Mini Review

Special Topic: Advances in Urolithiasis Treatment

Current Urology

OPEN

A contemporary step-by-step guide to performing flexible ureterorenoscopy for renal calculi

Thomas Fonseka*, Alberto Melchionna, Nicolo De Luyk, Vimoshan Arumuham, Simon Choong

Stone and Endourology Unit, Institute of Urology, University College London Hospitals NHS Foundation Trust, London, UK

Abstract

With advancements in laser technology and urological techniques, flexible ureterorenoscopy has emerged as a vital surgical approach for managing stone disease. Various techniques can be employed to customize endourological stone treatments. Despite the continuous evolution of equipment, it remains crucial to comprehend the fundamental steps of the procedure. This paper offers a comprehensive step-by-step guide that integrates the latest advancements in both scopes and lasers. Additionally, it outlines potential pitfalls and strategies to circumvent them, aiming to achieve optimal stone clearance and deliver individualized patient care safely and efficiently.

Keywords: Flexible ureterorenoscopy technique; Tailored endourological stone treatment; Minimally invasive stone treatment

1. Introduction

Flexible ureterorenoscopy (FURS) was first described in 1987, wherein a flexible endoscope, supported by a cystoscope, was utilized to examine the ureter and intrarenal collecting system.[1] Since its inception, numerous advancements have occurred in both technology and surgical techniques. Flexible ureterorenoscopy is now employed to manage a broad spectrum of renal stones, often obviating the necessity for percutaneous nephrolithotomy. Herein, we delineate a contemporary, step-by-step technique for executing FURS efficiently and safely.

2. Surgical planning and preparation

Flexible ureterorenoscopy can be executed in the majority of patients; however, certain contraindications to this procedure exist. These include patients with conditions such as severe cardiopulmonary disease, which precludes them from receiving general anesthesia, or those unable to lie flat with a high spinal anesthetic. Active, untreated urinary tract infections also serve as contraindications. Additional exclusions such as pregnancy, bleeding diathesis, and impassable anatomy hindering the insertion and usage of a flexible ureterorenoscope are particularly pertinent.

All patients should undergo preoperative urine cultures to guide the preoperative and intraoperative administration of antibiotics. Up-to-date imaging is crucial for planning and should be conducted within at least 6 weeks prior to surgery. Low-dose or ultralow-dose CT KUB (kidneys, ureters, and bladder) furnishes all necessary information and does not subject the patient to higher radiation doses than a standard abdominal radiograph.

3. Technique

The patient was positioned in the lithotomy posture and prepared and draped for a standard transurethral procedure. A 22Ch dual-flow cystoscope was carefully inserted into the bladder using a preloaded sensor guidewire. The ureteric orifice was cannulated with a sensor guidewire and advanced up to the renal pelvis under fluoroscopic guidance. The initial wire serves as a “safety wire” during semirigid ureteroscopy or insertion of a ureteric access sheath. Maintaining a safety wire is crucial as it ensures that the instruments remain intraluminal, thus reducing the risk of false passage creation, intramural tunneling, or ureteric perforation.

Before performing a FURS, a semirigid ureteroscopy should be conducted to rule out any anatomical or structural abnormalities such as stones, neoplasms, or strictures. The ureteroscope was introduced using a preloaded guidewire. The “railway track” technique involves one guidewire positioned at 12 o'clock and the second guidewire emerging from the ureteroscope at 6 o'clock.[2] The tip of the second guidewire was extended a few centimeters out of the ureteroscope and utilized as a proboscis to gently flatten the ureteric wall ahead of the ureteroscope tip for smoother insertion. A ureteroscope was maneuvered between these 2 wires while being monitored at the top and bottom of the screen. The “railway track” technique ensures that the ureteroscope remains within the ureteral lumen, preventing injury to the wall.

Once it is confirmed that the ureter is clear of pathology, the introduction of a ureteral access sheath becomes feasible. Various access sheaths with single or dual lumens, available in different sizes, can be utilized. A fundamental tenet of endourological surgery is to adapt the equipment to the patient’s anatomy, and not vice versa. This approach aligns with the concept of providing tailored endourological stone treatment.[3] Consequently, the access sheath with the largest diameter suitable to comfortably accommodate the patient’s ureter should be selected (typically ranging from 9 to 14Fr).

Subsequently, a flexible ureterorenoscope was inserted through the sheath under direct visualization or radiological guidance. Particular care was exercised to prevent trauma to the medial

*Corresponding Author: Thomas Fonseka, Specialist Registrar, Institute of Urology, University College Hospital at Westmoreland Street, 16-18 Westmoreland St, W1G 8PH, London NW1 2BU, UK. E-mail address: T.fonseka@nhs.net (T. Fonseka).

Current Urology, (2024) 18, 4, 265–267

Supplemental Digital Content is available for this article.

http://dx.doi.org/10.1097/CU9.0000000000000252

Table 1

A selection of contemporary flexible ureteroscopes with key features.

Image						
Brand	Olympus	Storz	Storz	Boston Scientific	Wolf	Pusen
Model	URF-V3	Flex X2	Flex Xc	Lithovue	Cobra	Uscope PU3022
Reusable vs. disposable	Reusable	Reusable	Reusable	Disposable	Reusable	Disposable
Diameter	8.4Fr	7.5Fr	8.5Fr	7.7Fr	9.9Fr	9Fr
Length	98 cm	67 cm	70 cm	65 cm	68 cm	65 cm
Working channel diameter	3.6Fr	3.6Fr	3.6Fr	3.6Fr	3.6 and 2.4Fr	3.6Fr
Digital vs. fiber-optic	Digital	Fiber-optic	Digital	Digital	Digital	Digital
Deflection angle	275° dual direction	270° dual direction	270° dual direction	270° dual direction	270° dual direction	270° dual direction
Approximate purchase cost	\$20,000–85,000	\$14,000	\$17,000–\$70,000	\$1,000–\$3,000	\$58,000	\$800

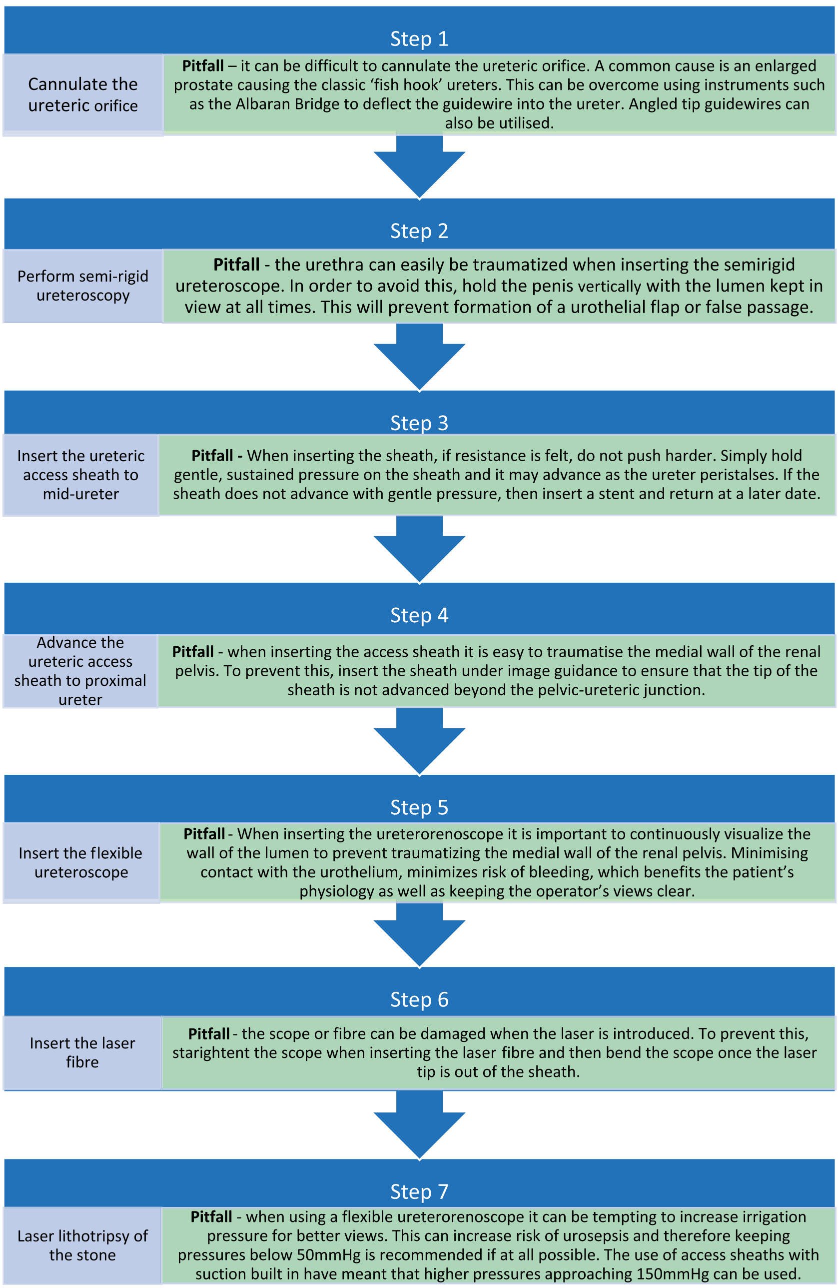

Figure 1. Potential pitfalls with each key step and how to avoid them.

wall of the renal pelvis, and the scope was deflected at the pelvi-ureteric junction.

Modern flexible ureterorenoscopes come with various features, dimensions, and costs. Table 1 presents a summary of contemporary flexible ureterorenoscopes currently available in the market. The choice of model depends on the resources and preferences of the institution and surgeon; however, most scopes operate on the same principles. Advanced generations of scopes enable the passage of a variety of instruments through them, including baskets, lasers, forceps, and electrocautery instruments, depending on the requirements of the operation.

The treatment of renal stones requires optimal laser settings tailored to both the specific laser device utilized and the characteristics of the stones themselves. For the traditional holmium:yttrium-aluminum-garnet (Ho:YAG) laser, initial settings typically commence at 0.5 J, 5 Hz and can be further adjusted as needed. In contrast, thulium fiber laser (TFL) settings exhibit a wide range of variability encompassing energy, frequency, and pulse duration parameters. Given the enhanced efficiency of energy transmission inherent to TFL technology, it is imperative to maintain power levels as minimal as feasible and refrain from prolonged activation of the "on" pedal to mitigate the risk of excessive heating and thermal injury.[4]

The application of this technique must be adjusted according to the type of laser employed. With the traditional Ho:YAG laser, the tip of the laser fiber may rest on the surface of the stone during dusting and fragmentation procedures. Conversely, when utilizing TFL or Moses technology, it is advisable to maintain a distance of approximately 1 mm between the tip and the surface of the stone to mitigate sparking and enhance energy transfer.[5]

Stones can be lasered using various techniques by adjusting the laser settings. These techniques are known as dusting (low energy and high frequency, to reduce stone to dust via layer-by-layer disintegration), fragmenting (high energy and low frequency, to break a stone up into small fragments that can be extracted using a basket), pop-corning (high energy and moderate frequency, to reduce renal stone fragments to submillimeter diameters), and pop-dusting (moderate energy and high frequency, to reduce renal stone fragments into a fine powder to be washed out). Various types of baskets are available for the extraction of small stones. They include twisted or helical wire designs, as well as front- and zero-tip baskets.

After treating the stones, a decision must be made regarding whether to insert a stent. Situations necessitating stent placement include the following: when a second procedure is planned, evidence of ureteric injury or extravasation is present, small stone fragments or blood clots remain, or when a ureteric access sheath has been utilized.

Several potential pitfalls exist at each step of the procedure. The methods employed to mitigate these pitfalls, along with others, are summarized in Figure 1. Refer to Supplementary File 1 (http://links.lww.com/CURRUROL/A59) for a summary video demonstrating FURS for laser stone fragmentation.

4. Conclusions

Flexible ureterorenoscopy has evolved into a safe and effective procedure for the treatment of complex renal stones. As future advancements occur in scope dynamics, instrumentation, and laser technology, this technique will continue to undergo refinement. These advancements may expand the range of cases suitable for treatment using minimally invasive technology.

Acknowledgments

None.

Statement of ethics

Formal ethics approval was not required for this study. Written informed consent was obtained from the patient for the use of the intraoperative video.

Conflicts of interest statement

The authors declare no conflicts of interest.

Funding source

No funding was received for the work reported and published in this manuscript.

Author contributions

SC: Conceptualization and design;
TF: Manuscript writing and editing;
AM: Data acquisition;
NDL, VA: Critical revision of the manuscript.

Data availability

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

References

[1] Bagley DH. Ureteral endoscopy with passively deflectable, irrigating flexible ureteroscopes. *Urology* 1987;29(2):170–173.
[2] Giusti G, Proietti S, Rodríguez-Socarrás ME, Saitta G, Bellinzoni P, Gaboardi F. Semirigid ureteroscopy: Step by step. *J Endourol* 2020;34(S1):S13–S16.
[3] Juliebø-Jones P, Keller EX, Haugland JN, et al. Advances in ureteroscopy: New technologies and current innovations in the era of tailored endourological stone treatment (TEST). *J Clin Urol* 2023;16(3):190–198.
[4] Khusid JA, Khargi R, Seiden B, Sadiq AS, Atallah WM, Gupta M. Thulium fiber laser utilization in urological surgery: A narrative review. *Investig Clin Urol* 2021;62(2):136–147.
[5] Aldoukhi AH, Roberts WW, Hall TL, Ghani KR. Watch your distance: The role of laser fiber working distance on fragmentation when altering pulse width or modulation. *J Endourol* 2019;33(2):120–126.

How to cite this article: Fonseka T, Melchionna A, De Luyk N, Arumuham V, Choong S. A contemporary step-by-step guide to performing flexible ureterorenoscopy for renal calculi. *Curr Urol* 2024;18(4):265–267. doi: 10.1097/CU9.0000000000000252