Endourol Bull. 2025;17(3):132-138. doi: 10.54233/endourolbull-1707846

Does Timing of Retrograde Intrarenal Surgery Following Extracorporeal Shock Wave Lithotripsy Failure Influence the Outcomes?

Vücut Dışı Şok Dalga Litotripsi Başarısızlığı Sonrası Retrograd İntrarenal Cerrahinin Zamanlaması Sonuçları Etkiler mi?

Özgür Arıkan, Ferhat Keser, Ayberk İplikçi, Özgür Kazan, Ahmet Keleş, İlkin Hamid-zada, Muhammet Talha Nuroğlu, Adnan Başaran, Meftun Çulpan, Asıf Yıldırım

Department of Urology, Istanbul Medeniyet University, Istanbul, Türkiye

ABSTRACT

Objective: The objective of this study is to determine the impact of the timing of retrograde intrarenal surgery (RIRS) following extracorporeal shock wave lithotripsy (SWL) on renal stone treatment outcomes.

Material and Methods: This retrospective study included 138 patients who underwent RIRS for renal stones after at least two failed SWL sessions between 2020 and 2024. Patients were divided into three groups based on the time interval between SWL and RIRS: 7-14 days (group 1), 15-22 days (group 2), and 23-30 days (group 3). Demographic data, stone characteristics, operative time, stone-free rate, and complication rates were compared.

Results: Stone-free rates were similar across the three groups (group 1: 85.4%, group 2: 84.8%, group 3: 86.3%, p=0.978). There were no statistically significant differences between the groups in terms of median operative time (p=0.249), median length of hospital stays (p=0.865), perioperative complications (p=0.884), or postoperative complications (p=0.962).

Conclusions: The timing of RIRS after failed SWL does not appear to impact treatment outcomes for renal stones significantly, and these findings suggest flexibility in scheduling RIRS after SWL failure.

Keywords: endourology, extracorporeal shock wave lithotripsy, retrograde intrarenal surgery, timing, urolithiasis

Cite As: *Arikan O, Keser F, Iplikci A, Kazan O, Keles A, Hamid-zada I, Nuroglu MT, Basaran A, Culpan M, Yildirim A. Does Timing of Retrograde Intrarenal Surgery Following Extracorporeal Shock Wave Lithotripsy Failure Influence the Outcomes?. Endourol Bull. 2025;17(3):132-138.* https://doi.org/10.54233/endourolbull-1707846

Corresponding Author : *Ayberk Iplikci, MD, FEBU, Egitim Mahallesi, Dr. Erkin Cd., 34722 Kadikoy, Istanbul, Türkiye*
e-mail: ayberkiplikci@gmail.com

Received : May 28, 2025 ***Accepted*** : August 8, 2025

ÖZET

Amaç: Bu çalışmanın amacı, ekstrakorporeal şok dalga litotripsi (SWL) sonrası retrograd intrarenal cerrahinin (RIRS) zamanlamasının böbrek taşı tedavi sonuçlarına etkisini belirlemektir.

Gereç ve Yöntemler: Bu retrospektif çalışmaya, 2020 ile 2024 yılları arasında en az iki başarısız SWL seansından sonra böbrek taşları için RIRS uygulanan 138 hasta dahil edildi. Hastalar SWL ile RIRS arasındaki zaman aralığına göre üç gruba ayrıldı: 7-14 gün (Grup 1), 15-22 gün (Grup 2) ve 23-30 gün (Grup 3). Demografik veriler, taş özellikleri, operasyon süresi, taşsızlık oranı ve komplikasyon oranları karşılaştırıldı.

Bulgular: Taşsızlık oranları üç grupta da benzerdi (Grup 1: %85,4, Grup 2: %84,8, Grup 3: %86,3, p=0,978). Gruplar arasında medyan ameliyat süresi (p=0,249), medyan hastanede kalış süresi (p=0,865), perioperatif komplikasyonlar (p=0,884) veya postoperatif komplikasyonlar (p=0,962) açısından istatistiksel anlamlı bir fark yoktu.

Sonuç: Başarısız SWL'den sonra RIRS zamanlamasının böbrek taşları için tedavi sonuçlarını önemli ölçüde etkilemediği görülmektedir. Bu bulgular SWL başarısızlığından sonra RIRS planlamada esnek olunabileceğini göstermektedir.

Anahtar Kelimeler: endoüroloji, ekstrakorporeal şok dalga litotripsi, retrograd intrarenal cerrahi, ürolitiyazis, zamanlama

INTRODUCTION

Nephrolithiasis is a widespread health concern, exhibiting varying prevalence rates across continents and representing a significant proportion of urological clinic visits. Observed rates range up to 13% in North America, 9% in Europe, and 5% in Asia, suggesting potential influences of genetic, dietary, or environmental factors (1). Several treatment options are frequently suggested for kidney stones, including extracorporeal shockwave lithotripsy (SWL), retrograde intrarenal surgery (RIRS), and percutaneous nephrolithotomy (PNL). The selection of the most appropriate approach depends on various patient-specific factors. SWL, a minimally invasive approach, offers the advantage of avoiding general anesthesia and demonstrates acceptable success rates (2). Current clinical guidelines recommend both RIRS and SWL as initial treatment modalities for kidney stones measuring less than 2 cm in diameter. While SWL is also considered a primary treatment option, its efficacy can be influenced by various factors, including stone composition, patient body mass index, and renal anatomical variations (3). In cases of SWL failure, other treatment options are recommended to the patients, and RIRS comes to the forefront because it is more minimally invasive (3,4). While several studies have explored various aspects of kidney stone management, the impact of prior failed SWL on RIRS outcomes, the existing literature lacks data regarding the optimal timing of RIRS following unsuccessful SWL for renal stones (5-9). The purpose of this study was to assess the effect of the timing of RIRS operation on success and complications after failed SWL for renal stone.

MATERIALS AND METHODS

Study Design and Patient Selection

A retrospective analysis was conducted on 528 patients who underwent SWL for the treatment of kidney stones at our clinic between 2020 and 2024. Among these, 327 patients (61.9%) achieved stone-free status or had residual fragments ≤2 mm following SWL. A subsequent evaluation excluded patients based on predefined criteria: age younger than 18 years, renal anatomical anomalies, solitary kidney, multiple stones, prior ipsilateral renal surgery, ureteral narrowing preventing access sheath advancement, or refusal of additional interventions, and who were recommended for follow-up without further intervention. This process identified 138 patients who underwent RIRS after SWL failure and were included in the study (Figure 1). Ethical approval for this study was obtained from the local ethics committee.

Ethics Committee of Istanbul Medeniyet University Faculty of Medicine approved (Clinical trial number: 2025-GOSEK-0027, Date: 2025/01/22) the commencement of the presented study.

SWL Procedure

SWL procedure, performed using the Lithostar Modularis Lithotripter (Siemens AG Healthcare, Munich, Germany). The procedure commenced with a shock wave frequency of 60 per minute and an energy flow density of 0.1 mJ/

mm². These settings were adjusted based on the patient's tolerance, with the frequency potentially increasing to 90 shocks per minute and the energy flow density reaching 3.0 mJ/mm². A total of 3000 shock waves were delivered during the single session. SWL failure was defined as the lack of any change in stone status after a minimum of two SWL treatments for a kidney stone.

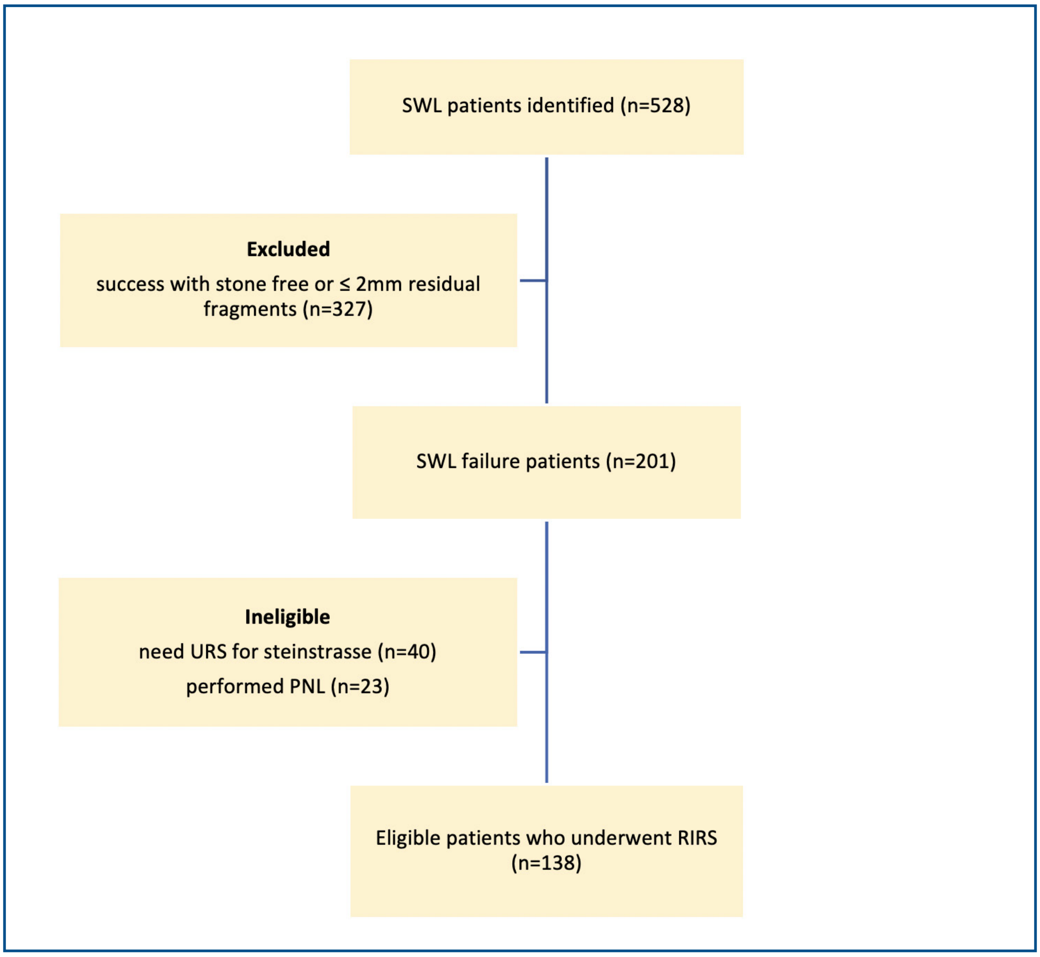

Figure 1. Study flowchart

RIRS Protocol and Group Stratification

Patients undergoing RIRS were stratified into three groups based on the interval between SWL and RIRS: group 1 (7–14 days post-SWL), group 2 (15–22 days post-SWL), and group 3 (23–30 days post-SWL). Preoperative evaluations included urine cultures to ensure negative results, and antimicrobial therapy was administered based on antibiogram findings in cases of positive cultures. All patients received preoperative antibiotic prophylaxis with second-generation cephalosporins.

The RIRS procedure was performed under general anesthesia with the patient positioned in the lithotomy position. A semi-rigid ureteroscope (URS) was initially used to passively dilate the ureter and assess for concurrent ureteral stones or strictures. A guidewire was advanced into the pelvicalyceal system, followed by placement of a ureteral access sheath (UAS). A flexible ureteroscope (F-URS) was then advanced through the UAS, and stone fragmentation was performed using a Holmium: YAG laser with a 272 µm fiber. The stone dusting technique was employed to fragment stones into fine particles. After lithotripsy, the pelvicalyceal system was visually inspected for residual fragments, and fluoroscopy was used to confirm the absence of larger fragments. The ureter was carefully examined for residual fragments and any significant damage upon withdrawal of the flexible ureteroscope and access sheath. All patients received a double-J stent postoperatively.

Follow-up Procedure

Patients were evaluated at 1 month postoperatively with non-contrast low-dose computed tomography. Stone-free status, defined as the absence of residual stones or the presence of residual fragments measuring ≤2 mm, was used as the criterion for success.

Statistical Analysis

Statistical analyses were conducted using SPSS version 27.0 (IBM Corp., Armonk, NY). The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Comparisons between two independent groups were performed using the Mann-Whitney U test for non-normally distributed data and the Student's t-test for normally distributed data. For comparisons of three or more independent groups, the Kruskal-Wallis test was applied for non-normally distributed data. At the same time, one-way analysis of variance (ANOVA) was used for normally distributed data. Pearson's chi-squared test was used for the analysis of categorical variables.

RESULTS

The study population comprised 41 patients in group 1, 46 in group 2, and 51 in group 3. Baseline demographic and stone characteristics were similar across the three groups. Statistical analysis revealed no significant differences between the groups concerning age (p=0.754), sex (p=0.806), body mass index (p=0.559), comorbidity (p=0.256), stone location (p=0.648), side of the stone (p=0.523), stone size (p=0.930), or Hounsfield Unit level (p=0.225) (Table 1). There were no significant differences between the groups in either median operation time (group 1: 45 minutes, range 33-67; group 2: 50 minutes, range 35-68; group 3: 50 minutes, range 35-70; p=0.249) or median length of hospital stay, which was consistently one day for all groups (p=0.865) (Table 1).

Table 1. Comparison of demographic data and surgical outcomes between the groups

	Group 1 (n=41)	Group 2 (n=46)	Group 3 (n=51)	p value
Age (years), mean ± SEM	44 ± 2.2	44.8 ± 2.1	42.7 ± 1.7	0.754[a]
Gender, n (%)				
Female	17 (41.5)	16 (34.8)	20 (39.2)	0.806[b]
Male	24 (58.5)	30 (65.2)	31 (60.8)	
BMI, median (IQR)	27.1 (24.3-29.7)	26.8 (24.4-29.9)	26.1 (24-29.4)	0.559[c]
CCI, median (IQR)	0 (0-1)	0 (0-2)	0 (0-1)	0.256[c]
Stone Location, n (%)				
Lower Calyx	12 (29.3)	13 (28.3)	11 (21.6)	0.648[b]
Non-Lower Calyx	29 (70.7)	33 (71.7)	40 (78.4)	
Stone Side, n (%)				
Right	20 (48.8)	26 (56.5)	23 (45.1)	0.523[b]
Left	21 (51.2)	20 (43.5)	28 (54.9)	
Stone Size (mm), median (IQR)	12 (8.5-13.5)	10 (8-14)	11 (8-14)	0.935[c]
HU, mean ± SEM	897.9 ± 32.8	838.6 ± 22.6	902.6 ± 30.9	0.225[a]
Operation Time (min), median (IQR)	45 (40-54)	50 (41.5-56.2)	50 (40-60)	0.249[c]
Hospitalization Time (days), median (IQR)	1 (1-1)	1 (1-1)	1 (1-1)	0.865[c]

SEM: standard error of the mean, BMI: body mass index, IQR: interquartile range (25^{th} to 75^{th} percentile), CCI: charlson comorbidity index, HU: hounsfield unit.

[a] One way ANOVA test

[b] Pearson's Chi-squared test

[c] Kruskal-Wallis test

Stone-free rates were comparable across the groups, with 85.4% in group 1, 84.8% in group 2, and 86.3% in group 3 (p=0.978). There were no statistically significant differences in perioperative or postoperative complication rates among the three groups. No severe perioperative complications like ureteral avulsion or perforation occurred. Minor perioperative complications as mucosal injury and hematuria were occurred at similar rates (group 1: 2.4%, group 2: 4.3%, group 3: 3.9%; p=0.884), as did postoperative urinary tract infections with fever (group 1: 7.3%, group 2: 6.5%, group 3: 5.9%; p=0.962) and major complications like Clavien-Dindo 3 or above were not seen (Table 2).

Table 2. Comparison of complication rates and stone-free status of the patients between the groups

	Group 1 (n=41)	Group 2 (n=46)	Group 3 (n=51)	p value
Perioperative Complication, n (%) (Hematuria, Mucosal injury)	1 (2.4)	2 (4.3)	2 (3.9)	0.884[a]
Postoperative Complication, n (%) (Urinary tract infection)	3 (7.3)	3 (6.5)	3 (5.9)	0.962[a]
Stone Clearance, n (%)	35 (85.4)	39 (84.8)	44 (86.3)	0.978[a]

[a] Pearson's Chi-squared test

DISCUSSION

This study aims to fill a significant gap in the current literature by investigating the optimal timing for RIRS procedures following failed SWL. To the best of our knowledge, this is the first study to specifically examine the impact of the time interval between failed SWL and subsequent RIRS on clinical outcomes. Previous studies have primarily focused on comparing RIRS outcomes in patients with and without a history of prior SWL, without specifically addressing the timing of RIRS after SWL failure.

Several studies have not demonstrated a statistically significant difference in stone-free rates between patients undergoing RIRS with and without prior SWL (6-10). In line with these findings, a systematic review and meta-analysis by Wang et al. reported no significant differences in stone-free rates, operative time, and complication rates between RIRS following failed SWL and primary RIRS (11). Our current findings corroborate these observations, as we did not observe any significant impact of the time interval between SWL and RIRS on stone-free rates, operative time, length of hospital stay, or complication rates. The comparable stone-free rates (85.4%, 84.8%, and 86.3% in groups 1, 2, and 3, respectively) indicate that the timing of RIRS does not influence the likelihood of achieving complete stone clearance. The similar operative times and length of hospital stay across the groups further support this conclusion, suggesting that the interval between procedures does not impact the technical difficulty or recovery period associated with RIRS. The low and comparable perioperative and postoperative complication rates across the three groups are also noteworthy. The absence of severe complications, such as ureteral avulsion or significant mucosal injury, underscores the safety of RIRS in this setting, regardless of the timing after SWL. The most common postoperative complication, urinary tract infection with fever, is a known risk factor associated with both SWL and RIRS and was managed effectively with antibiotic protocols. These results collectively suggest that the timing of RIRS procedures following unsuccessful SWL does not adversely affect treatment efficacy or patient safety. This finding is clinically relevant, as it provides flexibility in scheduling RIRS procedures after SWL failure, allowing for logistical considerations and patient preferences to be considered.

McAteer et al. have shown that tissue and vascular damage are observed after SWL, which has been practiced in clinical practice for many years (12). Our initial hypothesis for this study was that the timing of RIRS following failed SWL might influence clinical outcomes, potentially due to factors such as mucosal and vascular injury caused by prior SWL. However, our findings did not support this hypothesis. These results suggest that any mucosal or vascular damage sustained during SWL either resolves within 7 days or does not significantly impact the subsequent RIRS procedure.

A study by Holland et al. compared RIRS for renal and proximal ureteral stones between patients who underwent RIRS as initial treatment and those who underwent RIRS after failed SWL. The study found a significantly higher stone-free rate in the primary RIRS group compared to the salvage RIRS group (80% vs. 67%). Although not statistically significant, the salvage RIRS group had longer hospital stays and higher complication rates. This study concluded that the low success rate of RIRS after SWL was not due to SWL-related effects, but that factors such as inferior calyx stone and infundibular anatomy, which affect the success of SWL, also affect the success of RIRS (5).

It is important to note that some studies have suggested a potential benefit to delaying URS after SWL failure. Irer et al. investigated the impact of timing on URS outcomes for proximal ureteral stones. Their findings indicated a significantly increased risk of complications in patients undergoing URS within 16.5 days of SWL compared to those with a longer interval between procedures (13). This suggests that a waiting period may be beneficial in the healing process of the affected ureteral wall after SWL, but in our study, we have shown that this is not the case for kidney stones.

This study has several limitations. First, the retrospective design inherently carries a risk of selection bias. Second, although the sample size was adequate for the present analysis, a larger cohort would increase statistical power and enhance the generalizability of the results. Additionally, the involvement of multiple surgeons in the RIRS procedures at a tertiary hospital may introduce variability in outcomes, which is acknowledged as a study limitation. Nevertheless, this study is the first to specifically evaluate the impact of timing between failed SWL and subsequent RIRS on surgical outcomes. Its strengths include a homogeneous patient cohort, clearly defined time intervals, and standardized surgical protocols, which enhance the reliability and clinical relevance of the findings.

CONCLUSIONS

This study demonstrates that the timing of RIRS after failed SWL for renal stones does not significantly impact stone-free rates, operative time, length of hospital stays, or perioperative and postoperative complication rates. These findings suggest that clinicians have flexibility in scheduling RIRS following unsuccessful SWL, allowing for individualized patient management based on logistical considerations, patient preference, and resource availability.

Data Availability: All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interests: No potential conflict of interest relevant to this article was reported.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Ethical Approval: The Ethics Committee of the Istanbul Medeniyet University Faculty of Medicine approved (Clinical trial number: 2025-GOSEK-0027, Date: 2025/01/22) the commencement of the presented study.

Author Contributions: OA: Project development, data analysis, manuscript writing. FK: Manuscript writing, statistical analysis. AI: Data analysis, manuscript writing. OK: Data collection, manuscript editing, statistical analysis. AK: Data collection, manuscript editing. IH: Data collection. MTN: Data collection. AB: Study design. MC: Study design. AY: Manuscript reviewing. All authors contributed to the study conception and design. All authors read and approved the final manuscript.

REFERENCES

1. Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, et al. Epidemiology of stone disease across the world. *World J Urol*. 2017;35(9):1301–20. https://doi.org/10.1007/s00345-017-2008-6
2. Raheem OA, Khandwala YS, Sur RL, Ghani KR, Denstedt JD. Burden of Urolithiasis: Trends in Prevalence, Treatments, and Costs. *Eur Urol Focus*. 2017;3(1):18–26. https://doi.org/10.1016/j.euf.2017.04.001
3. Setthawong V, Srisubat A, Potisat S, Lojanapiwat B, Pattanittum P. Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. *Cochrane Database Syst Rev*. 2023;8(8):CD007044. https://doi.org/10.1002/14651858.CD007044.pub4
4. Akram M, Jahrreiss V, Skolarikos A, Geraghty R, Tzelves L, et al. Urological Guidelines for Kidney Stones: Overview and Comprehensive Update. *J Clin Med*. 2024;13(4):1114. https://doi.org/10.3390/jcm13041114
5. Holland R, Margel D, Livne PM, Lask DM, Lifshitz DA. Retrograde intrarenal surgery as second-line therapy yields a lower success rate. *J Endourol*. 2006;20(8):556–9. https://doi.org/10.1089/end.2006.20.556
6. Selmi V, Sarı S, Çakıcı MÇ, Özdemir H, Kartal İG, et al. Does Previous Failed Shockwave Lithotripsy Treatment Have an Influence on Retrograde Intrarenal Surgery Outcome? *J Laparoendosc Adv Surg Tech A*. 2019;29(5):627–30. https://doi.org/10.1089/lap.2018.0487
7. Pricop C, Ivanuta M, Radavoi GD, Toma CV, Cumpanaş A, et al. Determining whether previous SWL for ureteric stones influences the results of ureteroscopy as the second-line treatment: A clinical study. *Exp Ther Med*. 2022;23(1):38. https://doi.org/10.3892/etm.2021.10960
8. Philippou P, Payne D, Davenport K, Timoney AG, Keeley FX. Does previous failed ESWL have a negative impact of on the outcome of ureterorenoscopy? A matched pair analysis. *Urolithiasis*. 2013;41(6):531–8. https://doi.org/10.1007/s00240-013-0603-6
9. Yürük E, Binbay M, Akman T, Özgör F, Berberoğlu Y, et al. Previous shock-wave lithotripsy treatment does not impact the outcomes of flexible ureterorenoscopy. *Turk J Urol*. 2014;40(4):211–5. https://doi.org/10.5152/tud.2014.83446
10. Ibrahim RM, Mohamed AG, Abdelsattar AF, Elzawy F, Yousef A, et al. Impact of previously failed extracorporeal shock wave lithotripsy on ureterorenoscopy outcomes in upper urinary tract stones: a prospective comparative study. World J Urol. 2024;42(1):392. https://doi.org/10.1007/s00345-024-05073-3
11. Wang W, Peng L, Di X, Gao X, Wei X. Does previous unsuccessful shockwave lithotripsy influence the outcomes of ureteroscopy?–a systematic review and meta-analysis. *Transl Androl Urol*. 2021;10(5):2122–32. https://doi.org/10.21037/tau-21-39
12. McAteer JA, Evan AP. The acute and long-term adverse effects of shock wave lithotripsy. *Semin Nephrol*. 2008;28(2):200–13. https://doi.org/10.1016/j.semnephrol.2008.01.003
13. Irer B, Sahin MO, Erbatu O, Yildiz A, Ongun S, et al. Impact of previous SWL on ureterorenoscopy outcomes and optimal timing for ureterorenoscopy after SWL failure in proximal ureteral stones. *World J Urol*. 2020;38(3):769–74. https://doi.org/10.1007/s00345-019-02809-4