Section: Urology

Systematic Review

COMPARISON OF SINGLE-USE AND REUSABLE FLEXIBLE URETEROSCOPES IN RETROGRADE INTRA-RENAL SURGERY: A SYSTEMATIC REVIEW

D. Jason Philip[1], Thanveer Ahamed Z[2], Mohamed Salmon M[2]

[1]Assistant Professor, Department of Urology, Madras Medical College, Tamilnadu, India
[2]Senior Resident, Department of Urology, Madras Medical College, Tamilnadu, India

Received : 11/09/2025
Received in revised form : 28/10/2025
Accepted : 18/11/2025

Keywords:
Cost-Benefit Analysis, Equipment Reuse, Ureteroscopy, Urolithiasis, Single-Use Devices.

Corresponding Author:
Dr. D.Jason Philip,
Email: jpurologist@gmail.com

DOI: 10.47009/jamp.2025.7.6.85

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 451-458

ABSTRACT

Background: Retrograde intrarenal surgery (RIRS) has become a cornerstone in the management of renal calculi, driven by advances in flexible ureteroscope technology. The emergence of single-use flexible ureteroscopes (FURS) aims to overcome limitations associated with reusable models, including maintenance costs, infection risk, and equipment downtime. This systematic review aimed to compare the clinical outcomes, safety profile, and economic implications of single-use versus reusable flexible ureteroscopes in RIRS for renal stones. **Materials and Methods:** A comprehensive search of PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library was conducted up to October 2025, following PRISMA guidelines. Eligible studies included adult patients undergoing RIRS with either single-use or reusable FURS and reported outcomes such as stone-free rate (SFR), operative time, complications, hospital stay, and cost analysis. Randomised controlled trials and comparative cohort studies were included, and study quality was assessed using the Newcastle–Ottawa Scale and Cochrane RoB 2 tool. **Result:** Thirteen studies involving over 6,000 procedures were included, comprising randomised controlled, prospective, and multicentre registry data. Single-use and reusable FURS demonstrated comparable SFRs (70–95%) and operative times (mean 40–92 minutes) across most studies. Some trials reported marginally shorter operative durations with disposable scopes due to improved irrigation and manoeuvrability, while some showed no difference. Complication rates were similarly low (5–17%), with fewer infection-related events observed in single-use groups. Hospital stay tended to be shorter among patients treated with disposable scopes, attributed to reduced infection risk and faster recovery.
Economic analyses revealed volume-dependent cost-effectiveness: single-use ureteroscopes were more economical in low-to-medium-volume centres (<200 cases/year) due to the absence of repair and sterilisation expenses, whereas reusable models remained cost-efficient in high-volume institutions with optimised reprocessing workflows. Beyond cost, single-use devices provided consistent optical quality, immediate availability, and eliminated cross-contamination risks. **Conclusion:** Single-use and reusable flexible ureteroscopes offer equivalent safety and efficacy in RIRS for renal calculi. Single-use devices provide practical advantages in infection control, accessibility, and workflow efficiency, while reusable scopes remain preferable in high-volume centres for long-term cost containment. Future multicentre trials and life-cycle cost analyses are needed to guide optimal scope selection considering economic, environmental, and clinical factors.

INTRODUCTION

Urolithiasis is a common urinary tract condition observed worldwide, affecting approximately 1-20% of individuals. It stresses the healthcare systems due to its tendency to recurrence and the expense during repeated management.[1] Advanced minimally invasive techniques, retrograde intrarenal surgery (RIRS), combined with a flexible ureteroscope, are currently used in management. The latest flexible ureteroscope has better flexibility, durability, imaging, and a smaller size, and has made the treatment of small or complex renal stones safer, faster, and effective.[2]

Recent technological developments have improved visibility, control, and durability, thus providing

better outcomes in kidney stone treatment.[3] Reusable flexible ureteroscopes are the regular tools for RIRS; however, they are weak and need repairs after 15 uses, resulting in high maintenance and sterilisation costs.[4] Single-use flexible ureteroscopes were introduced to reduce the expenses, maintenance, and infection risks. They are the practical option available, as they provide reliable performance without the need for sterilisation or repair.[5]

Reusable flexible ureteroscopes require intense cleaning, specialised staff, and careful handling to prevent infection and damage. Reusing them takes time, costly, and increases repair risk; therefore, the doctors required more efficient and cost-effective alternatives that maintain safety and performance.[6] Single-use flexible ureteroscopes provide good image quality and performance while avoiding the risk of infection or sterilisation errors. They are easily available for use and have no delays caused by maintenance or repair.[7] Single-use ureteroscopes perform similarly to reusable ureteroscopes in terms of image quality and handling. However, they have higher per-case costs and contribute to environmental waste. Current studies provide mixed results, and there is no clear report or conclusion on which option has better overall value.[7,8]

Several studies and reviews comparing single-use and reusable flexible ureteroscopes have reported different results of stone clearance, complication rates, and overall.[8-10] Given these contradictory findings and the ongoing debate, a systematic review is needed to analyse the comparative performance and value of single-use and reusable flexible ureteroscopes. Therefore, this systematic review aimed to evaluate and compare the clinical outcomes, safety, and cost-effectiveness of single-use and reusable flexible ureteroscopes in RIRS for renal stones to determine their relative advantages in modern urological practice.

MATERIALS AND METHODS

Search strategy: A comprehensive electronic search was conducted in the PubMed/MEDLINE, Scopus, Web of Science, and Cochrane Library databases for studies published up to October 2025. The search terms include "single-use ureteroscope," "disposable ureteroscope," "reusable ureteroscope," "flexible ureteroscopy," "retrograde intra-renal surgery," "RIRS," "FURS", "renal stones," "renal calculi", "urolithiasis," and "nephrolithiasis."

Study selection: Article selection was conducted independently in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Studies were considered eligible for inclusion if they met the following criteria: adult patients undergoing flexible ureteroscopy or RIRS for renal calculi were included as the study population; the intervention involved the use of a single-use flexible ureteroscope; and the comparator was a reusable flexible ureteroscope. Eligible studies were required to report at least one relevant outcome, such as the stone-free rate (SFR), operative time, complication rate, device performance or image quality, deflection capability, cost analysis, or scope damage/failure rate. Only randomised controlled trials (RCTs), prospective or retrospective cohort studies, and comparative case series published in English were included. The exclusion criteria comprised case reports, editorials, conference abstracts, letters, and non-comparative studies, as well as studies involving paediatric populations or procedures other than RIRS, such as rigid ureteroscopy or percutaneous nephrolithotomy.

Data extraction: All retrieved records were imported into EndNote X9 for deduplication. Two independent reviewers screened the titles and abstracts for relevance, followed by a full-text evaluation of the potentially eligible studies. Any disagreements during the selection process were resolved through discussion or by consulting a third reviewer. The final selection of studies is summarised using a PRISMA flow diagram [Figure 1].

Data extraction was performed independently by two reviewers using a standardised template, collecting the author and year of publication, study design and setting, sample size, and patient demographics. Other information includes the type and model of ureteroscope used, stone characteristics (size, location, and number), and perioperative parameters, including operative time, SFR, complication rate, hospital stay, and conversion rate. Scope-related outcomes, including deflection angle, image quality, and scope damage or failure rates, were also recorded. Data on cost or cost-per-case analysis and follow-up duration were extracted. Any discrepancies identified during data extraction were resolved by consensus among the reviewers.

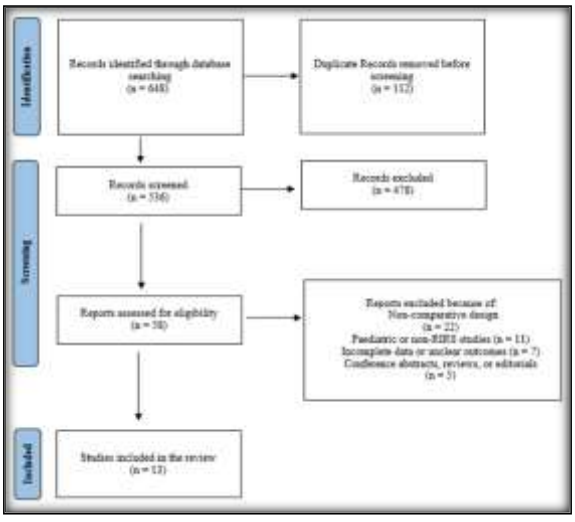

Figure 1: Study selection flow chart

RESULTS & DISCUSSION

1. Functional capabilities: mechanical, irrigation, optical properties, and access sheath importance.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

The included studies compared a broad range of reusable and single-use flexible ureteroscopes with both fibre-optic and digital platforms. Reusable devices included Karl Storz Flex-Xc, Flex-X2, and Flex-X2S, Olympus URF-V and URF-V2, and Wolf Cobra, whereas single-use models included LithoVue (Boston Scientific), Uscope PU3022/UE3022 (Pusen, China), Innovex US31B-12, ZebraScope, and NeoFlex (Wolf).

Mechanical and deflection properties

Deflection and mechanical flexibility are the main determinants of complete calyceal access, especially to the lower pole. Across several studies, single-use ureteroscopes showed a better or comparable deflection relative to reusable scopes.[11,12] Hennessey et al. and Bozzini et al. reported downward and upward deflection angles of 270°-295° for single-use scopes compared with 219°-285° for reusable devices, even when the working channel was occupied.[13,14] Salvado et al. similarly found equal bidirectional deflection of 270° for both the UScope 3022 and Cobra reusable models.[15]

Irrigation efficiency: Irrigation efficiency has a direct role in maintaining intrarenal visibility and limiting thermal injury during laser lithotripsy.[16] Hennessey et al. confirmed that LithoVue achieved higher irrigation flow rates (0.53 mL/s) than URF-V (0.43 mL/s) and Flex-Xc (0.46 mL/s) at similar pressures.[13]

Disposable digital ureteroscopes maintained more stable irrigation, even when laser fibres or baskets were inserted, due of the consistent channel diameter and the absence of luminal wear.[17,18] Bozzini et al. and Kam et al. reported that this resulted in better intraoperative visibility and fewer interruptions for irrigation adjustment.[14,19]

Optical and digital performance: In optical quality, digital single-use ureteroscopes achieved visibility and image resolution comparable to high-definition reusable models.[20] Kam et al. reported that URF-V2 achieved slightly higher visibility (4.9/5), but LithoVue scored better for manoeuvrability and field of view.19 Similarly, Qi et al. and Mager et al. found that visibility during lithotripsy, laser activation, and basket extraction was equivalent between groups. The ZebraScope and Uscope UE3022 provided superior colour rendering and light intensity compared to fibre-optic reusables, emphasising the technological convergence between scope generations.[21,22]

Access sheath importance: Ureteral access sheaths (UAS) improve procedural safety and efficiency by allowing repeated instrument entry without traumatising the ureter and by maintaining lower intrapelvic pressures through continuous outflow. This helps reduce the risk of infectious complications and improves visibility during stone fragmentation and extraction.[23] Gauhar et al. reported more UAS usage with single-use scopes (99.6%) compared to reusables (90.7%, $p < 0.001$).[24]

Innovations in UAS design, particularly negative-pressure or suction-assisted sheaths, have been shown to improve overall outcomes by shortening operative time, increasing immediate stone-free rates, and reducing postoperative infection rates.[25-27] These data confirm that instrument performance and perioperative outcomes are modulated by sheath design and flow dynamics, regardless of scope type.

Scope durability and failure rates: Mager et al. reported one LithoVue replacement under warranty, while reusable devices required periodic repair due to channel leakage or diminished optical clarity.[22] Similarly, Usawachintachit et al. noted scope failure rates of 4.4% (single-use) vs. 7.7% (reusable), and Kam et al. reported 5-10% malfunction among both categories, mainly due to mechanical fatigue.[19,28] Overall, single-use ureteroscopes remove repair-related downtime and provide consistent performance for each case, whereas reusable models show wear and tear that can affect manoeuvrability and image quality over time.

2. Operative time

Operative time was reported across studies ranging from 43 to 92 minutes. Five studies by Salvado et al., Mourmouris et al., Usawachintachit et al., Gauhar et al., and Salman et al. found that differences in operative time were mostly affected by procedural complexity and stone type.[24,27-29] Mourmouris et al. reported a significant decrease in mean operative time with single-use scopes compared to reusable ones (45 vs. 65 minutes, $p < 0.001$). They concluded that this was possible due to smoother navigation and the absence of interruptions for scope cleaning.[27] Similarly, Salvado et al. reported shorter operative times for disposable ureteroscopes (56.1±34.8 vs. 77±37.4 minutes, $p = 0.01$), which they associated with improved irrigation flow and ergonomic handling.[15] In contrast, Gauhar et al. observed longer operative durations with single-use devices (78 vs. 57 minutes, $p < 0.001$). It could be due to their inclusion of patients with larger stones and lower-pole calculi, which directly increases procedural time.[24] Usawachintachit et al. found a significant difference between the two scope types, with reduced operative time in single-use (57.3 ± 25.1 vs 70.3 ± 36.9 minutes, $p < 0.05$).28 Other studies by Huang et al., Kam et al., Qi et al., Bozzini et al., and Mager et al. reported similar operative times, generally within the range of 40-70 minutes, with overlapping interquartile distributions.[14,19,21,22,30] Therefore, the available evidence shows that operative time does not differ significantly between single-use and reusable flexible ureteroscopes. Although minor time savings with disposable models may be observed in complex anatomical cases or when immediate device availability and readiness are important factors.

3. Stone-free rates and postoperative complications

The SFR was consistently high across studies, ranging from 70% to 95%, with minimal statistical differences. Bozzini et al. reported SFRs of 86.6% (Flex-Xc) vs. 90% (Innovex US31B-12) ($p = 0.11$),[14] while Huang et al., Qi et al., Kam et al., and Hennessey et al. observed similar results (65-

ISSN (O): 2687-5365; ISSN (P): 2753-6556

95%).[19,21,30] In Mourmouris et al., single-use scopes achieved higher SFRs (78% vs. 43%, $p < 0.001$), particularly in patients with difficult lower pole anatomy.[27] Gauhar et al.'s multicenter registry confirmed a statistically significant but mild SFR advantage for disposables (78.2% vs. 74.8%, $p < 0.001$).[24] Ding et al. specifically evaluated single-use flexible ureteroscopes in patients with renal anatomical anomalies such as horseshoe and ectopic pelvic kidneys. Overall SFR 91.1% vs 85.6% (reusable vs single-use); lower-pole 82.0% vs 69.2% ($p = 0.022$).[31] Similarly, other studies reported ranging between 84 and 94%. No intraoperative changes or major complications were noted, and the postoperative infection rate remained below 5%.[32,33] These results demonstrate that single-use digital ureteroscopes provide a better functional performance and safety even in anatomically altered kidneys.

In terms of retreatment or re-intervention, Salvado et al. reported that only one patient in the single-use group required rehospitalisation for pain management, with no secondary procedures.[15] Huang et al. reported comparable secondary intervention rates of 8.4% (reusable) vs. 7.6% (single-use).[30] In contrast, Gauhar et al. found re-treatment rates of 10.1% in reusable and 13.9% in single-use groups, though this difference was not significant.[24] These findings indicate that re-intervention requirements are low and comparable between device types.

Complication rates ranged between 5% and 13%, predominantly Clavien I–II events.

Bozzini et al. and Mourmouris et al. found higher infectious complications with reusable scopes (8.8% and 11 cases) compared to single-use (3.3% and 0 cases, respectively). Minor fever or hematuria included the majority of events, with major complications (Clavien ≥III) reported in <2% of cases.[14,27] Across propensity-matched analyses (Qi et al., Kam et al., Huang et al., Goger et al.), total complication rates were similar.[19,21,30,34] Thus, both device have excellent safety, though infection-related complications appear reduced with single-use ureteroscopes, due to the absence of sterilisation failures and micro-contamination risks.

4. Hospital stays

Hospital stay duration, reported in 9 of the 13 included studies, ranged between 1 and 5.9 days. Bozzini et al. observed a significantly shorter mean hospital stay among patients treated with single-use ureteroscopes compared to reusable ones (1.8 ± 1.2 days vs. 3.5 ± 2.8 days, $p = 0.04$).[14] Similarly, Huang et al. found that patients in the disposable scope group had a lesser hospital stay (6.86 ± 1.82 days) compared with those in the reusable group (7.42 ± 2.06, $p = 0.026$).[30] Mourmouris et al. reported a higher proportion of patients discharged within 24 hours when single-use ureteroscopes were employed (87% vs. 74%, $p = 0.042$), highlighting their role in facilitating early postoperative recovery.[27] In contrast, Kam et al. and Usawachintachit et al. observed equivalent hospital stays of approximately 1-2 days for both scope types, aligning with standardised fast-track RIRS protocols.[19,28] Gauhar et al. also reported no significant difference, attributing similar hospitalisation durations to institutional discharge practices rather than the type of ureteroscope used.[24] In patients with congenital renal anomalies, Ding et al. observed a mean hospital stay of 2.1 ± 0.7 days.[31] Overall, the evidence indicates that the mean hospital stay tends to be slightly shorter for patients treated with single-use flexible ureteroscopes, particularly in centres adopting day-surgery or early ambulation pathways. This reduction in hospital stay may be partially explained by the lower postoperative infection rates and fewer re-interventions observed in the disposable scope cohorts, suggesting a modest advantage in terms of recovery efficiency.

5. Cost-effectiveness and economic outcomes

Several studies have noted that the true cost of a ureteroscope extends beyond the initial purchase price, with repairs, maintenance, sterilisation, and case volume changing the overall budget.[35,36] Six studies showed detailed economic evaluations comparing single-use and reusable ureteroscopes, explaining how different institutional settings and workload patterns can alter cost-effectiveness in favour of one option over the other. Hennessey et al. reported that reusable ureteroscopes required repairs after every 11-19 procedures, resulting in cumulative repair costs of approximately AUD $162,000 over 30 months. In lower-volume centres, the per-case expense of maintaining reusable scopes exceeded the per-unit cost of single-use devices, making disposables more economical in such settings.[13] Similarly, Mourmouris et al. and Bozzini et al. highlighted the substantial maintenance and sterilisation costs linked to reusable scopes, including expenses related to repair downtime and service contracts. Whereas disposable ureteroscopes provided predictable, fixed costs per procedure without hidden maintenance overheads.[14,27] In contrast, Gauhar et al.'s multicenter registry confirmed cost neutrality when annual case volumes exceeded 200 RIRS procedures, as higher procedural amount allowed reusable devices to amortise repair and maintenance costs more efficiently.[24] Kam et al. also noted that reusable scopes become more cost-effective in high-volume, well-equipped centres with dedicated reprocessing infrastructure. However, they highlighted that single-use scopes mitigate hidden costs such as contamination risk, repair logistics, and staff labour for reprocessing.[19] To support these findings, Qi et al. observed that disposable ureteroscopes are particularly advantageous in emergency or satellite centres where repair facilities and sterilisation capabilities are limited.[21] Overall, the economic evidence recommends that cost-effectiveness is situation-dependent, preferring reusable scopes in high-material institutions and single-use scopes in low-volume, resource-limited, or time-sensitive surgical settings.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Single-use ureteroscopes are generally more economically favourable in low- to medium-volume hospitals performing fewer than 200 cases per year, where the high costs of repairs, maintenance, and sterilisation significantly increase the overall expense of reusable devices.[10] In contrast, reusable scopes have advantage in high-volume centres, where handling protocols, repair cycles, and reusing infrastructures are well optimised and evenly distribute costs effectively across a larger number of procedures.[37] Apart from direct financial considerations, single-use ureteroscopes have operational benefits, including consistent optical quality, elimination of cross-contamination and infection risk, and less equipment delay due to maintenance or sterilisation. These factors contribute to improved procedural efficiency, reliability, and patient safety, highlighting the complex nature of cost-effectiveness assessments in ureteroscopic practice.

Table 1: Characteristics of the studies included in the analysis

Studies (year)	Scope models compared	Mean stone size/location	Operative time (min)	SFR (%)	Complication rate (%)	Hospital stays (days)	Key findings/remarks
Ding et al. (2015),[31]	Reusable: URF P-5 (Olympus) Single-use: PolyScope (PolyDiagnost GmbH)	Stones < 30 mm, various calyceal sites	83.3 ± 17.1 vs 92.6 ± 20.2 (p < 0.01)	Overall, 91.1 vs 85.6 %; lower pole 82.0 vs 69.2 (p = 0.022)	No significant difference (hematuria 2.8 %, fever 13.9 %, urosepsis 5.0 %)	1.46 ± 1.25 vs 1.33 ± 1.04 (p = 0.27)	Comparable efficacy; slightly inferior for lower pole stones; longer OT; no added morbidity.
Usawachintachit et al. (2017),[28]	Reusable: URF-P6 (Olympus, fibre-optic) Single-use: LithoVue (Boston Scientific)	Mean stone burden 15.2 ± 10.7 mm; 44.7% lower pole	57.3 ± 25.1 vs 70.3 ± 36.9 (p < 0.05)	60.0 vs 44.7 (p = 0.36)	5.4 vs 18.0 (p < 0.05)	0.2 vs 0.35 days (p = 0.34)	LithoVue significantly reduced operative time and complications with comparable SFR and hospital stay; a safe and efficient single-use option.
Hennessey et al. (2018),[13]	Reusable: URF-V (Olympus), Flex-X^c (Storz) Single-use: LithoVue (Boston Scientific)	9 mm; mid-zone and lower-pole stones	Nil	100 % vs 77.3 %	Nil	Nil	LithoVue demonstrated superior flexion (285–286° vs 180–270°) and similar/better irrigation; technically comparable to reusable scopes. Economic analysis showed potential cost savings if priced ≤ $1200 per use. Recommended for high-risk or damage-prone cases (e.g., lower-pole, staghorn).
Mager et al. (2018),[22]	Reusable: Flex-X2S/XC (Karl Storz) Single-use: LithoVue (Boston Scientific)	Mean stone burden 101 ± 226 vs 90 ± 244 mm²; lower pole 47% vs 41%	76.2 ± 46.8 vs 76.8 ± 40.2 (p = 0.9)	82 vs 85% (p = 0.8)	7 vs 17 (p = 0.06)	Nil	Comparable clinical outcomes. Total cost per case: reusable $1212–$1743 vs single-use $1300–$3180. Single-use is cost-effective in low-volume settings; reusable is better for high-volume centres.
Salvado et al. (2019),[15]	Reusable: Cobra (Richard Wolf) Single-use: Uscope 3022 (Pusen Medical)	Lower-pole stones; mean 9.0 ± 3.3 vs 10.8 ± 5.0 mm (p = 0.2)	77 ± 37.4 vs 56 ± 34.8 (p = 0.01)	88.2 vs 95 (p = 0.1)	3 % (1 case renal colic)	2.0 ± 0.9 vs 1.9 ± 0.8 (p > 0.05)	Disposable scope significantly reduced operative and fluoroscopy times (66 vs 83 s, p = 0.02), achieved comparable SFR, and eliminated sterilisation-

ISSN (O): 2687-5365; ISSN (P): 2753-6556

							related contamination risk; effective, low-morbid option for lower-pole stones.
Kam et al. (2019),[19]	Reusable: URF-V2 (Olympus) Single-use: LithoVue (Boston Sci.), PU3022A (Pusen)	Mean stone burden = 13–15 mm; 40–60 % lower pole stones	86.1 vs 87.0 vs 72.3	Relook 13 % vs 7 % vs 10 %	15 % vs 29 % vs 19 %	Day-surgery (< 1 day)	URF-V2 had the highest visibility (4.8/5) and manoeuvrability. LithoVue is better than Pusen ($p < 0.01$). All had similar clinical outcomes. Single-use scopes approach reusable performance; economically viable in low-volume or high-risk (stone or anatomy) cases.
Qi et al. (2020),[21]	Reusable: URF-V (Olympus)Single-use: ZebraScope (Happiness Workshop, Beijing, China)	Mean stone size: 11.09 ± 4.53 vs 11.08 ± 4.34 mm ($p = 0.995$); location: upper 1.6 %, middle 4.8 %, lower 39.7 %, pelvis 11.1 %, upper ureter 42.9 % vs 38.1 %	42.97 ± 19.24 vs 41.63 ± 17.74 ($p = 0.687$)	77.78 vs 68.25 ($p = 0.229$)	4.76 vs 1.59 ($p = 0.31$)	Total 7.71 ± 3.69 vs 8.19 ± 3.04 ($p = 0.43$); post-op 2.03 ± 1.27 vs 2.06 ± 1.05 ($p = 0.88$)	Single-use ZebraScope™ demonstrated non-inferior SFR, similar operative time and complication rates, and no scope failures. It provided comparable image quality and operability to URF-V, confirming safety and effectiveness as an alternative to reusable digital scopes.
Salman et al. (2021),[29]	Reusable: Flex-X2™ (Karl Storz, Germany) Single-use: Uscope PU3022 (Pusen, China)	10–20 mm; lower calyx stones	53 ± 17.4 vs 73.1 ± 21.6 ($p < 0.001$)	77.5 vs 72.5 ($p = 0.606$)	5.0 vs 7.5 ($p = 0.644$)	Nil	Comparable SFR between both groups, but the reusable scope achieved shorter operative time, fewer sessions, and higher first-attempt success. Both were safe with low complication rates.
Bozzini et al. (2021),[14]	Reusable: Flex-X^c (Karl Storz SE & Co., Germany) Single-use: US31B-12 (Innovex, Shanghai, China)	Mean stone diameter 13.1 ± 4.9 vs 15.8 ± 4.1 mm ($p = 0.27$); comparable distribution and density	45.1 ± 18.3 vs 42.7 ± 21.2 ($p = 0.12$)	86.6 vs 90.0 ($p = 0.11$)	8.8 vs 3.3 ($p = 0.05$); major (Clavien ≥IIIa) 2.2 vs 0	3.5 ± 2.8 vs 1.8 ± 1.2 ($p = 0.04$)	Single-use ureteroscopes achieved similar SFR but significantly fewer complications, infections (16.6 vs 3.3%), and shorter hospitalisation. Costs comparable (€2321 vs €2543). Disposable scopes provide superior safety with equivalent efficacy.
Huang et al. (2021),[30]	Reusable: URF-V (Olympus, Tokyo) Single-use: ZebraScope (Happiness Workshop, Beijing, China)	Similar baseline stone burden (≈69 cm²); balanced distribution across	60.43 ± 22.76 vs 61.61 ± 19.36 ($p = 0.666$)	82.4 vs 84.9 ($p = 0.599$)	10.1 vs 11.8 ($p = 0.678$)	7.42 ± 2.06 vs 6.86 ± 1.82 ($p = 0.026$)	Comparable surgical efficacy and safety. Single-use ZebraScope had a shorter hospital stay and no increased

ISSN (O): 2687-5365; ISSN (P): 2753-6556

		calyceal and ureteral sites					complications. Cost analysis: reusable becomes more economical after 275 procedures; device choice should depend on hospital volume and resources.
Mourmouris et al. (2021),[27]	Reusable: Flex-X2™ (Karl Storz, fibre-optic) Single-use: LithoVue (Boston Scientific, digital)	Median stone size =12.6 mm; most in the renal pelvis and lower pole	45 vs 65 ($p < 0.001$)	Immediate: 70 vs 43 ($p = 0.005$); 24h: 78 vs 43 ($p < 0.001$)	Sepsis 0 vs 11 ($p = 0.049$); overall complications not significant	1.75 ± 1.96 vs 1.38 ± 0.64 ($p = 0.261$)	Single-use LithoVue significantly reduced operative time, improved SFR, and lowered sepsis risk. No significant difference in hospital stay or overall complications. Recommended as a safe and effective alternative, especially in low-resource or high-infection-risk settings.
Goger et al. (2021),[34]	Reusable: Flex-X2S (Karl Storz) Single-use: Uscope 3022 (Pusen, China)	Lower pole stones; 11.75 ± 4.89 vs 12.17 ± 4.44 mm ($p = 0.62$)	47.0 ± 9.9 vs 58.0 ± 14.3 ($p = 0.001$)	84.6 vs 80.0 ($p = 0.51$)	17.3 vs 10.0 ($p = 0.24$)	2.25 ± 2.97 vs 1.57 ± 1.97 ($p = 0.15$)	Disposable fURS achieved comparable SFR and complications but significantly shorter operative time. Both safe and effective for lower-pole stones.
Gauhar et al. (2023),[24]	Reusable (n = 4808) – fiber-optic/digital mix vs Disposable (n = 1855) – various single-use models	9.62 vs 11.84 mm ($p < 0.001$); lower pole stones 43 % vs 47 %	57.7 ± 43.8 vs 78.4 ± 43.3 ($p < 0.001$)	74.8 vs 78.2 ($p < 0.001$)	8.5 vs 10.9 ($p < 0.001$)	3.96 ± 3.5 vs 2.52 ± 3.0 ($p < 0.001$)	Disposable scopes are used more for large, lower-pole, harder stones; they achieved slightly higher SFR and shorter stay despite longer OT and more minor fevers. Safe and effective in expert hands.

Footnotes: OT – operative time; SFR – stone-free rate; PCNL – percutaneous nephrolithotomy; URS – ureteroscopy; RIRS – retrograde intrarenal surgery; UAS – ureteral access sheath; fURS – flexible ureteroscopy. Data are presented as mean ± standard deviation, median, frequencies and percentages.

CONCLUSION

In the management of renal stones using RIRS, single-use and reusable flexible ureteroscopes have similar performance, with comparable SFR, operative times, and low complication profiles. Single-use scopes have an advantage in difficult anatomy, providing stable deflection, optical quality, reliable irrigation, reduced contamination risk, and shorter hospital stays, with a high per-case cost. Reusable scopes are cost-effective in high-volume centres with established maintenance systems but have risks of scope damage, image degradation, and cross-contamination. However, choosing between the two should be by institutional case volume, economic feasibility, and infection-control priorities. Although both options are effective and safe, larger clinical studies are required to confirm their long-term outcomes, economic impact, and environmental considerations.

REFERENCES

1. Zhang L, Zhang X, Pu Y, Zhang Y, Fan J. Global, regional, and national burden of urolithiasis from 1990 to 2019: A systematic analysis for the Global Burden of Disease Study 2019. Clin Epidemiol 2022;14:971–83. https://doi.org/10.2147/CLEP.S370591.
2. Bhanot R, Jones P, Somani B. Minimally invasive surgery for the treatment of ureteric stones - state-of-the-art review. Res Rep Urol 2021;13:227–36. https://doi.org/10.2147/RRU.S311010.
3. Alenezi H, Denstedt JD. Flexible ureteroscopy: Technological advancements, current indications and outcomes in the treatment of urolithiasis. Asian J Urol 2015;2:133–41. https://doi.org/10.1016/j.ajur.2015.06.002.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

4. Rindorf DK, Tailly T, Kamphuis GM, Larsen S, Somani BK, Traxer O, et al. Repair rate and associated costs of reusable flexible ureteroscopes: A systematic review and meta-analysis. Eur Urol Open Sci 2022;37:64–72. https://doi.org/10.1016/j.euros.2021.12.013.
5. Scotland KB, Chan JYH, Chew BH. Single-use flexible ureteroscopes: How do they compare with reusable ureteroscopes? J Endourol 2019;33:71–8. https://doi.org/10.1089/end.2018.0785.
6. Isaacson D, Ahmad T, Metzler I, Tzou DT, Taguchi K, Usawachintachit M, et al. Defining the costs of reusable flexible ureteroscope reprocessing using time-driven activity-based costing. J Endourol 2017;31:1026–31. https://doi.org/10.1089/end.2017.0463.
7. Kasmani Z, Ravindraanandan M, Mahmalji W. Flexible ureteroscopy: Global user experience using disposable devices. Cureus 2023;15:e46626. https://doi.org/10.7759/cureus.46626.
8. Bragaru M, Multescu R, Geavlete P, Popescu R, Geavlete B. Comparison of flexible ureteroscope performance between reusable and single-use models. J Clin Med 2023;12:1093. https://doi.org/10.3390/jcm12031093.
9. Li Y, Chen J, Zhu Z, Zeng H, Zeng F, Chen Z, et al. Comparison of single-use and reusable flexible ureteroscopes for renal stone management: a pooled analysis of 772 patients. Transl Androl Urol 2021;10:483–93. https://doi.org/10.21037/tau-20-1009.
10. Ventimiglia E, Godínez AJ, Traxer O, Somani BK. Cost comparison of single-use versus reusable flexible ureteroscope: A systematic review. Turk J Urol 2020;46:S40–5. https://doi.org/10.5152/tud.2020.20223.
11. Proietti S, Dragos L, Molina W, Doizi S, Giusti G, Traxer O. Comparison of new single-use digital flexible ureteroscope versus nondisposable fiber optic and digital ureteroscope in a cadaveric model. J Endourol 2016;30:655–9. https://doi.org/10.1089/end.2016.0051.
12. Eisel M, Strittmatter F, Ströbl S, Freymüller C, Pongratz T, Sroka R. Comparative investigation of reusable and single-use flexible endoscopes for urological interventions. Sci Rep 2020;10:5701. https://doi.org/10.1038/s41598-020-62657-w.
13. Hennessey DB, Fojecki GL, Papa NP, Lawrentschuk N, Bolton D. Single-use disposable digital flexible ureteroscopes: an ex vivo assessment and cost analysis. BJU Int 2018;121 Suppl 3:55–61. https://doi.org/10.1111/bju.14235.
14. Bozzini G, Filippi B, Alriyalat S, Calori A, Besana U, Mueller A, et al. Disposable versus reusable ureteroscopes: A prospective multicenter randomized comparison. Res Rep Urol 2021;13:63–71. https://doi.org/10.2147/RRU.S277049.
15. Salvadó JA, Cabello JM, Moreno S, Cabello R, Olivares R, Velasco A. Endoscopic treatment of lower pole stones: is a disposable ureteroscope preferable? Results of a prospective case-control study. Cent European J Urol 2019;72:280–4. https://doi.org/10.5173/ceju.2019.1962.
16. Pauchard F, Ventimiglia E, Corrales M, Traxer O. A practical guide for intra-renal temperature and pressure management during rirs: What is the evidence telling us. J Clin Med 2022;11:3429. https://doi.org/10.3390/jcm11123429.
17. Tom WR, Wollin DA, Jiang R, Radvak D, Simmons WN, Preminger GM, et al. Next-generation single-use ureteroscopes: An in vitro comparison. J Endourol 2017;31:1301–6. https://doi.org/10.1089/end.2017.0447.
18. 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;36:529–36. https://doi.org/10.1007/s00345-017-2131-4.
19. Kam J, Yuminaga Y, Beattie K, Ling KY, Arianayagam M, Canagasingham B, et al. Single use versus reusable digital flexible ureteroscopes: A prospective comparative study. Int J Urol 2019;26:999–1005. https://doi.org/10.1111/iju.14091.
20. Knudsen BE, Posid T, Scimeca A, Sourial M, Wong KFV, Paterson RF, et al. Mp65-19 reusable digital flexible ureteroscope vs. A single-use flexible ureteroscope in the treatment of urolithiasis: An edge consortium prospective randomized clinical trial. J Urol 2021;206. https://doi.org/10.1097/ju.0000000000002105.19.
21. Qi S, Yang E, Bao J, Yang N, Guo H, Wang G, et al. Single-use versus reusable digital flexible ureteroscopes for the treatment of renal calculi: A prospective multicenter randomized controlled trial. J Endourol 2020;34:18–24. https://doi.org/10.1089/end.2019.0473.
22. Mager R, Kurosch M, Höfner T, Frees S, Haferkamp A, Neisius A. Clinical outcomes and costs of reusable and single-use flexible ureterorenoscopes: a prospective cohort study. Urolithiasis 2018;46:587–93. https://doi.org/10.1007/s00240-018-1042-1.
23. Shu C, Liu J. Status study of clinical application of ureteral access sheath in urology: a narrative review. Transl Androl Urol 2025;14:441–53. https://doi.org/10.21037/tau-24-557.
24. Gauhar V, Chai CA, Chew BH, Singh A, Castellani D, Tailly T, et al. RIRS with disposable or reusable scopes: does it make a difference? Results from the multicenter FLEXOR study. Ther Adv Urol 2023;15:17562872231158072. https://doi.org/10.1177/17562872231158072.
25. Zeng G, Wang D, Zhang T, Wan SP. Modified access sheath for continuous flow ureteroscopic lithotripsy: A preliminary report of a novel concept and technique. J Endourol 2016;30:992–6. https://doi.org/10.1089/end.2016.0411
26. Zhu Z, Cui Y, Zeng F, Li Y, Chen Z, Hequn C. Comparison of suctioning and traditional ureteral access sheath during flexible ureteroscopy in the treatment of renal stones. World J Urol 2019;37:921–9. https://doi.org/10.1007/s00345-018-2455-8.
27. Mourmouris P, Tzelves L, Raptidis G, Berdempes M, Markopoulos T, Dellis G, et al. Comparison of a single-use, digital flexible ureteroscope with a reusable, fiberoptic ureteroscope for management of patients with urolithiasis. Arch Ital Urol Androl 2021;93:326–9. https://doi.org/10.4081/aiua.2021.3.326.
28. Usawachintachit M, Isaacson DS, Taguchi K, Tzou DT, Hsi RS, Sherer BA, et al. A prospective case-control study comparing LithoVue, a single-use, flexible disposable ureteroscope, with flexible, reusable fibre-optic ureteroscopes. J Endourol 2017;31:468–75. https://doi.org/10.1089/end.2017.0027.
29. Salman MY, Bayar G, Dincer HR, Sinanoglu O. Comparison of reusable and single-use ureteroscopes for the treatment of medium-sized stones in the lower calyx: A prospective randomized study. Ann Clin Anal Med 2021;12:770–4. https://doi.org/10.4328/acam.20446.
30. Huang F, Zhang X, Cui Y, Zhu Z, Li Y, Chen J, et al. Single-use vs. Reusable digital flexible ureteroscope to treat upper urinary calculi: A propensity-score matching analysis. Front Surg 2021;8:778157. https://doi.org/10.3389/fsurg.2021.778157.
31. Ding J, Xu D, Cao Q, Huang T, Zhu Y, Huang K, et al. Comparing the efficacy of a multimodular flexible ureteroscope with its conventional counterpart in the management of renal stones. Urology 2015;86:224–9. https://doi.org/10.1016/j.urology.2015.04.018.
32. Bozkurt OF, Tepeler A, Sninsky B, Ozyuvali E, Ziypak T, Atis G, et al. Flexible ureterorenoscopy for the treatment of kidney stone within pelvic ectopic kidney. Urology 2014;84:1285–9. https://doi.org/10.1016/j.urology.2014.07.041.
33. Geavlete B, Popescu R, Georgescu D, Geavlete P. Single-use ureteroscopes in ectopic pelvic kidney stones. J Med Life 2021;14:557–64. https://doi.org/10.25122/jml-2021-0251.
34. Göger YE, Özkent MS, Kılınç MT, Taşkapu HH, Göger E, Aydın A, et al. Efficiency of retrograde intrarenal surgery in lower pole stones: disposable flexible ureterorenoscope or reusable flexible ureterorenoscope? World J Urol 2021;39:3643–50. https://doi.org/10.1007/s00345-021-03656-y.
35. Taguchi K, UsawachintachitintraT, Sherer BA, Metzler I, Isaacson D, et al. Micro-costing analysis demonstrates comparable costs for LithoVue compared to reusable flexible fiberoptic ureteroscopes. J Endourol 2018;32:267–73. https://doi.org/10.1089/end.2017.0523.
36. Khedekar PG, Viswaroop SB, Arul M, Gopalakrishnan G, Kandasami SV. The cost-effectiveness of reusable flexible ureteroscopes: An institutional audit. Indian J Urol 2024;40:179–84. https://doi.org/10.4103/iju.iju_41_24.
37. Talso M, Goumas IK, Kamphuis GM, Dragos L, Tefik T, Traxer O, et al. Reusable flexible ureterorenoscopes are more cost-effective than single-use scopes: results of a systematic review from PETRA Uro-group. Transl Androl Urol 2019;8:S418–25. https://doi.org/10.21037/tau.2019.06.13.

ISSN (O): 2687-5365; ISSN (P): 2753-6556