Clinical Outcomes and Complication Profiles of Single-Use versus Reusable Flexible Ureteroscopes in Complex Renal Lithiasis: A Multicenter Retrospective Analysis

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ABSTRACT

Introduction: Complex renal lithiasis presents technical challenges for flexible ureteroscopy (fURS), especially in cases involving abnormal renal anatomy, steep infundibulo-pelvic angles, or partial staghorn calculi. As single-use ureteroscopes increasingly enter routine practice, comparative data on safety, efficiency, and complication profiles remain essential.

Materials and Methods: This retrospective multicenter analysis included 185 patients with complex renal stones (≤25 mm) treated with flexible ureteroscopy between January and December 2024 at two tertiary urology centers in Bucharest, Romania. Patients were divided into two groups based on device availability: Group 1 used reusable ureteroscopes (Richard Wolf and Hawk) and single-use devices (Pusen), while Group 2 used primarily reusable flexible ureteroscopes alongside Pusen single-use scopes. All procedures were performed using a 75W Ho:YAG laser. Outcomes included operative time, complications (Clavien–Dindo), stone-free rate (SFR), fever incidence, and hospital stay.

Results: The overall SFR was 87.1%, with no significant intergroup difference (89.5% vs. 84.4%). Operative time was significantly lower in the single-use group (54.8 ± 11.3 min) compared to reusable ureteroscopes (60.2 ± 13.1 min; P=0.03). Complications occurred in 13.5% of cases, predominantly Clavien I–II, while Clavien III complications were rare (1.08%). Fever rates were lower with single-use scopes (4.2% vs. 8.5%; P=0.04). Hospitalization was shorter in the single-use group (1.5 vs. 2.1 days; P=0.02).

Conclusions: Single-use ureteroscopes offer improved operative efficiency and reduced postoperative fever and hospital stay. Given similar SFR and complication rates, case-tailored selection represents the most cost-effective and clinically balanced strategy.

Keywords: flexible ureteroscopy, single-use ureteroscope, reusable ureteroscope, renal lithiasis, complications, staghorn calculi, Clavien–Dindo

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Introduction

The prevalence of renal lithiasis continues to rise worldwide, with complex stones—such as those located in anomalous kidneys, partial staghorn calculi, or lower-pole calculi with acute infundibulo-pelvic angles—posing significant challenges for endourologists (1,2). Flexible ureteroscopy (fURS) has become a primary modality for treating stones up to 25 mm due to advances in digital imaging, laser fragmentation efficiency, and ureteroscope deflection capabilities (3). However, the performance of fURS remains influenced by scope type, ergonomics, deflection durability, and image quality (4).

The recent rise of single-use ureteroscopes aims to overcome limitations associated with reusable devices, including sterilization failures, structural wear, optical degradation, and maintenance costs (5–7). Several studies suggest comparable stone-free rates between single-use and reusable fURS, with potential advantages in infection control, especially in high-risk or complex anatomical cases (8,9).

Despite increased adoption, real-world multicenter evaluations focusing on complications in complex renal lithiasis remain scarce. This study compares outcomes and complication profiles between single-use and reusable flexible ureteroscopes in a large retrospective multicenter cohort from two tertiary Romanian centers.

Materials and Methods

Study Design and Patient Population

This retrospective multicenter study included 185 consecutive patients treated for complex renal lithiasis at two tertiary centers in Bucharest, Romania, between January 1 and December 31, 2024. Inclusion criteria:

- Stones ≤25 mm
- Complex renal anatomy (horseshoe kidney, partial staghorn, steep IPA <45°, narrow infundibulum)
- Age ≥18 years

Exclusion criteria included solitary kidney, active infection, coagulopathy, pregnancy, and incomplete imaging.

Patients were divided into two groups:

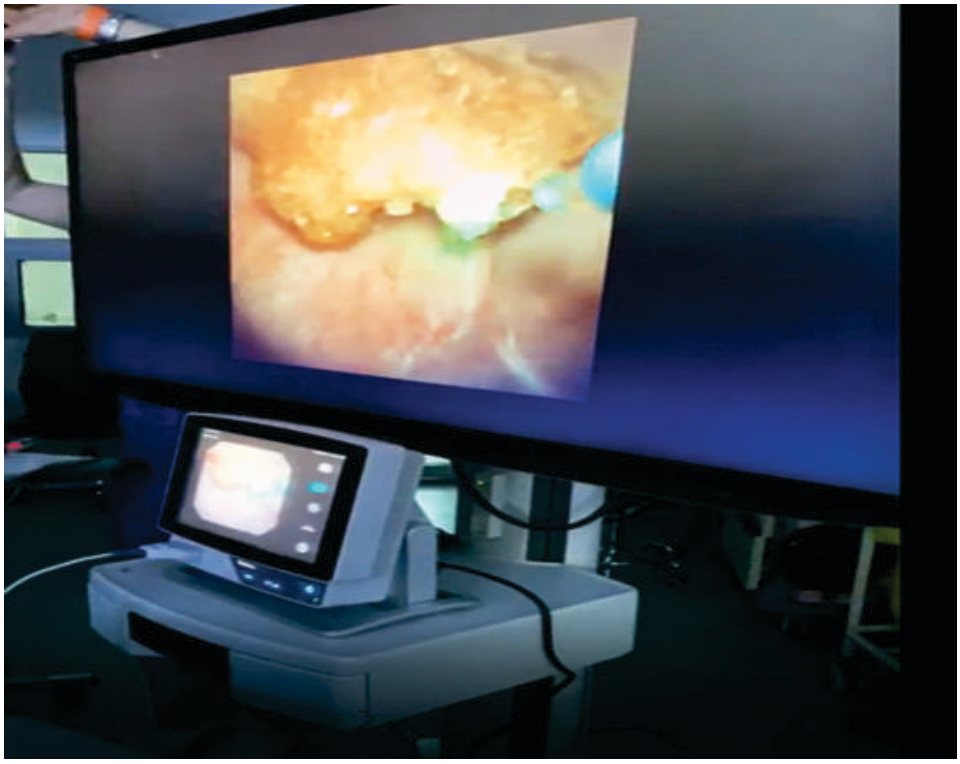
- Group 1 (n=95): Saint John Clinical Emergency Hospital
  - Reusable scopes: Richard Wolf
  - Single-use: Pusen fURS
- Group 2 (n=90): Prof. Dr. Th. Burghele Clinical Hospital
  - Reusable scopes: Hawk
  - Single-use: Pusen fURS

Figure 1 – Single-use Pusen fURS



Procedure and Technique
All procedures used:
· 7.5–9.5 Fr access sheaths
· 75W Holmium:YAG laser (settings adapted per stone density and location)
· Postoperative JJ stent when indicated
· Standard antibiotic prophylaxis per EAU guidelines (10)

Figure 2 - Starting lithotripsy for caliceal stone – Holmium laser



Stone density was classified according to predefined Hounsfield unit categories (750–1350 HU). Postoperative assessment was performed using X-ray, ultrasonography, or non-contrast CT, depending on clinical requirements. The primary outcomes included the stone-free rate (SFR) and the complication rate as defined by the Clavien–Dindo classification. Secondary outcomes consisted of operative time, the incidence of postoperative fever, the length of hospitalization, and the need for second-look ureteroscopy.

Results

A total number of 185 patients were included in this study. Baseline demographics and clinical characteristics were comparable between groups, demonstrating successful randomization (Table 1).

Table 1. Baseline Patient Characteristics

Variable	Overall (n=185)	Reusable fURS (n=95)	Single-use fURS (n=90)	P-value
Mean age (years)	52.6 ± 13.4	51.8 ± 12.9	53.4 ± 13.8	0.41
Male sex, n (%)	109 (58.9%)	57 (60.0%)	52 (57.8%)	0.77
Mean stone size (mm)	14.8 ± 4.1	15.1 ± 4.2	14.5 ± 3.9	0.32
HU density range	750–1350	750–1350	750–1350	—
Pre-operative JJ stent, n (%)	133 (71.8%)	70 (73.7%)	63 (69.7%)	0.56

No statistically significant differences were observed between groups in terms of age, sex distribution, stone size, or pre-operative stenting rates, confirming baseline equivalence.

Operative parameters are summarized in Table 2. The single-use fURS group demonstrated significantly shorter operative time compared to the reusable fURS group (54.8 ± 11.3 min vs. 60.2 ± 13.1 min, P=0.03). The use of ureteral access sheaths was high and comparable between groups (96% vs. 94%, P=0.61). Second-look procedures were required in 14.1% of reusable fURS cases and 11.5% of single-use fURS cases, with no statistically significant difference (P=0.49).

Figure 3 – Intraoperative imaging of Single-use fURS lithotripsy

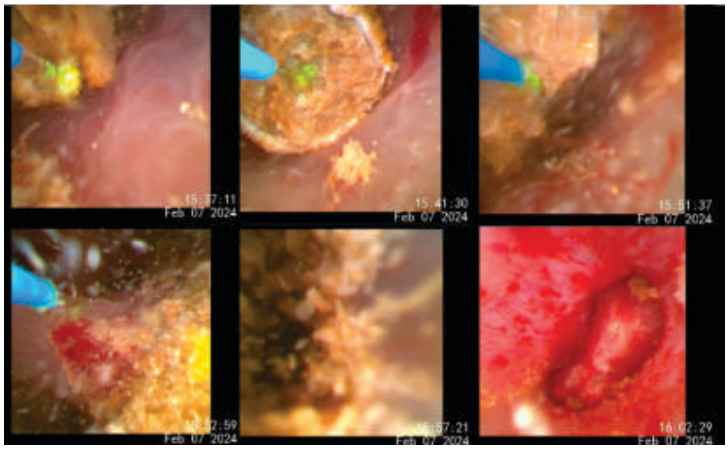


Table 2. Operative Data

Parameter	Reusable fURS (n=95)	Single-use fURS (n=90)	P-value
Mean operative time (min)	60.2 ± 13.1	54.8 ± 11.3	0.03
Use of access sheath, n (%)	89 (94%)	86 (96%)	0.61
Second-look procedure, n (%)	13 (14.1%)	10 (11.5%)	0.49

Perioperative complications were classified according to the Clavien–Dindo system (Table 3). The overall complication rate was 13.5%, with a trend toward lower rates in the single-use fURS group (9.3% vs. 13.9%, P=0.07).

Grade I complications (fever and pain) occurred significantly less frequently in the single-use group (4.2% vs. 8.5%, P=0.04). Grade II complications, including urinary tract infections and hematuria requiring medical management, were similar between groups (3.1% vs. 4.3%, P=0.51). Grade III complications requiring intervention (stent repositioning, ureteral injury management) were rare and comparable in both groups (1.0% vs. 1.1%, P=0.89).

Table 3. Complications According to Clavien–Dindo Classification

Complication Grade	Reusable fURS (n=95)	Single-use fURS (n=90)	Overall (n=185)	P-value
Grade I (fever, pain)	8 (8.5%)	4 (4.2%)	12 (6.5%)	0.04
Grade II (UTI, hematuria requiring medication)	4 (4.3%)	3 (3.1%)	7 (3.8%)	0.51
Grade III (stent repositioning, ureteral injury)	1 (1.1%)	1 (1.0%)	2 (1.08%)	0.89
Total complications	13 (13.9%)	8 (9.3%)	21 (13.5%)	0.07

The overall stone-free rate (SFR) at first follow-up was 87.1%. The single-use fURS group achieved a numerically higher SFR compared to the reusable group (89.5% vs. 84.4%), though this difference did not reach statistical significance.

Mean hospital stay was significantly shorter in the single-use fURS group (1.5 ± 0.9 days vs. 2.1 ± 1.3 days, P=0.02), representing a reduction of approximately 0.6 days

Table 4. Stone-Free Rate and Hospitalization

Outcome	Reusable fURS (n=95)	Single-use fURS (n=90)	Overall (n=185)	P-value
Stone-free rate, n (%)	80 (84.4%)	81 (89.5%)	161 (87.1%)	0.29
Mean hospital stay (days)	2.1 ± 1.3	1.5 ± 0.9	1.8 ± 1.1	0.02

Figure 4 – Intraoperative imaging of Reusable scopes fURS lithotripsy

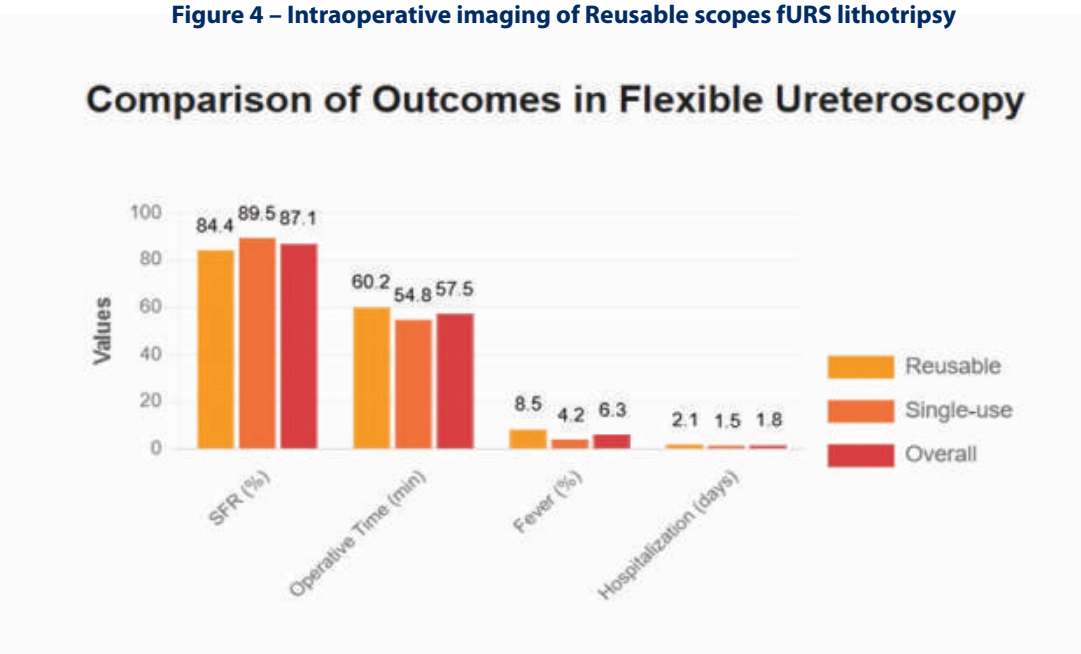
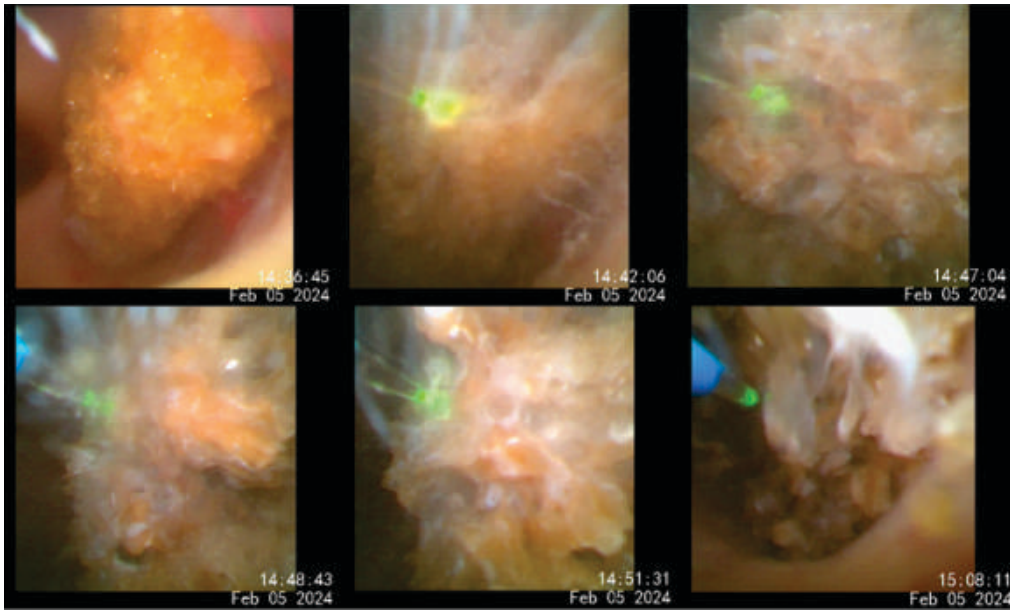


Figure 5 – Comparison of Outcomes



Operative time was significantly reduced when single-use fURS was employed, with procedures averaging 5.4 minutes shorter (P=0.03). Grade I complications, such as fever and pain, were also significantly lower in the single-use group (P=0.04). Hospital stay was notably shorter in this group as well (P=0.02). Stone-free rates were comparable between the two approaches (89.5% vs. 84.4%, P=0.29), while overall complication rates showed a trend toward being lower with single-use fURS (9.3% vs. 13.9%, P=0.07).

Discussion

This multicenter retrospective analysis demonstrates that single-use ureteroscopes provide better operative efficiency and lower infectious complication rates compared with reusable fURS in treating complex renal lithiasis.

The findings align with previous studies showing equivalent SFR between reusable and single-use scopes (11,12). However, device reliability and reduced sterilization-associated risks may explain shorter operative times and lower fever incidence in the single-use cohort (13–15).

Overall complications (13.5%) were consistent with published literature, where fURS complication rates range from 9–25% depending on case complexity (16,17). Clavien I complications were most frequent, particularly postoperative fever—a known concern in complex lithiasis due to prolonged intrarenal pressure, bacterial colonization within stones, and scope contamination risks (18).

Our lower fever rates observed with single-use devices support the hypothesis that disposable scopes reduce infectious risk through the absence of sterilization-related biofilm, the lack of microdamage in deflection and irrigation channels, and improved optical performance that enables faster fragmentation (19). The stone-free rate of 87.1% aligns with previous reports for complex stones ≤25 mm (20,21). Although not statistically different, the tendency toward a higher stone-free rate with single-use scopes may reflect superior visualization and deflection capabilities. The shorter hospitalization noted in the single-use group is likely associated with fewer infectious complications and reduced perioperative morbidity. Given comparable stone-free rates but

lower fever incidence and shorter operative time, single-use ureteroscopes may be advantageous for high-risk infectious patients, individuals with anomalous renal anatomy, and cases requiring maximal deflection. Nevertheless, considering cost implications, a case-tailored strategy remains the most appropriate approach.

Conclusions

Single-use flexible ureteroscopes provide significant benefits in reducing operative time, postoperative fever, and hospital stay while maintaining comparable SFR and overall complication rates to reusable devices. Their use should be individualized based on patient anatomy, infection risk, stone complexity, and institutional cost considerations.

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