

## Lower Cost Way of Retrograde Intrarenal Surgery

### Retrograd Intrarenal Cerrahi'de Maliyeti Düşürmek

Aydemir Asdemir<sup>1</sup> , Abuzer Öztürk<sup>2</sup> , İsmail Emre Ergin<sup>3</sup> , Hüseyin Saygın<sup>1</sup> , Esat Korğalı<sup>1</sup> 

<sup>1</sup> Department of Urology, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Türkiye

<sup>2</sup> Clinic of Urology, Sivas Numune Hospital, Sivas, Türkiye

<sup>3</sup> Clinic of Urology, Etlik City Hospital, Ankara, Türkiye

#### ABSTRACT

**Objective:** The aim of this study is to compare the results of operations with re-use flexible ureterorenoscope (URS) (FLEX X2, Karl Storz ) and single-use digital URS (RP-U-C12, Redpine) and find lower cost way of retrograde intrarenal surgery (RIRS) without compromising their clinical performance.

**Material and Methods:** One re-use URS and one single-use digital URS were investigated with respect to operation numbers, times, laser and fluoroscopy times in operations and their effectiveness in the operations. All operations were achieved by same surgeon who has completed RIRS learning curve. Two small groups of patients (n = 63 for each group) was taken because it can be reached by one re-use URS.

**Results:** The clinical application of the single-use URS is of equal quality compared to re-use one. In our study one case with FLEX X2 costs 399 euros, one case with RP-U-C12 costs 51.5 euros (only ureterorenoscope and its sterilization costs). This shows us single-use URS is lower cost way of retrograde intrarenal surgery.

**Conclusion:** Now for our country one FLEX X2 costs as same as 41 RP-U-C12. But if you use RP-U-C12 as re-use flexible URS as we do, for one case with FLEX X2 costs nearly 8 times with RP-U-C12 costs. This shows us that RP-U-C12 has much lower cost. Our clinical evaluation showed markedly high performance for the single-use ureterorenoscope, which is comparable to the one of multi-used instruments.

**Keywords:** cost-effective, re-use, flexible ureterorenoscope

**Cite As:** Asdemir A, Ozturk A, Ergin IE, Saygin H, Korgali E. Lower Cost Way of Retrograde Intrarenal Surgery. Endourol Bull. 2025;17(2):39-46. <https://doi.org/10.54233/endourolbull-1598975>

**Corresponding Author:** İsmail Emre Ergin, Clinic of Urology, Etlik City Hospital, Akyüzler Street No: 1, 06890, Ankara, Türkiye

**e-mail:** [emreergin55@hotmail.com](mailto:emreergin55@hotmail.com)

**Received:** December 10, 2024

**Accepted:** March 21, 2025



**ÖZET**

**Amaç:** Bu çalışmanın amacı, yeniden kullanılan fleksibl üreterorenoskop (URS) (FLEX X2, Karl Storz) ve tek kullanımlık dijital URS (RP-U-C12, Redpine) ile yapılan operasyonların sonuçlarını karşılaştırmak ve klinik performanslarından ödün vermeden retrograd intrarenal cerrahinin daha düşük maliyetli bir yolunu bulmaktır.

**Gereç ve Yöntemler:** Bir yeniden kullanılan URS ve tek kullanımlık dijital URS'ler ile, operasyon sayıları, süreleri, lazer ve floroskopi süreleri ile operasyonlardaki etkinlikleri incelenmiştir. Tüm operasyonlar, RIRS öğrenme eğrisini tamamlamış aynı cerrah tarafından gerçekleştirilmiştir. Bir yeniden kullanılan URS ile yapılabilecek sayıda hasta grubu ile (her grup için n = 63) çalışma planlanmıştır.

**Bulgular:** Tek kullanımlık URS'nin klinik uygulaması, yeniden kullanılan URS ile karşılaştırıldığında eşit kalitededir. Çalışmamızda bir FLEX X2 vakasının maliyeti 399 Euro, bir RP-U-C12 vakasının maliyeti ise 51,5 Euro'dur (sadece üreterorenoskop ve sterilizasyon maliyetleri). Bu, tek kullanımlık URS'nin retrograd intrarenal cerrahinin daha düşük maliyetli bir yolu olduğunu göstermektedir.

**Sonuç:** Şu anki durumda, ülkemizde bir FLEX X2, 41 adet RP-U-C12'ye eşdeğer maliyetlere sahiptir. RP-U-C12'yi bizler gibi yeniden kullanılabilir fleksible URS olarak kullanırsanız, FLEX X2 ile bir vakada harcanan maliyet, RP-U-C12 ile yapılan bir vakadan yaklaşık 8 kat daha fazladır. Bu, RP-U-C12'nin çok daha düşük maliyetli olduğunu göstermektedir. Klinik değerlendirmemiz, tek kullanımlık üreterorenoskopun, çok kullanımlı aletlerle karşılaştırılabilir şekilde oldukça yüksek performans gösterdiğini ortaya koymuştur.

**Anahtar Kelimeler:** flexible ureterorenoscope, kostefektivite, re-use

**INTRODUCTION**

Retrograde intrarenal surgery (RIRS) has emerged as a cornerstone in the treatment of upper urinary tract stones, as emphasized by the European Association of Urology Guidelines. Two main types of ureterorenoscopes (URS) are utilized in RIRS: reusable and single-use models. Despite advancements in the technology of reusable URSs, challenges such as limited durability, potential contamination risks, and high maintenance costs persist. These concerns have led to an increasing preference for single-use ureterorenoscopes in procedures like ureterorenoscopic laser lithotripsy, which is used for treating ureteral and renal stones.

In recent years, notable improvements have been achieved in areas like image quality, device durability, irrigation efficiency, and reduced shaft diameter (1). These advancements have made ureterorenoscopic laser lithotripsy a safer and more effective method for stone management (2). A significant innovation in this field is the advent of single-use ureterorenoscopes, which offer economic advantages by eliminating the need for sterilization and repair—two major cost factors for reusable devices (3). Additionally, some single-use URSs can be sterilized for limited reuse, further enhancing their cost-effectiveness (4).

The aim of this study is to compare the clinical outcomes of reusable flexible URSs (FLEX X2, Karl Storz) and single-use digital URSs (RP-U-C12, Redpine) to identify the most cost-efficient approach for RIRS without compromising clinical performance.

**MATERIAL AND METHODS**

This study was approved by the Cumhuriyet University Ethics Committee under the approval number 2023-09/06, and written consent was obtained from patients with upper urinary tract stone disease. A total of 126 interventions were conducted using the single-use URS (RP-U-C12, Redpine) and reusable URS (FLEX X2, Karl Storz), performed by a single, experienced surgeon.

The clinical performance of both devices was assessed by measuring operation numbers, operation times, laser and fluoroscopy durations, and effectiveness. To reduce costs, single-use URSs were sterilized with ethylene oxide for limited reuse, with the medical company's permission. Reusable URSs were sterilized using Cidex. Each device was used until it was no longer functional for any reason.

Two patient groups (n = 63 each) were formed. For the reusable URS, a single device was used across all cases. In contrast, five single-use URSs were required to complete the same number of procedures. Patients requiring active ureteral dilation were excluded. For reusable URS procedures, 7 patients were pre-stented, and a DJ stent was placed postoperatively in 62/63 cases. For single-use URS procedures, 9 patients were pre-stented, and a DJ stent was inserted in all cases.

All interventions involved the placement of a 12/14 F ureteral access sheath at the ureter/ureteropelvic junction. A Ho:YAG laser (CyberHo 150W, Quanta, Germany) was used for stone fragmentation with a laser parameter of 1.5 J per pulse and a 10 Hz repetition rate, utilizing a 272 µm fiber. Stone retrieval was performed using a 1.9 F nitinol basket. The primary goal was to determine the cost-effectiveness of single-use versus reusable URSs without compromising clinical outcomes. Secondary endpoints included comparisons of operative times, laser and fluoroscopy times, maneuverability, visibility, and third-month postoperative stone-free rates. Stone-free status was evaluated via non-contrast CT, with residual stones  $\geq 2$  mm considered significant. Maneuverability and visibility were rated as "very good," "good," or "satisfactory" based on the surgeon's immediate post-intervention feedback.

The devices' technical features are summarized in Table 1. Statistical analyses were conducted using SPSS 23.0, employing descriptive statistics, Independent Samples T-Test was used because the data followed a normal distribution., Chi-square analyses, and one-way ANOVA. A p-value  $< 0.05$  was considered statistically significant.

**Table 1.** Summary of technical features of the single-use and re-use URSs.

	RP-U-C12 Single-use	FLEX X2 Re-use
Technical data		
Platform	Digital	Fiberoptic
Reusable	No	Yes
Shaft diameter French (Fr)	9.12Fr (8.7-9.6)	7.5 Fr
Working channel French (Fr)	3.6 Fr	3.6 Fr
Deflection [°]		
Empty	268	248
272 µm fibre	249	223
Wire basket	260	245

## RESULTS

The mean age of patients in the single-use group was  $45.5 \pm 1.98$  (21–82 years), and in the reusable group, it was  $46.2 \pm 1.67$  (22–80 years) ( $p = 0.778$ ). In the single-use group, 32 female and 31 male patients (n = 63) were included, while the reusable group consisted of 25 female and 38 male patients (n = 63). The total number of stones in the single-use group was 89, with a mean stone size of  $12.1 \pm 0.47$  mm (4–25 mm), while in the reusable group, there were 87 stones with a mean diameter of  $12.2 \pm 0.50$  mm (5–25 mm) ( $p = 0.905$ ).

Regarding stone localization, in the single-use group, 33 stones were located in the lower pole of the kidney, 21 in the upper/mid-pole, and 35 in the pelvis. In the reusable group, 16 stones were in the lower pole, 36 in the upper/mid-pole, and 35 in the pelvis. Seventeen patients in the single-use group had multiple stones, while twenty-three patients in the reusable group had multiple stones. Patients' characteristics and procedure details are summarized in Table 2.

**Table 2.** Summary of patients' demography, stone and intervention data.

Patients demography	Single-use	Re-use
Number of patients	63	63
single stone	46	40
multiple stone	17	23
Age [year] mean (min-max)	45.5 ± 1.9 (21–82)	46.2 ± 1.6 (22–80)
Sex (female/male)	32/31	25/38
Preoperative stent	9/63	7/63
Stone data		
Total number of stones	89	87
Mean Stone diameter [mm] mean (min-max)	12.1 ± 0.4 (4–25)	12.2 ± 0.5 (5–25)
Stone localization		
Upper-mid pole	21/89	36/87
Lower pole	33/89	16/87
Renal pelvis	35/89	35/87
No stone	-	1/87
Intervention data		
Access sheath	63/63	63/63
Lithotripsy (Ho:YAG)	63/63	62/63
Basket (1.9 F)	16/63	27/63
Postoperative Stent	63/63	62/63
HU of stones mean±SD (min-max)	1164 ± 28.8 (698–1549)	1152 ± 36.7 (632–1555)

No additional or replacement ureterorenoscopes were required during the procedures. The mean operation time for the single-use group was 44.5 ± 2.03 minutes (min-max 20–90 minutes), while for the reusable group, it was 53.9 ± 2.83 minutes (min-max 17–90 minutes) ( $p = 0.08$ ). The mean fluoroscopy time for the single-use group was 18.52 ± 0.90 seconds (min-max 5–37 seconds), and for the reusable group, it was 17.73 ± 0.84 seconds (min-max 5–30 seconds) ( $p = 0.521$ ). The mean laser time in the single-use group was 11.13 ± 0.49 minutes (min-max 3.5–20 minutes), compared to 12.15 ± 0.82 minutes (min-max 4–25 minutes) in the reusable group ( $p = 0.360$ ). No significant differences were observed between the two groups regarding age, stone size, number of stones, operation time, fluoroscopy time, laser time, or Hounsfield unit scores. The  $p$ -values for these comparisons were 0.778, 0.905, 0.720, 0.08, 0.521, 0.360, and 0.792, respectively. A summary of the data is presented in Table 3.

**Table 3.** The average values of the groups

	Single-use (n=63)	Re-use (n=63)	p
Age	45.5 ± 1.9	46.2 ± 1.7	0.778
Size (mm)	12.1 ± 0.5	12.2 ± 0.5	0.905
Number of Stones	1.4 ± 0.1	1.3 ± 0.1	0.720
Operation Time (min)	44.5 ± 2.0	53.9 ± 2.8	0.08
Fluoroscopy Time (sec)	18.5 ± 0.9	17.7 ± 0.8	0.521
Laser Time (min)	11.1 ± 0.5	12.1 ± 0.8	0.360
HU	1164 ± 28.8	1152 ± 36.7	0.792

**Table 4.** Maneuverability of URSs (rfURS: re-use flexible URS, sfURS: single-use flexible URS)

	Very Good (first cases, times)				Good or Satisfying (later cases, times)			
	number	operation	laser	Floroscopy	number	op	laser	Floroscopy
	of cases	time (min)	time (min)	time (sec)	of cases	time (min)	time (min)	time (sec)
rfURS	45	2865	607	828	18	527	234	316
sfURS 1	10	545	130	182	8	260	68	161
sfURS 2	6	300	71	101	5	140	47	87
sfURS 3	6	345	75.5	122	4	145	32	58
sfURS 4	6	345	63.5	100	5	175	52	96
sfURS 5	7	303	76.5	161	6	277	84	99

**Table 5.** Visibility of URSs (rfURS: re-use flexible URS, sfURS: single-use flexible URS)

	Very Good (first cases, times)				Satisfying or Enough (later cases, times)			
	number	operation	laser	Floroscopy	number	operation	laser	Floroscopy
	of cases	time (min)	time (min)	time (sec)	of cases	time (min)	time (min)	time (sec)
rfURS	55	2940	742	1009	8	452	99	135
sfURS 1	11	585	137	195	7	220	68	161
sfURS 2	7	345	84	116	4	95	34	72
sfURS 3	8	430	92.5	152	2	60	15	28
sfURS 4	7	390	76.5	118	4	130	39	78
sfURS 5	9	415	111.5	200	4	165	49	60

In chi-square analysis, categorical variables such as gender, stone side, location, presence of residual stones, and the placement of a DJ catheter prior to the procedure showed no significant differences between the groups. The p-values were 0.52, 0.52, 0.08, 0.38, and 0.61, respectively. Post-procedure, a stone-free rate of 48/63 patients was achieved in the single-use group, while 51/63 patients in the reusable group were stone-free. The clinical performance of the single-use URS was evaluated across clinical procedures (n = 63), totaling 2835 minutes with five devices.

Maneuverability was rated as "very good" in 10/18 cases (first device, 545 minutes), and "good" or "satisfactory" in 6/13 cases (last device, 277 minutes). The average time for maneuverability was 367.6 minutes across the five devices. Visibility was "very good" in 11/18 cases (first device, 585 minutes), and "satisfactory" or "sufficient" in 7/18 cases (last device, 220 minutes). The average time for visibility was 433 minutes.

When comparing the five single-use devices, the average operation time, fluoroscopy time, laser time, stone sizes, number of stones, and Hounsfield unit scores were similar. The p-values for these variables were 0.71, 0.88, 0.78, 0.93, 0.09, and 0.32, respectively. The clinical performance of the reusable URS was tested across 63 clinical procedures, totaling 3392 minutes. Maneuverability was rated as "very good" in 45/63 cases, and "good" or "satisfactory" in 18/63 cases. Visibility was rated as "very good" in 55/63 cases, while it was "satisfactory" or "sufficient" in 8/63 cases.

## DISCUSSION

The durability of reusable ureterorenoscopes has been a subject of various studies, with working hours ranging between 14 and 48 hours before they are no longer functional. The FLEX X2) was used for an average of 56.5 working hours, which exceeds the typical usage times reported in previous studies (5-7). Our findings suggest that both single-use and reusable ureterorenoscopes can offer comparable performance, provided that all associated costs (e.g., labor, sterilization, consumables, and repair) are taken into consideration.

The introduction of single-use digital flexible ureterorenoscopes has significantly reduced the need for costly repairs and the risk of unpredictable performance, which could otherwise delay procedures. In our study, the FLEX X2 had a cost of €25,000, while the RP-U-C12 was priced at €600. This means the cost of one FLEX X2 device is equivalent to that of 41 RP-U-C12 units. When the RP-U-C12 is used for limited re-use, the cost becomes even lower. For instance, in our country, sterilization costs for FLEX X2 with Cidex are €2 per case, while for RP-U-C12 with ethylene oxide sterilization, the cost is €4 per case. Consequently, the cost per case for FLEX X2 was €399, whereas for RP-U-C12, it was €51.5, covering only the cost of the ureterorenoscope and sterilization (8).

These findings suggest that single-use ureterorenoscopes could be a more economically viable option, particularly for smaller hospitals with limited budgets. The initial purchase cost of RP-U-C12 is lower than that of FLEX X2, and the absence of maintenance or repair costs further reduces overall expenses. Moreover, using single-use URSs in teaching hospitals might have advantages, as the risk of damaging the instrument during training is minimized.

Despite their higher environmental impact, as single-use devices contribute to waste disposal, they offer a significant advantage in terms of safety and ease of use. In contrast, reusable devices require proper sterilization, and their performance cannot always be guaranteed throughout their lifecycle. This is especially relevant in teaching settings where instruments might fail earlier due to improper handling.

Mazzucchi et al. have pointed out that single-use flexible ureterorenoscopes tend to be lighter and offer superior image quality when compared to fiberoptic models (9). These devices are also ergonomically favorable for surgeons. However, environmental concerns regarding waste disposal remain a notable disadvantage of single-use instruments (10). On the other hand, the environmental impact of instruments is associated with the use of toxic detergents for sterilization (11).

When evaluating surgical outcomes, there was no difference between the single-use and reusable URS groups. Both types of devices produced nearly identical results, indicating that single-use ureterorenoscopes can be a viable alternative to reusable ones, providing comparable performance in upper urinary tract stone treatment.

Our study aligns with findings from other research, where no significant differences were found between single-use digital flexible ureterorenoscopes and reusable fiberoptic models in terms of image quality, device failure rates, lithotripsy success rates, and adverse event occurrences. Single-use URSs have demonstrated good safety and effectiveness in treating upper urinary tract stones (12). Additionally, a study by Wei Zheng So et al. highlighted that devices like RP-U-C12 and INNOVEX EU-Scope™ were favored by participants for their performance (13).

## CONCLUSION

Our clinical evaluation indicates that the performance of the single-use ureterorenoscope is comparable to that of reusable instruments. The clinical outcomes achieved with the single-use device were on par with those observed with reusable models, suggesting that single-use ureterorenoscopes can be a reliable alternative. Furthermore, single-use devices offer significant economic benefits, particularly in terms of reduced repair costs, sterilization expenses, and maintenance efforts. These factors contribute to lower overall costs, making single-use ureterorenoscopes a more cost-effective option for hospitals with limited resources.

However, it is important to consider the environmental impact of single-use devices, which result in increased waste production. On the other hand, reusable ureterorenoscopes, although more ecologically favorable, are associated with the use of toxic sterilization agents and the potential risk of performance degradation over time.

In conclusion, single-use ureterorenoscopes, such as the RP-U-C12, provide an economically advantageous solution for treating upper urinary tract stones, without compromising clinical effectiveness. Their reliability, lower cost, and ease of use make them an attractive option for healthcare facilities, particularly in settings where cost reduction is a priority. Nevertheless, further studies are needed to evaluate the long-term outcomes and safety of these devices, as



well as to assess their potential in comparison to the latest generation digital and fiberoptic ureterorenoscopes.

**Data Availability:** Data are available on specific request

**Funding:** No funding was received for conducting this study

**Conflict of Interest:** The authors have no financial or proprietary interests in any material discussed in this article.

**Ethical Approval:** This study was approved by the Sivas Cumhuriyet University Ethics Committee (Approval No: 2023-09/06, Date: 2023/09/21). Research involving human participants and/or animals All analysis performed involving human participants were in accordance with the 1964 Helsinki Declaration and its later amendments.

**Consent to Participate:** All patients signed an informed consent agreeing to supply their anonymous information for research purposes.

**Author Contributions:** Aydemir Asdemir first author, review of articles, manuscript preparation. Abuzer Öztürk data collection, manuscript writing/editing. Ismail Emre Ergin analysis and interpretation of data, manuscript editing. Hüseyin Saygın manuscript writing/editing. Esat Korğalı supervising the manuscript. All the authors discussed the results and commented on the manuscript.

## REFERENCES

1. Somani BK, Al-Qahtani SM, de Medina SD & Traxer O. Outcomes of flexible ureterorenoscopy and laser fragmentation for renal stones: comparison between digital and conventional ureteroscope. *Urology*. 2013;82:1017-1019 <https://doi.org/10.1016/j.urology>.
2. Gridley CM & Knudsen BE. Digital ureteroscopes: technology update. *Research and reports in urology*. 2017;9:19-25, <https://doi.org/10.2147/RRU.S104229>
3. Davis NF, Quinlan MR, Browne C, Bhatt NR, Manecksha RP, D'Arcy FT et al. Single-use flexible ureteropyeloscopy: a systematic review. *World J Urol*. 2018;36:529-536 <https://doi.org/10.1007/s00345-017-2131-4> (2018).
4. Legemate JD, Kamphuis GM, Freund JE, Baard J, Zanetti SP et al. Durability of Flexible Ureterscopes: A Prospective Evaluation of Longevity, the Factors that Affect it, and Damage Mechanisms. *Eur Urol Focus*. 2019;5(6):1105-1111 <https://doi.org/10.1016/j.euf.2018.03.001>.
5. Carey RI, Gomez CS, Maurici G, Lynne CM, Leveillee RJ, Bird VG. Frequency of ureterscope damage seen at a tertiary care center. *J. Urol*. 2006;176:607-610 <https://doi.org/10.1016/j.juro.2006.03.059>
6. Karaolides T, Bach C, Kachrilas S, Goyal A, Masood J, Buchholz N. Improving the durability of digital flexible ureteroscopes. *Urology*. 2013;81:717-722 <https://doi.org/10.1016/j.urology.2013.01.016> (2013).
7. Tosoian JJ, Ludwig W, Sopko N, Mullins JK & Matlaga BR. The effect of repair costs on the profitability of a ureteroscopy program. *J Endourol*. 2015;29:406-409 <https://doi.org/10.1089/end.2014.0435> (2015).
8. Taguchi K, Usawachintachit M, Tzou DT, Sherer BA, Metzler I, Isaacson D et al. Micro-Costing Analysis Demonstrates Comparable Costs for LithoVue Compared to Reusable Flexible Fiberoptic Ureterscopes. *J Endourol*. 2018;32:267-273 <https://doi.org/10.1089/end.2017.0523>
9. Mazzucchi E, Marchini GS, Berto FCG, Denstedt J, Danilovic A, Vicentini FC et al. Single-use flexible ureteroscopes: Update and perspective in developing countries. A narrative review. *Int Braz J Urol*. 2022;48(3):456-6.
10. Doizi S & Traxer O. Re: Evaluation of a Novel Single-use Flexible Ureterscope. *Eur Urol*. 2017;72:152-153 <https://doi.org/10.1016/j.eururo>.
11. Eckelman MJ, Sherman J. Environmental Impacts of the U.S. Health Care System and Effects on Public Health. *PLoS*

One. 2016;11(6):e0157014. Published 2016 Jun 9. <https://doi.org/10.1371/journal.pone.0157014>

12. Wenbiao L, Guohua Z, Jinchun X, Chao S, Yunhe X, Lingchao M et al. A prospective multicenter randomized controlled clinical trial study of a domestic single-use digital flexible ureteroscope versus a reusable digital flexible ureteroscope for the treatment of upper urinary tract stones. Chin J Urol. 2022;43:5. <https://doi.org/10.3760/cma.j.cn112330-20210901-00467>
13. So WZ, Gauhar V, Chen K, Lu J, Chua WJ, Tiong HY. An in vitro Comparative Assessment of Single-Use Flexible Ureteroscopes Using a Standardized Ureteroscopy Training Model [published correction appears in Urol Int. 2022;106(10):1089. doi: [10.1159/000525721](https://doi.org/10.1159/000525721)]. Urol Int. 2022;106(12):1279-1286. <https://doi.org/10.1159/000525246>