Clinical Outcomes of Single-Use vs Reusable Flexible Ureteroscopes in Management of Urolithiasis: A Comprehensive Systematic Review

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Abstract

Background: **The widespread adoption of disposable flexible ureteroscopes (FURS) is attributed to their high sterility state, safety, and effectiveness compared with multiple-use flexible ureteroscopes.** ***Aim:*** **This systematic review aimed to study clinical outcomes of disposable vs reusable ureteroscopes in the management of upper tract urinary stones.** ***Methods:*** **Three electronic databases Web of Science, PubMed and Scopus were searched for relevant articles published over the past ten years. Prospective and retrospective cohort studies randomized clinical trials, and case-control studies were included in the current study. Selected articles were screened, and eligible studies were included for data synthesis and analysis.** ***Results:*** **The final full-article review included 19 studies, encompassing a total of 10,729 patients, 3,853 in the disposable FURS group and 6,876 in the multiple use FURS group. The stone-free rates (SFR), operative time (OT), length of hospital stay (LOS), and complication rates were investigated. Results demonstrated that reusable FURS had shorter operative times and lower complication risks, while single-use FURS achieved higher stone-free rates and shorter hospitalization durations. Additionally, no significant statistical differences were detected in SFR, OT and LOS. In the treatment of upper tract urolithiasis, single-use FURS demonstrated efficacy comparable to that of reusable FURS.** ***Conclusion:*** **This systematic review comprehensively compared disposable and reusable FURS in urolithiasis treatment, analyzing data from 19 studies involving 10,729 patients. The evidence demonstrates that single-use FURS offer significant clinical advantages. Future research on long-term economic analyses and sustainable device development is required to address the environmental concerns associated with disposable technologies.**

Keywords Single use ureteroscope; Flexible; Reusable Ureteroscope; Ureteroscopy

Introduction

Urinary stone disease (urolithiasis) is recognized as a prevalent and clinically significant condition in daily urological practice. Recent epidemiological studies demonstrate a clearly increasing global prevalence of kidney stones, with substantial impacts on patient quality of life and healthcare systems [(1)]. In 2021, worldwide incident cases of urolithiasis reached 106 million [(2)]. Urolithiasis commonly causes stabbing pain, recurrent hospitalizations, and complications including urinary tract, infection, obstruction and long standing renal function impairment [(3)].

The rapid technical innovations in flexible ureteroscopy (FURS) have led to its increasing usage in clinical practice. FURS is considered a vital tool in the urologist's devices for treating various urinary stones. Currently, retrograde intrarenal surgery performed with various types of FURS is recognized as one of the primary treatment

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modalities for active renal stone removal according to clinical guidelines [4,5].

FURS are classified based on their functional and optical visibility properties, among other criteria. Recently, digital scopes have been developed as an advancement in this field. Although the use of FURS is widespread, several concerns have been raised, including sterilization challenges, high acquisition and maintenance costs, limited durability, the need for qualified trainers, and significant reprocessing expenses [6]. Moreover, the effectiveness of sterilization for reusable FURS has been investigated by numerous studies, which found that reprocessing methods were often insufficient and could lead to instrument contamination [7]. Additionally, regarding repair costs and scope longevity, certain endoscopic procedures particularly those targeting lower pole calyces that require greater scope deflection pose a risk of damaging the shaft of reusable FURS. This damage adversely affects procedural quality, degrades image quality, and compromises the scope's ability to effectively break stones in the most remote positions [8].

Thus, single-use FURS have been launched and are extensively used to mitigate reusable FURS disadvantages [9]. The purpose of its development was to overcome the constraints of reusable FURS in terms of maintenance and maneuverability [10]. The adoption of disposable FURS facilitates access to remote areas with forced deflection, eliminating concerns about scope shaft damage. Importantly, single-use FURS require no sterilization or repair, thereby reducing the risk of cross-contamination and eliminating repair costs entirely. Unlike multi-use FURS, which are reused multiple times over their lifespan, single-use FURS ensure equitable quality and effectiveness for all patients [11–13]. This systematic review comparatively evaluated disposable and reusable FURS for urolithiasis management, specifically analyzing operative time, stone-free rates, length of hospital stay, and complication profiles.

Methods

Research Question

Are there differences between disposable and reusable flexible ureteroscopes in the management of urolithiasis regarding stone-free rate, operative time, hospital stay and complications? Studies were selected for inclusion in our systematic review based on the PICOS (Patient/Population, Intervention, Comparison, Outcomes) framework criteria:

Population (P): Patients with urinary stones undergoing flexible ureteroscopy.

Intervention (I): Single-use flexible ureteroscopes.

Comparison (C): Reusable flexible ureteroscopes.

Outcomes (O): Stone-free rate (SFR), Operative time (OT), postoperative hospital stay and complications.

Search Strategy

The PubMed, Web of Science, and Scopus databases were systematically searched on March 3, 2025. A combination of MeSH terms and keywords was developed. English-language studies published between 2015 and March 3, 2025, were retrieved. The inclusion criteria were patients with urinary stones treated by intervention including reusable and disposable flexible ureteroscope (FURS). The disposable FURS comprised the interventional group, whereas the reusable FURS was the control group. The clinical outcomes parameters were the operation time OT, SFR, postoperative hospital stay and complication rate. Prospective, retrospective, case-control studies, and randomized clinical trial study (RCTs) were included. Reviews, opinion papers, case reports, conference abstracts, animal studies, and in vitro studies were excluded. Search terms and headings keywords used to identify these papers included: “flexible ureteroscope” OR “ureteroscopy” AND “single-use” OR “disposable” AND “reusable” AND “urolithiasis” OR “kidney stone" OR "upper urinary calculi" OR "ureteral calculi", and combinations of these search terms by Boolean operators (e.g., AND, OR).

Study Selection and Data Extraction

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was followed in current review [14]. All title and abstract of researched articles were screened by two independent reviewers (E.A.I. and S.A.S.) to identify eligible relevant articles from January 1, 2015, until March 1st, 2025. Any arguments between reviewers were fixed by (A.E.E./ A.M.M.). A data extraction Excel sheet was designed to collect relevant data from the included articles. The extracted data comprised: (1) study characteristics (authors, publication year, country, study design, sample size, and ureteroscope details); (2) participant age and (3) Clinical outcomes such as SFR, OT, complication rates and LOS. Complications were categorized using the Clavien-Dindo classification to standardize severity assessment. Grade I–II complications were considered minor, while Grade III–V were classified as major. Grade V complications are related to death. All extracted data were systematically organized and presented in figures and tables.

Quality Assessment

The bias risk and quality of selected articles were independently evaluated by two investigators, and any discrepancies between reviewers were resolved through consultation with two additional reviewers. The quality of non-randomized controlled trials was assessed based on The Newcastle-Ottawa Quality Assessment Scale (NOS) with a total score of nine points. Studies scoring from 0 to 5 were categorized as low quality and excluded, while articles scoring from 6 to 9 were considered high quality. RCTs quality was evaluated with the Cochrane Risk of Bias tool (five items) involving randomization, data integrity, blinding, allocation concealment and selective reporting or other biases.

Results

A. <u>Demographic Results:</u>

Our comprehensive systematic search across PubMed, Scopus, and Web of Science identified 519 potentially relevant studies. 286 duplicate records were removed. The remaining 233 publications' titles and abstracts were screened. This initial screening process narrowed the selection to 78 articles warranting full-text evaluation. A full-text review was conducted to exclude non-eligible articles, thus generating 19 references for qualitative analysis. Each of these 19 studies underwent rigorous evaluation to ensure methodological validity and relevance to our systematic review objectives. A PRISMA flowchart (Figure 1).

Study Designs:

Nineteen studies were included in our systematic review. The study designs were categorized as follows: one studies used prospective cohort designs [15], four studies employed retrospective cohort designs [16–18], eight studies utilized case-control designs [19–26] and seven studies utilized RCT designs [4,27–32].

Study Distribution Across Countries:

The 19 studies encompassed in this systematic review exhibit a diverse geographic distribution across different continents. The China (6) is prominent contributors followed by United States (2), Turkey (2), India (2). Other countries, including Australia, Germany, Italy, France, Greece, Chile, and Egypt also contributing valuable insights into the FURS. (Figure 2)

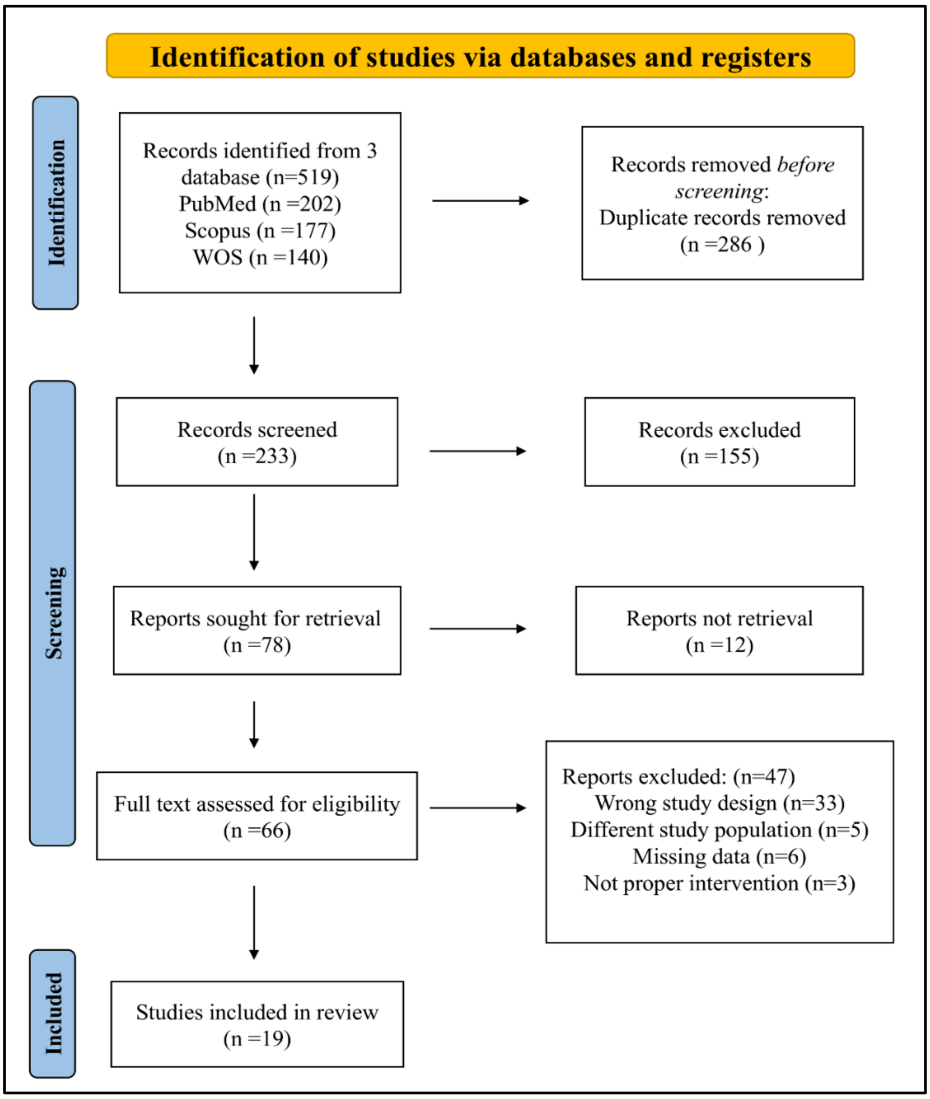

Figure (1): PRISMA flowchart demonstrating the study identification, screening, inclusion process, and final number of selected studies

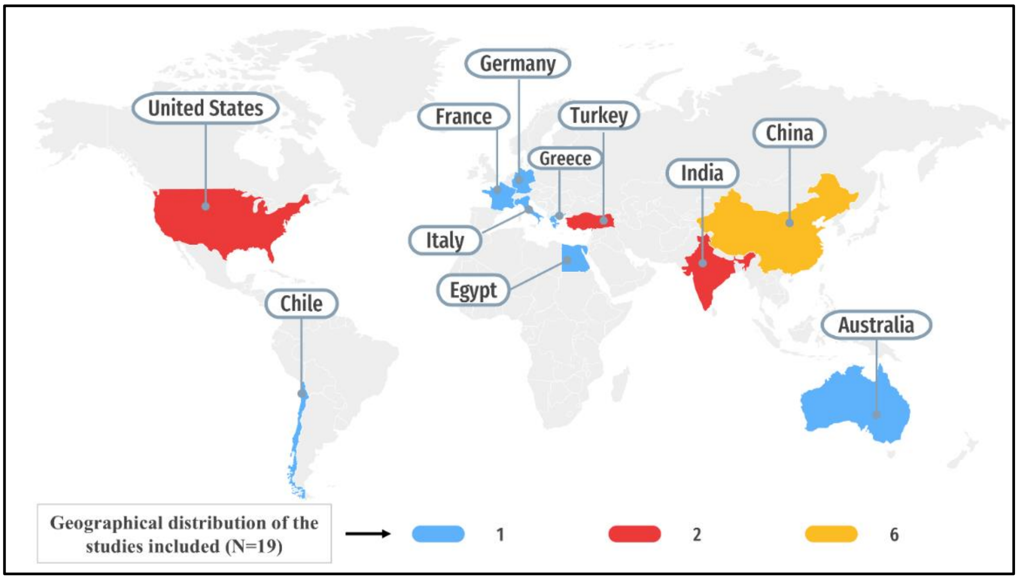

Figure (2): Geographic distribution of included studies

Sample Size Variability and Age Distribution:

The total sample size 10,729 patients (3853 single FURS and 6876 reusable FURS). The included articles determined substantial heterogeneity in patients number, ranging from a smallest sample size 49 [25] to a maximum of 6663 cases [17]. The age distribution of participants demonstrated considerable variability among studies, reflecting the heterogeneity of the examined populations.

The included studies' features exhibited diversity in study design, geographic origin, sample size, and participant age ranges in Table 1. A total of 519 studies were identified in the current review search strategy. Of these, 66 underwent full review, and 19 were ultimately selected, all published between 2015 and 2025 [4, 15-32].

Table 1. Design, population, and geographic profile of selected studies

Study	Country	Study design	SU FURS		RU FURS	
			Sample size	Age (y)	Sample size	Age (y)
Ding et al.(2015)	China	RCT	180	50.5±12.8	180	51.1±13.7
Kam et al (2019)	Australia	Prospective case–control	86	Median 53.5 (IQR I46.2–60.7)	64	Median 53.3 (IQR 47.6-59.0)
Mager et al. (2018)	Germany	Prospective cohort	68	54±17	68	59 ± 16
Shiyong et al. (2019)	China	RCT	63	51.84±13.16	63	53.25±12.11
Salvadó et al. (2019)	Chile	Prospective case–control study	31	50.4±13.8	30	49.9±16.5
Usawachintachit et al. (2017)	USA	Prospective case–control study	115	55.8±15.1	65	50.5±12.6
Zhu et al.(2020)	China	RCT	45	45.1±9.3	45	44.5±8.5
Bozzini et al. (2021)	Italy	RCT	90	59.4 ± 19.8	90	55.7 ± 24.8
Göger et al. (2021)	Turkey	Prospective case–control	52	52.4 ± 19.4	70	48.73 ± 14.7
Mourmouris et al. (2021)	Greece	RCT	40	55.73 ±13.47	37	55 ± 11.2
Yang et al.(2021)	China	Prospective case-control	25	52.72 ±11.79	24	54.00 ± 12.69
Huang et al. (2022)	China	RCT	119	49.4 ± 12.7	119	49.0 ± 12.0
Baboudjian et al. (2021)	France	Retrospective cohort	136	Median 57 (IQR 44–66)	186	Median 57 (IQR 45–65)
Jing et al. (2024)	China	Prospective case–control	78	41.31 ±13.86	135	38.91 ± 10.41
Şahin et al. (2025)	Turkey	Prospective case–control	229	46.61 ± 13.54	229	45.85 ± 13.96
Gauhar et al. (2023)	India	Retrospective cohort	1855	48.93 ± 14.29	4808	49.52 ± 16.06
Unno et al.(2023)	USA	Retrospective cohort	500	51.94 ± 16.24	491	52.87 ± 15.49
Ali et al.(2022)	Egypt	RCT	121	20–85 / 48.2 ± 13	121	20–77 / 47.6 ± 12.4
Philip et al (2024)	India	Retrospective case-control	51	NR	51	NR

Ureteroscope information:

Our study incorporated various models of single-use FURS, with the most frequently utilized being the LithoVue™ (Boston Scientific, Marlborough, USA), followed by the ZebraScope™ (Happiness Workshop, Beijing, China) and other devices. Among reusable FURS, the URF-V (Olympus) was the predominant model, with additional types detailed in Table 2.

Table 2. Distribution of scope model in the Study

Study	Ureteroscope information	
	SU FURS	RU FURS
Ding et al. (2015)	Modular (PolyDiagnost)	URF P5 (Olympus)
Kam et al. (2019)	LithoVue™ (Boston Scientific) PU3022A (Pusen)	URF-V2 (Olympus)
Mager et al. (2018)	LithoVue™ (Boston Scientific)	Flex-X2S, Flex-XC (Karl Storz)
Shiyong et al. (2019)	ZebraScope (China)	URF-V (Olympus)
Salvadó et al. (2019)	Uscope 3022	Cobra ™
Usawachintachit et al. (2017)	LithoVue™ (Boston Scientific)	URF-P6 ™
Zhu et al. (2020)	PU3022A	FLEX -X2
Bozzini et al. (2021)	US31B-12 (Innovex)	FLEX X (Karl Storz)
Göger et al. (2021)	Uscope 3022	FLEX -X2 (Karl Storz)
Mourmouris et al. (2021)	LithoVue™ (Boston Scientific)	Flex X2 (Karl Storz)
Yang et al. (2021)	ZebraScope™	URF-V (Olympus)
Huang et al. (2022)	ZebraScope™	URF-V (Olympus)
Baboudjian et al. (2021)	Uscope PU3022™	Not reported
Jing et al. (2024)	Uscope 3022A® (Pusen)	URF-V (Olympus)
Şahin et al. (2025)	HU-30 Hugemed	FLEX X (Karl Storz)
Gauhar et al. (2023)	LithoVue™ (Boston Scientific) and Multiple brands	71% fiberoptic and 29% digital
Unno et al. (2023)	LithoVue™ (Boston Scientific)	URF-P6 (Olympus)
Ali et al. (2022)	WiScope® (OTU Medical)	Flex-XC (Karl Storz)
Philip et al (2024)	KMC	ROY

Assessment of clinical outcomes

Two-proportion z-test was used in SFR evaluation while in OT and HS Welch's t-test was used (for unequal variances/sample sizes), with studies lacking standard deviations, unreported outcomes, or medians without raw data excluded from testing.

1. Stone-Free Rate

A systematic analysis of 17 studies revealed that SU FURS achieved a better SFR than RU FURS Table (3). Regarding SFR, the SU group has a significantly higher SFR than the RU group (80.4% vs. 76.0%, $p < 0.0001$). This suggests that SU is linked with a higher overall success rate in attaining SFR compared to RU.

Table 3. Comparative clinical outcomes of stone-free rate

Study (Year)	Intervention	Patients	SFR	Intergroup p- value	Overall p-value
Ding et al. (2015)	SU FURS	180	85.60%	0.101*	
	RU FURS	180	91.10%		
Ali et al. (2022)	SU FURS	121	96%	1.000*	
	RU FURS	121	96%		
Baboudjian et al. (2021)	SU FURS	136	61.70%	0.928*	
	RU FURS	186	62.90%		
Bozzini et al. (2021)	SU FURS	90	90.00%	0.486*	
	RU FURS	90	86.60%		
Philip et al (2024)	SU FURS	51	80.40%	0.048*	
	RU FURS	51	62.70%		
Salvadó et al. (2019)	SU FURS	31	95%	0.417#	
	RU FURS	30	88.20%		
Mager et al. (2018)	SU FURS	68	85%	0.641*	
	RU FURS	68	82%		
Mourmouris et al. (2021)	SU FURS	40	78%	0.002*	
	RU FURS	37	43%		
Gauhar et al. (2023)	SU FURS	1,855	78.22%	0.001*	p < 0.0001
	RU FURS	4,808	74.83%		
Göger et al. (2021)	SU FURS	52	84.60%	0.511*	
	RU FURS	70	80.00%		
Huang et al. (2022)	SU FURS	119	84.90%	0.599*	
	RU FURS	119	82.40%		
Jing et al. (2024)	SU FURS	78	88.50%	0.041*	
	RU FURS	135	77.00%		
Yang et al. (2021)	SU FURS	25	84.00%	0.047*	
	RU FURS	24	58.33%		
Shiyong et al. (2019)	SU FURS	63	77.78%	0.229*	
	RU FURS	63	68.25%		
Unno et al. (2023)	SU FURS	500	90.0%	0.004*	
	RU FURS	491	83.90%		
Usawachintachit et al. (2017)	SU FURS	92	60.0%	0.072*	
	RU FURS	50	44.70%		
Şahin et al. (2025)	SU FURS	229	74.9%	0.132*	
	RU FURS	229	78.8%		

* Chi-square, #Fisher's exact, SU FURS; Single-use flexible ureteroscopes, RU FURS; reusable flexible ureteroscopes

2. Operative Time

A systematic analysis of 15 studies revealed that reusable FURS had shorter OT than SU FURS in Table (4). Regarding OT, were highly variable, reusable FURS had shorter OT compared with SU FURS. No statistically significant difference in OT between SU and RU groups was found overall (-2.26 minutes, 95% CI: -9.17 to 4.66, $p > 0.05$). Gauhar et al. (2023) and Ding et al. (2015) found that reusable scope was faster than single use by 20.7 min ($p<0.001$) and 9.3 min ($p<0.001$), respectively. While Jing et al. (2024) documented that single use was faster than RU FURS by 18.23 min ($p<0.001$).

However, this disagreement could be due to the sample size discrepancy of Gauhar (6,663 patients) vs. Jing (213 patients).

Table 4. Comparative clinical outcomes of operative time

Study (Year)	Intervention	Patients	Operative Time (Minutes)	Intergroup p- value	Overall p-value
Ding et al. (2015)	SU FURS	180	92.6 ± 20.2	1.000	P>0.05
	RU FURS	180	83.3 ± 17.1		
Ali et al. (2022)	SU FURS	121	Median 65 (IQR 50–75)	0.841	
	RU FURS	121	Median 65 (IQR 53.5–77.5)		
Baboudjian et al. (2021)	SU FURS	136	Median 60 (IQR 45–76)	0.962	
	RU FURS	186	Median 60 (IQR 45–79)		
Bozzini et al. (2021)	SU FURS	90	42.71 ± 21.22	0.425	
	RU FURS	90	45.07 ± 18.33		
Philip et al (2024)	SU FURS	51	60.16 ± 8.10 min	1.000	
	RU FURS	51	60.16 ± 8.10 min		
Salvadó et al. (2019)	SU FURS	31	56.1 ± 34.8 min	0.021	
	RU FURS	30	77 ± 37.4 min		
Mager et al. (2018)	SU FURS	68	76.8 ± 40.2 min	0.935	
	RU FURS	68	76.2 ± 46.8 min		
Gauhar et al. (2023)	SU FURS	1,855	78.37 ± 43.29	0.001	
	RU FURS	4,808	57.67 ± 43.84		
Göger et al. (2021)	SU FURS	52	47.02 ± 9.91	0.001	
	RU FURS	70	57.97 ± 14.28		
Huang et al. (2022)	SU FURS	119	61.61 ± 19.36	0.669	
	RU FURS	119	60.43 ± 22.76		
Jing et al. (2024)	SU FURS	78	51.27 ± 13.80	0.001	
	RU FURS	135	69.50 ± 16.76		
Yang et al. (2021)	SU FURS	25	40.52 ± 17.63	0.667	
	RU FURS	24	42.88 ± 20.14		
Shiyong et al. (2019)	SU FURS	63	42.97 ± 19.24	0.687	
	RU FURS	63	41.63 ± 17.74		
Usawachintachit et al. (2017)	SU FURS	92	57.3 ± 25.1	0.015	
	RU FURS	50	70.3 ± 36.9		
Şahin et al. (2025)	SU FURS	229	59.38 ± 40.84 minutes	0.319	
	RU FURS	229	62.68 ± 25.01 minutes		

Independent samples t-test (Welch's) for studies reporting mean ± SD; Mann-Whitney U test for studies reporting median (IQR), SU FURS; Single-use flexible ureteroscopes, RU FURS; reusable flexible ureteroscopes

3. Length of hospital Stay

A systematic analysis of 10 studies revealed that SU FURS had shorter hospitalization durations than RU FURS. Hospital stays results demonstrated a duration reduction in SU FURS particularly in large studies. Gauhar et al. (2023) and Huang et al. (2022) found HS was reduced in single use by 1.44 days (p <0.001) and 0.56 days (p <0.027), respectively. In contrast, Mourmouris et al. (2021) RU had non-significant shorter of HS than SU (1.38±0.64 vs. 1.75±1.96). There is no statistically significant difference in hospital stay duration P>0.05between SU and RU groups across the studies analyzed.

The point estimate favors SU by 0.42 days, but high heterogeneity and wide confidence intervals preclude definitive conclusion. Table 5

Table 5. Comparative clinical outcomes of length of hospital stay					
Study (Year)	Intervention	Patients	Hospital Stay (Days)	Intergroup p- value	Overall p-value
Ding et al. (2015)	SU FURS	180	1.46 ± 1.25	0.284	P>0.05
	RU FURS	180	1.33 ± 1.04		
Bozzini et al. (2021)	SU FURS	90	1.8 ± 1.2	<0.001	
	RU FURS	90	3.5 ± 2.8		
Mourmouris et al. (2021)	SU FURS	40	1.75 ± 1.96 days	0.264	
	RU FURS	37	1.38 ± 0.64 days		
Gauhar et al. (2023)	SU FURS	1,855	2.52 ± 2.99	<0.001	
	RU FURS	4,808	3.96 ± 3.54		
Göger et al. (2021)	SU FURS	52	2.25 ± 2.97	0.155	
	RU FURS	70	1.57 ± 1.97		
Huang et al. (2022)	SU FURS	119	6.86 ± 1.82	0.027	
	RU FURS	119	7.42 ± 2.06		
Jing et al. (2024)	SU FURS	78	2.86 ± 1.50	0.177	
	RU FURS	135	3.14 ± 1.37		
Yang et al. (2021)	SU FURS	25	7.52 ± 2.86	0.308	
	RU FURS	24	8.42 ± 3.23		
Shiyong et al. (2019)	SU FURS	63	7.71 ± 3.69	0.427	
	RU FURS	63	8.19 ± 3.04		
Şahin et al. (2025)	SU FURS	229	1.09 ± 0.41 days	0.030	
	RU FURS	229	1.19 ± 0.56 days		
Statistical test of difference (Welch's t-test); SU FURS; Single-use flexible ureteroscopes, RU FURS; reusable flexible ureteroscopes					

4. Complications

The data from 17 studies comparing complication rates between SU and RU devices was analyzed in table 6. Individual studies showed mixed results, with a minority (3/17) (Şahin et al. (2025), Salvadó et al. (2019) and Usawachintachit et al. (2017)) indicating significantly lower complications with RU devices. The overall complications rate of SU FURS was 12.6% (total SU patients: 3,588) compared to 10.8% for RU FURS (total RU patients: 6,634). An unadjusted Chi-square Test:

- Odds ratio (OR): 1.19 (SU had 19% higher odds of complications vs. RU).
- Risk ratio (RR): 1.17 (SU had a 17% higher risk of complications than RU).

The analysis suggested a statistically significant higher complication rate with SU devices (p=0.0057). However, sample sizes varied across studies, which may explain the lower complication rate observed with RU FURS (e.g., Gauhar et al. disproportionately sample size). Table 6.

In Table (7); Comparing 11 studies by using the Clavien-Dindo classification, statistical analysis. The overall complications were 1.04 (95% CI: 0.78–1.4). SU scopes had slightly higher raw overall rates (11.2% vs. 9.4%), with no significant difference in overall complication risk between SU and RU scopes (p-value: 0.79). Regarding severe complications (Grades III–IV) (RR): 0.96 (95% CI: 0.60–1.53) and there was no significant difference in severe complication risk (Chi-square Test: $\chi^2 = 0.65$, p=0.42; p-value: 0.88) Figure (1). Sahin et al. (2025) reported higher RU FURS complications (15.7% vs. 4.8%), while Huang et al. (2022) favored RU FURS (10.1% vs. 11.8%).

Table 6. Comparative analysis of complication rates between single-use and reusable flexible ureteroscopes

Author (Year)	Intervention	Patients	Complications rate	Intergroup p-value	Overall p-value
Baboudjian et al. (2021)	SU FURS	136	24	0.53*	0.0058
	RU FURS	186	28		
Bozzini et al. (2021)	SU FURS	90	3	0.12*	
	RU FURS	90	8		
Şahin et al. (2025)	SU FURS	229	11	<0.001*	
	RU FURS	229	36		
Göger et al. (2021)	SU FURS	52	9	0.25#	
	RU FURS	70	7		
Huang et al. (2022)	SU FURS	119	14	0.68*	
	RU FURS	119	12		
Gauhar et al. (2023)	SU FURS	1,855	202	0.002*	
	RU FURS	4,808	407		
Mager et al. (2018)	SU FURS	68	12	0.068*	
	RU FURS	68	5		
Kam et al. (2019)	SU FURS	86	18	0.74*	
	RU FURS	64	12		
Mourmouris et al. (2021)	SU FURS	40	2	0.15#	
	RU FURS	37	6		
Salvadó et al. (2019)	SU FURS	31	1	1.00#	
	RU FURS	30	0		
Unno et al. (2023)	SU FURS	323	43	0.92*	
	RU FURS	360	47		
Ali et al. (2022)	SU FURS	121	2	1.00#	
	RU FURS	121	2		
Ding et al. (2015)	SU FURS	180	36	0.21*	
	RU FURS	180	27		
Jing et al. (2024)	SU FURS	78	36	0.48*	
	RU FURS	135	69		
Yang et al. (2021)	SU FURS	25	8	0.20*	
	RU FURS	24	12		
Shiyong et al. (2019)	SU FURS	63	26	0.72*	
	RU FURS	63	28		
Usawachintachit et al. (2017)	SU FURS	92	5	0.02#	
	RU FURS	50	9		

* Chi-square, #Fisher's exact, SU FURS; Single-use flexible ureteroscopes, RU FURS; reusable flexible ureteroscopes

Table 7. Clavien-Dindo graded postoperative complications in single-use vs. reusable ureteroscopy

Author (Year)	Intervention	Patients	Minor		Major		Overall
			G I	G II	G III	G IV	
Baboudjian et al. (2021)	SU FURS	136	7	14	3	0	24
	RU FURS	186	12	15	1	0	28
Bozzini et al. (2021)	SU FURS	90	3	0	0	0	3
	RU FURS	90	6	0	2	0	8
Şahin et al. (2025)	SU FURS	229	0	8	3	0	11
	RU FURS	229	5	15	15	1	36
Göger et al. (2021)	SU FURS	52	2	7	0	0	9
	RU FURS	70	3	3	1	0	7
Huang et al. (2022)	SU FURS	119	9	4	0	1	14
	RU FURS	119	6	3	1	2	12
Gauhar et al. (2023)	SU FURS	1,855	137	33	32	0	202
	RU FURS	4,808	270	51	86	0	407
Mager et al. (2018)	SU FURS	68	7	2	3	0	12
	RU FURS	68	4	0	1	0	5
Kam et al. (2019)	SU FURS	86	12	5	1	0	18
	RU FURS	64	8	4	0	0	12
Mourmouris et al. (2021)	SU FURS	40	2	0	0	0	2
	RU FURS	37	2	0	0	4	6
Salvadó et al. (2019)	SU FURS	31	1	0	0	0	1
	RU FURS	30	0	0	0	0	0
Unno et al. (2023)	SU FURS	323	9	30	2	2	43
	RU FURS	360	17	27	2	1	47

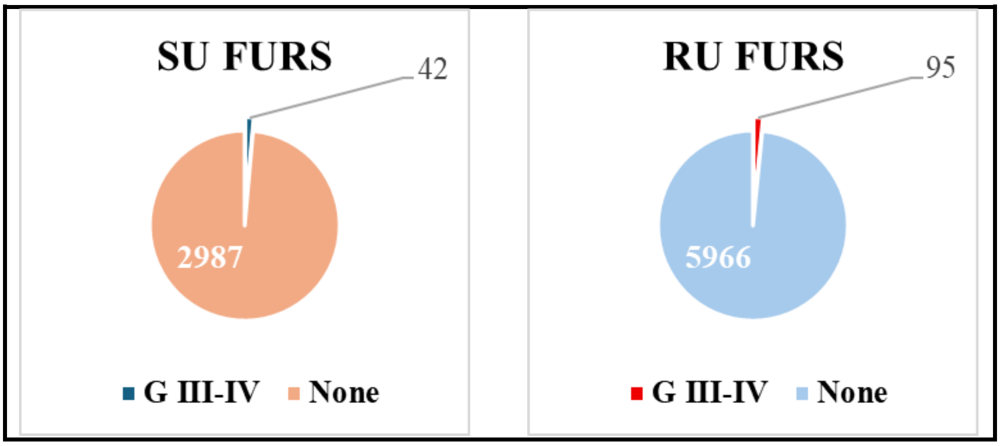

Figure (3): Severe complications (Grades III–IV) Clavien-Dindo graded

Discussion

Technological advancements in endourology have enabled urologists to transition from invasive surgical procedures like PCNL to less invasive FURS for stone management. Owing to its superior urinary tract access and visualization capabilities, FURS has emerged as both a safe and effective therapeutic option for nephrolithiasis. Current guidelines now recommend FURS as a primary treatment for renal calculi, particularly for stones <20 mm in diameter [33]. However, FURS still has various disadvantages, including high acquisition cost, the frequent repair and maintenance, limited deflection range and risk of cross infection. This systematic review aimed to comprehensively investigate clinical outcomes OT, SFR, hospital stay duration, and complication rates of disposable flexible ureteroscopes Vs a repeated ureteroscope in the urinary stones therapy.

Our review demonstrated that reusable FURS had shorter operative times, while SU FURS achieved higher SFR, shorter hospitalization durations, and lower complication risks. Overall, disposable FURS demonstrated similar efficacy to multi use FURS in treating urolithiasis. These results could be attributed to sample size discrepancies (large studies favored reusable ureteroscopes for operative time but single-use ureteroscopes for stone-free rate and hospital stay), methodological variability (e.g., inconsistent SFR definitions or OT reporting formats), and geographical/protocol differences.

Regarding SFR findings outcomes, single-use FURS demonstrated superior efficacy in stone treatment compared to reusable devices and multiple studies reported higher SFR with SU FURS. SFR definitions vary across studies, however most commonly define it as ≤2 mm residual fragments post-procedure (34). Mager et al. (2018) reported an SFR of 85% for single-use FURS versus 82% for reusable FURS, while Philip et al. (2024) found significantly higher rates with single-use devices (80.40% vs. 62.70%, respectively) (15,21). Shiyong Qi et al sound that digital SU FURS are a safe and effective alternative to RU FURS (30). Gauhar et al. (2023), in their large-scale study, also found that single-use FURS demonstrated superior SFR (78.22%) compared to multi-use devices (74.83%), although a statistically non-significant difference was observed between groups (17). Usawachintachit et al. reported that SU FURS, the patients who had substantial fragments (>2 mm), free of fragments, insignificant residual fragments (2 mm), and was 27.5%, 60.0% and 12.5%, respectively, while for multi-use FURS, those percentages were 42.1%, 44.7% and 13.2% (24). These results suggest that disposable scope may enhance stone clearance, possibly due to consistent optical quality, high quality with free movement, and optimal deflection mechanics inherent in new, single-use scopes (24). In contrast, Şahin et al. (2025) found that reusable FURS demonstrated greater effectiveness in achieving complete stone fragmentation without residual fragments (78.8%) compared to single-use FURS (74.9%) (22). This discrepancy may be attributed to variability in stone composition and location, differences in surgeon experience and familiarity with use scopes and heterogeneity in study protocols such as laser settings and fragmentation techniques (35). Further high-quality studies are needed to refine patient selection and optimize treatment strategies.

Regarding OT between the two types of devices. According to articles studied, disposable FURS were associated with more SFR, but a longer OT compared with repeated FURS, though subgroup analysis revealed no statistically significant differences in OT between the two modalities. The longer OT in single-use FURS could be attributed to its lesser image quality. Many studies stated that the RU FURS displayed superior visibility rates compared to single use FURS on a 5-point Likert scale (26,36,37). The type of ureteroscope may influence operative time, as digital FURS typically provide superior image quality compared to fiberoptic models. Somani et al stated that the mean OT was significantly longer in the fiberoptic FURS compared with digital FURS (38). In our systematic review, six studies utilized the LithoVue™ (Boston Scientific, Marlborough, USA). Bell et al. compared the LithoVue™ with both the URF-P5/P6 and the digital Flex-Xc, observing that the LithoVue™ demonstrated inferior performance in most assessments of user comfort and maneuverability (39). Furthermore, the operation of SU FURS needs more training under guidance. Thus, the increase in the quantity of operations, the mean OT gradually diminished [29].

The comparative analysis of complication rates and hospital stay between single-use and reusable reveals clinically important differences. A significantly higher complication rate with SU devices compared with RU (11.2% vs. 9.4%). This finding warrants careful consideration, as it suggests that while SU FURS may offer advantages in stone-free rates and HS, they might carry a modestly increased risk of procedural complications. Possible explanations for this discrepancy include possible differences in device flexibility or irrigation dynamics and variations in reporting standards across studies. A systematic analysis of 10 studies revealed that SU FURS had shorter hospitalization durations than RU FURS. Gauhar et al. (2023) and Huang et al. (2022) found HS was reduced in single use by 1.44 days (p <0.001) and 0.56 days (p <0.027), respectively [17,40]. In contrast, Mourmouris et al. (2021) RU had non-significant shorter of HS than SU (1.38±0.64 vs. 1.75±1.96) [32]. Prolonged operative duration correlates with increased susceptibility to systemic inflammatory response syndrome (SIRS), febrile episodes, and septic complications, particularly in cases involving infected urinary calculi [41]. Discharge protocol, differences in postoperative management strategies and variance in health care system and patient population studied [42].

Our systematic review has several limitations, particularly regarding discrepancies in sample sizes across the included studies, with some studies having particularly small cohorts. Additionally, the completeness of data reporting varied among the existing research articles.

Conclusion

The review found that reusable FURS were associated with shorter operative times and lower complication risks, while single-use FURS demonstrated higher stone-free rates and shorter hospitalization durations. Single-use FURS showed comparable efficacy to reusable FURS in treating renal lithiasis. Single-use FURS may represent a preferable option for medical centers with limited ureteroscope maintenance experience or relatively few ureteroscopy cases. However, additional clinical trials evaluating the efficacy of SU FURS replacement are warranted.

List of Abbreviations

FURS: Flexible Ureteroscopes
HS: Hospital Stay
LOS: Length of Hospital Stay
MeSH: Medical Subject Headings
NOS: Newcastle-Ottawa Quality Assessment Scale
OT: Operative Time
PICOS: Patient/Population, Intervention, Comparison, Outcomes
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT: Randomized Clinical Trial
RU FURS: Reusable Flexible Ureteroscope
SFR: Stone-Free Rate
SU FURS: Single-Use Flexible Ureteroscope
WOS: Web Of Science

Declarations

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