-0003-0288-704X

ORCID ID: S. Şahin 0000-0002-6043-6354 **M. Savun** 0000-0003-4434-9661 **Y. Çolakoğlu** 0000-0001-6432-765X **R. Uğur** 0000-0002-0593-8589 **H.L. Canat** 0000-0001-6481-7907

Abstract

Objective: To evaluate the surgical outcomes of iatrogenic distal ureteral injury repair using the modified Lich–Gregoir ureteroneocystostomy technique, focusing on perioperative parameters, complications, and long-term functional results.

Materials and Methods: In this retrospective analysis, 23 patients who experienced iatrogenic distal ureteral injuries underwent repair using the modified Lich–Gregoir technique from January 2021 to January 2025. The preoperative evaluation included tests such as serum creatinine, urinalysis, renal ultrasound, and cross-sectional imaging, with selective use of retrograde pyelography or renal scintigraphy. Surgical outcomes were measured by examining ureteral patency, renal function, operative details, and complications, which were categorized using the Clavien–Dindo classification. Patient-reported outcomes were assessed through the Patient Global Impression of Change (PGI-C) scale.

Results: The study included 11 men and 12 women, with a median age of 44 years. Gynecological surgery was the leading cause of injury, accounting for 52.2%, followed by urological surgery at 39.1%, and colorectal surgery at 8.7%. The median duration of surgery was 150 minutes, and patients typically stayed in the hospital for 4 days. A psoas hitch procedure was conducted in 3 patients, representing 13.0% of the group. The median follow-up period was 22 months. All patients (100%) experienced successful surgical outcomes. Complications were noted in two patients, with each experiencing a urinary tract infection and a wound infection, both at a rate of 4.3%. Based on PGI-C scores, 95.7% of patients felt "very much improved," while 4.3% reported being "much improved."

Conclusion: The Lich–Gregoir ureteroneocystostomy, when modified, offers a reliable, safe, and effective surgical solution for treating injuries to the distal ureter caused by medical procedures.

Keywords: iatrogenic disease; surgical procedures; ureteral injuries; ureteroneocystostomy

Özet

Amaç: Bu çalışmanın amacı, iyatrojenik distal üreter yaralanmalarının onarımında modifiye Lich–Gregoir üreteroneosistostomi tekniğinin cerrahi sonuçlarını; perioperatif parametreler, komplikasyonlar ve uzun dönem fonksiyonel sonuçlar açısından değerlendirmektir.

Gereçler ve Yöntemler: Bu retrospektif çalışmaya, Ocak 2021 ile Ocak 2025 tarihleri arasında modifiye Lich–Gregoir tekniği kullanılarak iyatrojenik distal üreter yaralanması onarımı yapılan 23 hasta dahil edildi. Preoperatif değerlendirme serum kreatinin düzeyi, idrar tahlili, renal ultrasonografi ve kesitsel görüntüleme

yöntemlerini içermekteydi. Retrograd piyelografi veya renal sintigrafi seçilmiş olgularda uygulandı. Cerrahi sonuçlar; üreteral açıklık, renal fonksiyon, operatif özellikler ve Clavien–Dindo sınıflamasına göre komplikasyonlar açısından değerlendirildi. Hasta bildirimli sonuçlar Hasta Küresel Değişim İzlenimi (Patient Global Impression of Change, PGI-C) ölçeği kullanılarak değerlendirildi.

Bulgular: Çalışma grubunu 11 erkek ve 12 kadın hasta oluşturdu; medyan yaş 44 yıl idi. En sık etiyolojik neden jinekolojik cerrahi (%52,2) olup, bunu ürolojik (%39,1) ve kolorektal cerrahiler (%8,7) izledi. Medyan operasyon süresi 150 dakika, medyan hastanede yatış süresi 4 gün olarak saptandı. Üç hastada (%13,0) psoas hitch uygulandı. Medyan takip süresi 22 ay idi. Tüm hastalarda (%100) cerrahi başarı sağlandı. İki hastada (%8,6) minör komplikasyon (bir idrar yolu enfeksiyonu ve bir yara enfeksiyonu) görüldü. PGI-C skorlarına göre hastaların %95,7'si "çok belirgin düzelme", %4,3'ü ise "belirgin düzelme" bildirdi.

Sonuç: Modifiye Lich–Gregoir üreteroneosistostomi, iyatrojenik distal üreter yaralanmalarının tedavisinde güvenli, etkili ve kalıcı bir cerrahi yöntemdir.

Anahtar kelimeler: iyatrojenik hastalık, cerrahi girişimler, üreter yaralanmaları, üreteroneosistostomi

Introduction

Ureteral injuries, although relatively uncommon, represent a serious surgical complication that can result in significant morbidity, including ureteral stricture, hydronephrosis, and loss of renal function if not promptly diagnosed and managed. The vast majority are iatrogenic in nature, with the distal third of the ureter being particularly vulnerable during pelvic procedures such as gynecological, colorectal, and urological surgeries [1–3].

Definitive management of distal ureteral injuries typically requires surgical reconstruction to restore urinary continuity and preserve renal function. Ureteroneocystostomy is the most widely accepted approach, with several techniques described, including the Politano–Leadbetter and the extravesical Lich–Gregoir methods [4]. The Lich–Gregoir technique, originally developed for anti-reflux ureteral reimplantation, has become popular due to its relative technical simplicity, shorter operative time, and low complication profile [5].

Over time, several modifications of the Lich–Gregoir technique have been introduced to optimize outcomes, especially in complex or reoperative settings. The extravesical approach minimizes bladder dissection and avoids extensive intravesical manipulation, which can be advantageous in patients with iatrogenic injuries after major pelvic surgery. However, the evidence specifically addressing the role of the modified Lich–Gregoir technique in adult iatrogenic distal ureteral injuries remains scarce. Most previous reports have either pooled various etiologies or focused primarily on pediatric or reflux populations [6,7].

The objective of this study was to assess the surgical and functional outcomes of repairing iatrogenic injuries to the distal ureter using the modified Lich–Gregoir ureteroneocystostomy technique, with a focus on perioperative factors, complication rates, and long-term functional outcomes.

Material and Methods

After receiving approval from the institutional ethics committee (Date: 06.08.2025; No: 264), a retrospective study was carried out at the Department of Urology, Cam and Sakura City Hospital. The study involved reviewing the medical records of patients who had undergone surgical repair for iatrogenic distal ureteral injuries from January 2021 to January 2025.

Inclusion criteria were: a confirmed iatrogenic injury involving the distal third of the ureter, repair performed using the modified Lich–Gregoir technique. Exclusion criteria included malignant ureteral injuries, bilateral involvement, prior ureteral reconstruction on the affected side, and concomitant bladder pathology requiring alternative reconstruction.

All patients underwent standardized assessment, including physical examination, serum creatinine measurement, and urinalysis. The diagnosis of ureteral injury was established based on clinical suspicion (such as persistent flank pain or fever) and confirmed via CT urography or retrograde pyelography. Imaging studies consisted of renal ultrasonography and either computed tomography urography or magnetic resonance urography to define the extent of injury. Retrograde pyelography was performed in selected cases, while renal scintigraphy was used when functional assessment was clinically indicated. In cases of infection or obstruction, appropriate antibiotics and urinary diversion (ureteral stenting or percutaneous nephrostomy) were applied before definitive surgery.

All procedures were performed via an open surgical approach under general anesthesia by experienced reconstructive urologists. After identification and proximal mobilization of the injured ureter, devitalized tissue was excised and a 4.8 Fr double-J stent was inserted. All patients underwent direct ureteroneocystostomy without the need for additional ureteroureterostomy. The bladder was mobilized toward the ipsilateral psoas tendon when required to reduce tension. The modified Lich–Gregoir ureteroneocystostomy consisted of creating a 2–3 cm submucosal tunnel on the bladder dome or lateral wall. The distal ureter was spatulated for 1–1.5 cm, and a mucosa-to-mucosa anastomosis was fashioned with interrupted 5-0 vicryle sutures. A psoas hitch was applied when necessary to achieve a tension-free anastomosis. A perivesical drain and urethral Foley catheter were placed in all patients, with drains removed once minimal output was achieved. The Foley catheter was removed on postoperative day 14. Double-J stent was removed on postoperative week 6.

The primary outcomes were anastomotic patency and preservation of renal function, assessed by ultrasonography or CT urography at 3, 6, and 12 months postoperatively, and annually thereafter. Secondary outcomes included perioperative parameters (operative time, hospital stay), complications (graded by the Clavien–Dindo system), need for secondary intervention, and patient-reported outcomes. Patient satisfaction was assessed using the Patient Global Impression of Change (PGI-C) scale at the latest follow-up. Postoperative evaluation was based on clinical symptoms and imaging. Routine voiding cystourethrography (VCUG) was not performed; however, it was reserved for patients presenting with symptoms suggestive of vesicoureteral reflux, such as recurrent urinary tract infections or flank pain during voiding. Ureteral patency was confirmed by the absence of hydronephrosis or obstructive uropathy on follow-up imaging.

Statistical Analysis

Data analysis was conducted using IBM SPSS Statistics for Windows, Version 24.0 (IBM Corp., Armonk, NY, USA). To summarize the data, descriptive statistics were applied: continuous variables were presented as median and interquartile range (IQR), while categorical variables were described using frequencies and percentages. The Wilcoxon signed-rank test was employed to assess differences in renal function parameters before and after surgery. A p-value of less than 0.05 was deemed statistically significant.

Results

Among the 23 patients who qualified for the study, there were 11 men and 12 women, with a median age of 44 years (IQR: 35–51). The median body mass index was recorded at 29 kg/m² (IQR: 25–39). Diabetes mellitus was present in 3 patients (13.0%), while hypertension was noted in 4 patients (17.4%). Gynecological surgery was the leading cause of iatrogenic ureteral injury, affecting 12 patients (52.2%), followed by urological procedures in 9 patients (39.1%) and colorectal surgery in 2 patients (8.7%). The right and left ureters were impacted almost equally, with 12 and 11 cases, respectively (**Table 1**).

In our study group, every injury (100%) was detected after surgery, with a median diagnosis time of 4 days (IQR: 2–7) following the initial operation. The median duration of surgery was 150 minutes (IQR: 110–205), and patients stayed in the hospital for a median of 4 days (IQR: 4–7). A psoas hitch procedure was necessary for 3 patients (13.0%). The median follow-up period was 22 months (IQR: 8–30). All patients (100%) experienced surgical success, which was defined as maintaining renal function and ureteral openness without needing further surgery. Renal function was preserved in all cases. The median serum creatinine level before surgery was 0.92 mg/dL (IQR: 0.78–1.10), and at the last follow-up, it was 0.88 mg/dL (IQR: 0.75–1.05). There was no statistically significant difference between preoperative and postoperative renal function metrics ($p > 0.05$) (**Table 2**).

Postoperative morbidity was low. Two patients experienced Clavien–Dindo grade II complications: one urinary tract infection (4.3%) and one wound infection (4.3%), both managed conservatively. The patient with a urinary tract infection was managed with culture-specific antibiotics and remained infection-free during the subsequent follow-up. No major complications or reoperations occurred during follow-up.

Patient-reported outcomes were highly favorable. According to the Patient Global Impression of Change (PGI-C) scale, 22 patients (95.7%) reported being “very much improved,” while one patient (4.3%) reported being “much improved.”

Discussion

In this study, we evaluated the surgical outcomes of iatrogenic distal ureteral injury repair using the modified Lich–Gregoir technique. We observed a 100% success rate in terms of ureteral

patency and preservation of renal function, with only two minor postoperative complications. These findings confirm that the modified Lich–Gregoir ureteroneocystostomy is a safe and effective reconstructive option in this challenging clinical scenario. The excellent outcomes in our cohort may be attributed to careful patient selection, standardized perioperative management, and the performance of surgery by experienced reconstructive urologists.

In our series, gynecological surgery was the primary etiology (52.2%), which is consistent with the distribution reported by Gild et al. [2] and Selzman et al. [3]. Our findings reinforce that despite advances in surgical techniques, the distal ureter remains highly vulnerable during major pelvic procedures, particularly in cases recognized postoperatively. Such injuries often remain unrecognized intraoperatively, underscoring the importance of early diagnosis and prompt surgical repair to prevent long-term sequelae such as stricture formation, hydronephrosis, and renal function loss.

A variety of surgical techniques have been described for the reconstruction of distal ureteral injuries, including the Politano–Leadbetter and Lich–Gregoir methods. The technical simplicity of the modified Lich–Gregoir technique, as previously noted by Ahn et al. [4] and Atar et al. [5], was reflected in our median operative time of 150 minutes. Furthermore, the complete preservation of renal function—confirmed by stable median creatinine levels (0.92 vs 0.88 mg/dL) supports the safety of this extravesical approach even in the potentially inflammatory environment of an iatrogenic injury. In our series, the use of a modified Lich–Gregoir technique yielded excellent surgical and functional outcomes. Only two minor postoperative complications; urinary tract infection and superficial wound infection were observed, both of which resolved with conservative management. Notably, no patient required reoperation during the follow-up period, and all reconstructions remained patent and functional.

Our results are comparable to those reported in previous studies. Demirdag et al. demonstrated favorable outcomes with the modified Lich–Gregoir ureteroneocystostomy in iatrogenic distal ureteral injuries, with a high success rate and low complication profile [1]. Similarly, laparoscopic adaptations of this technique, sometimes combined with psoas hitch or Boari flap, have been shown to yield excellent results in benign distal ureteral pathologies [5]. The 100% success rate observed in our study may be attributed to careful patient selection, standardized preoperative evaluation, and performance of surgery by experienced reconstructive urologists.

The present study has several limitations. First, its retrospective design may introduce selection bias. Second, the relatively small sample size limits the generalizability of our findings. While the modified Lich–Gregoir technique is inherently an anti-reflux procedure, a limitation of our study is the lack of routine objective reflux assessment via VCUG. Nevertheless, none of our patients demonstrated clinical symptoms or radiological findings necessitating such invasive testing during the median 22-month follow-up. Third, although our median follow-up duration was 22 months, longer-term outcomes beyond five years are lacking. Finally, the absence of a comparison group prevents direct evaluation of the superiority of this technique over alternative reconstructive methods.

Although there are some limitations, our findings contribute to the increasing evidence that supports the modified Lich–Gregoir ureteroneocystostomy as a reliable, effective, and long-lasting solution for treating iatrogenic distal ureteral injuries. Future prospective research involving larger participant groups and extended follow-up periods is necessary to confirm these results and to compare them with outcomes from other reconstructive methods.

Conclusion

In conclusion, the modified Lich–Gregoir ureteroneocystostomy is a safe, effective, and durable surgical technique for the management of iatrogenic distal ureteral injuries. Our study demonstrates excellent success rates with complete preservation of ureteral patency and stable renal function, alongside high patient satisfaction. This approach offers a reliable and simplified reconstructive option with a low complication profile, particularly for injuries recognized in the postoperative period.

Ethics Committee Approval: This study was approved by the Ethics Committee of Basaksehir Cam and Sakura City Hospital. (Date: 06.08.2025; No: 264).
Informed Consent: Written informed consent was obtained from all patients.
Publication: The results of the study were not published in full or in part in form of abstracts.
Peer-review: Externally peer-reviewed.
Authorship Contributions: Any contribution was not made by any individual not listed as an author. Concept – S.Ş., M.S., Ç.Ş.; Design – S.Ş., M.S., Ç.Ş.; Supervision – S.Ş., R.U., H.L.C.; Resources – M.S., Y.Ç.; Materials – M.S., Y.Ç.; Data Collection and/or Processing – M.S., Ç.Ş., Y.Ç.; Analysis and/or Interpretation – S.Ş., Ç.Ş., R.U.; Literature Search – Ç.Ş.; Writing Manuscript – Ç.Ş.; Critical Review – S.Ş., M.S., Y.Ç., H.L.C.
Conflict of Interest: The authors declare that they have no conflicts of interest.
Financial Disclosure: The authors declare that this study received no financial support.

References

[1] Demirdag Ç, Bulbul E, Gultekin MH, Simsekoglu MF, Ilki FY, Kalender G, et al. Comparison of split-cuff nipple and modified Lich-Gregoir ureteroneocystostomy in iatrogenic distal ureteral injuries: tertiary care center experience. Int Urol Nephrol. 2023;55:605–11. https://doi.org/10.1007/s11255-022-03449-1.

[2] Gild P, Kluth LA, Vetterlein MW, Engel O, Chun FKH, Fisch M. Adult iatrogenic ureteral injury and stricture-incidence and treatment strategies. Asian J Urol. 2018;5:101-6. https://doi.org/10.1016/j.ajur.2018.02.003

[3] Selzman AA, Spirnak JP. Iatrogenic ureteral injuries: a 20-year experience in treating 165 injuries. J Urol. 1996;155:878-81. https://doi.org/10.1016/s0022-5347(01)66332-8

[4] Ahn JH, Han JY, Nam JK, Park SW, Lee SD, Chung MK. Laparoscopic ureteroneocystostomy: modification of current techniques. Korean J Urol. 2013;54:26-30. https://doi.org/10.4111/kju.2013.54.1.26

[5] Atar A, Eksi M, Güler AF, Tuncer M, Akkas F, Tugcu V. Long Term Outcomes of Laparoscopic and Open Modified Lich-Gregoir Reimplantation in Adults: A multicentric comparative study. Pak J Med Sci. 2017;33:788-92. https://doi.org/10.12669/pjms.334.12661

[6] Ciancio G, Farag A, Gonzalez J, Vincenzi P, Gaynor JJ. Results of a previously unreported extravesical ureteroneocystostomy technique without ureteral stenting in 500 consecutive kidney transplant recipients. PLoS One. 2021;16:e0244248. https://doi.org/10.1371/journal.pone.0244248

[7] Silay MS, Turan T, Kayalı Y, Başıbüyük İ, Gunaydin B, Caskurlu T, et al. Comparison of intravesical (Cohen) and extravesical (Lich-Gregoir) ureteroneocystostomy in the treatment of unilateral primary vesicoureteric reflux in children. J Pediatr Urol. 2018;14:65.e1-65.e4. https://doi.org/10.1016/j.jpurol.2017.09.014

Table 1. Demographic and preoperative characteristics of patients

Number of patient	23
Gender (Male/Female)	11/12
Age (year)*	44 (35-51)
Body mass index (kg/m^2)*	29 (25-39)
Comorbidities	
Diabetes mellitus	3 (13.0%)
Hypertension	4 (17.4%)
Etiology	
Gynecological surgery	12 (52.2%)
Colorectal surgery	2 (8.7%)
Urological surgery	9 (39.1%)
Side of injury (right/left)	12/11

*: median (interquartile range)

Table 2. Peroperative and postoperative characteristics of patients

Operative time (min)*	150 (110-205)
Length of hospital stay (day)*	4 (4-7)
Use of psoas hitch	3 (13.0%)
Duration of follow-up (months)*	22 (8-30)
Patency	23 (100.0%)
Time to diagnosis (days)	4 (2-7)
Preoperative creatinine (mg/dL)	0.92 (0.78-1.10)
Postoperative creatinine (mg/dL)	0.88 (0.75-1.05)
Complications	
Urinary tract infection	1 (4.3%)
Wound infection	1 (4.3%)
Patient global impression of change score	
Much improved	1 (4.3%)
Very much improved	22 (95.7%)
Re-operation	0

*: median (interquartile range)