Original Article

The new Olympus digital flexible ureteroscope (URF-V): Initial experience

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Abstract

Objective: Flexible ureterorenoscopes (FURSs) are considered important additions to urology armamentarium. One of the technical drawbacks is the poor optic image provided by fiberoptic endoscope as well as the fragility of this conventional fiberoptic endoscope. This study aim is to evaluate practical performances and functional durability of the new Olympus digital flexible ureteroscope (ODF-URS) (URF-V) in a single center clinical setting.

Materials and Methods: A number of 60 diagnostic and therapeutic procedures were performed over a period of 6 months in a single center (Tenon University Hospital), using a single ODF-URS (URF-V). This device provided a 275° maximal down-deflection (MDD) and 180° maximal up-deflection (MUD).

Results: ODF-URS (URF-V) was used for a total time of 90 h and 30 min, with average time duration of 90.5 min per procedure. After 60 procedures, MDD decreased from 275° to 217°, while the MUD decreased from 180° to 161°. During six procedures (10%), URF-V failed to access inferior calyx due to a narrow lower calyx infundibulum.

Conclusion: New ODF-URS (URF-V) is a reliable and durable device, with a good success rate and improved functional parameters. It is a superior device compared to predecessor generations of conventional fiberoptic endoscopes for the light source and the image quality; however, randomized comparative studies are necessary to evaluate performances and durability of this device.

Key Words: Active deflection, digital flexible ureteroscope, durability, working channel

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INTRODUCTION

During the past two decades, development of flexible ureteroscope (F–URS) provided major diagnostic and treatment advantages concerning most of upper urinary tract (UUT) pathologies, with reduction of associated morbidity. F–URS allowed us to perform a visual inspection of the entire collecting system. Significant progresses were obtained in terms of visibility, maneuverability, working channel, deflection, and design; thus, creating a new era of a successful therapeutic approach of virtually any (UUT) pathology regardless of location. Tendency towards miniaturization, introduction of laser therapy as well as effective accessory instruments (such as guide–wires, baskets, access sheaths and grasping forceps) constantly improved success rate of retrograde minimally invasive approach in a large variety of cases. Smaller and smoother F–URS also displayed increased fragility and higher rate of endoscope repair; therefore, posing difficult problems in terms of cost–efficiency and long–term maintenance. In the present study, we followed the practical performances and functional durability of the new Olympus digital flexible ureteroscope – ODF–URS – (URF–V) in a single center clinical setting over a period of 6 months.

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MATERIALS AND METHODS

Between September 2009 and February 2010, 60 consecutive diagnostic and therapeutic procedures were performed in 55 patients in our institute. Twenty three procedures were performed in 18 patients with known or suspected cases of upper urinary tract transitional cell carcinoma (UUT-TCC), and 37 procedures for 37 patients with renal lithiasis [Table 1].

The same ODF-URS (URF-V) [Table 2] was used in all patients. It was replaced in six procedures (10%) by a thinner URF-P5 in cases that ODF-URS (URF-V) failed to access the entire renal collecting system (due to large diameter of the URF-V tip 8.4Fr compared to 6.9Fr for URF-P5). We used two stiff hydrophilic guidewires with a single floppy tip (Terumo 0.035"), one to introduce the device into renal collecting system and the other one as a safety wire. All procedures were performed using an access sheath 12/14 Flexor TM (Cook). Stone Light Ho: YAG laser from AMS (American medical system) was used if needed in certain patients. Working tools that were used in this series (introduced through working channel of the endoscope, measuring 3.6Fr) were represented by Ho : YAG laser fibers from AMS (200, 273 and 365 μm), nitinol baskets (Boston Scientific Zero Tip 1.9 Fr to 2.4Fr), graspers (Boston Scientific Triceps 3.0 Fr) and biopsy forceps (Boston Scientific Piranha 3Fr). After each procedure, we evaluated maximal up- and down-deflection of the URF-V fixed in a straight alignment, with an empty working channel and a 100 cm H_2O irrigation flow. We carefully assessed each procedure concerning operation time, introduction method, working channel instruments, access to lower calyx, subjective impression of the urologist concerning procedure difficulty (1. very easy; 2. easy; 3. fair; 4. difficult; 5. very difficult) and ODF-URS (URF-V) maneuverability (1. very easy; 2. easy; 3. fair; 4. bad; 5. very bad).

A single urologist (O.T) with 10 years experience of flexible ureteroscopes and previous training on URF-V performed all procedures. Experienced personnel had done the cleaning (brush cleaning of the working channel and 20 min immersion in a detergent agent) and sterilization (30 min immersion in Steranios disinfectant) of this device.

Table 1: Treatment indications: (Stone/UUT-TCC) characteristics

Stone/tumor	Results
Stone procedures	37%
Stone Size (mean±SD) mm	14 ± 6.3%
Stone site	
Pelvic	5 (13.5%)
Lower calyx	16 (43.2%)
Middle calyx	1 (2.7%)
Upper calyx	2 (5.4%)
Mixed pelvic and calyces	10 (27%)
Mixed calyces	3 (8.1%)
Stone number	
Isolated	22 (59.5%)
Multiple	15 (40.5%)
Tumor procedures	23%
Tumor size (mm)	
<10	16%
11-20	6%
Tumor site	
Pelvic	12%
Lower calyx	3%
Middle calyx	2%
Upper calyx	4%
Mixed pelvic-calyceal	2%

RESULTS

From our data, we were able to achieve successfully completed 54 procedures. In each of the six cases (10%) of ODF-URS (URF-V) failures (impossible access to the lower calyx due to narrow infundibulum), URF-P5 successfully completed the task. Balloon dilation of distal ureter was necessary in seven procedures (11.6%). Double-J stent was previously placed in 32 cases (%). In 37 patients with renal lithiasis (61.6%), 37 procedures were performed and employed Ho: YAG laser lithotripsy in 31 cases (83.8%), followed by tipless nitinol basket removal of remaining stone fragments in 24 (77.4%), and only basketing of calculi in six cases (16.2%). In total, there were treated 64 calculi with a mean size of 14 mm. Lower calyx calculi lithotripsy was necessary in 16 cases (51.6% of the lithotriptic procedures). It was performed *in situ* in 9 patients (56.2%), and after calculus repositioning to a favorable position (renal pelvis or upper calyx) in 7 patients. In 18 patients, we performed 23 procedures for UUT-TCC. Nine procedures were carried out using Ho : YAG laser for the detected lesions, 3 of them in the lower calyx. Holmium laser was used in 40 procedures (66.6%), with a 200-μm fiber in 12 cases (30%), a 273-μm fiber in 19 cases (47.5%), and a 365-μm fiber in 9 cases (22.5%). ODF-URS (URF-V) remained in the urinary tract for a total period of 90 h and 30 min, emphasizing an average time per procedure of 1 h and 30.5 min. Therapeutic procedures were found to have longer use of this device compared to diagnostic procedures (101 versus 74 min per procedure). One to four instruments were introduced through

Table 2: URF-V specifications

Working length (mm.):	670 mm
Outer diameter (Fr)	
Shaft tip	8.4Fr
Shaft	9.9Fr
Channel inner diameter (Fr)	3.6Fr
Rotating working channel	Yes
Optical system	
View field (degrees in air)	90°
View direction (degrees)	0°
Field depth (mm.)	2-50 mm
Active deflection angulation range (degrees down/up)	275°/180°
Image technology	CCD
NBI technique	Yes

CCD: Charged coupled device

the working channel during each procedure, resulting in a mean value of 2.8 per procedure. There were 168 instrument passages through working channel of ODF-URS (URF-V).

Active deflection deteriorated with time, describing a decrease of up and down deflections. Mean loss was 10.5% for up-deflection (loss of 19°, from 180° to 161°), and 21% for down-deflection (loss of 58°, from 275° to 217°) [Figure1]. Maneuverability of this device was rated at a mean value of 3.68 for first 30 procedures, and of 2.89 for last 30. Procedure difficulty described a mean score of 2.12 for first 30 procedures, and of 2.83 for last 30 procedures [Table 3]. Subjectively, quality of digital endoscopic image remained relatively constant throughout the 60 procedures, and no damages were recorded to working channel or to the endoscope sheath. ODF-URS (URF-V) failed to access inferior calyx during six procedures (10%) regardless of treatment indication due to failure of passing narrow infundibulum of lower calyx. During the 60th procedure, the device was ruptured in lower calyx during exploration in extremely acute infundibulo-pelvic angle (procedure was successfully completed by URF-P5), taking in consideration the fragility and fatigability of this endoscope after 59 procedure.

DISCUSSION

Poor quality of endoscopic images remains one of the most important technical limitations of conventional ureteroscope. In this regard, ODF-URS (URF-V) offers the largest image size currently available, about three times larger than that of conventional ureteroscope [Figure 2]. High-resolution quality of images enables close observation of upper tract lesions. Several studies evaluated durability of conventional ureteroscope, as well as their technical parameters' alterations. There are three major categories of problems that may impede with use of conventional ureteroscope: reliability of optical system, fatigability and major malfunctions that usually require replacement of the device. Concerning optical damages issue, after using Storz Flex-X ureteroscope during 50 procedures, Traxer *et al*., reported six broken fibres, appearing as black dots on endoscopic field.[1]

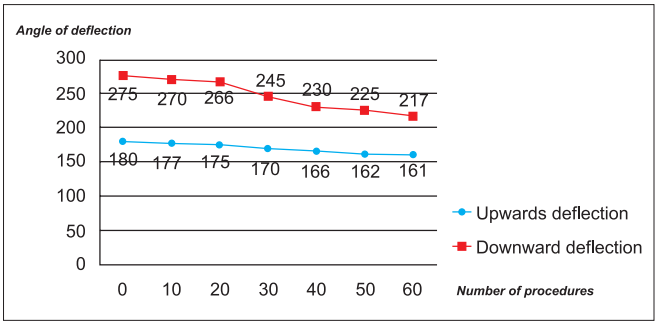

Figure 1: Changes of upwards and downwards deflection angles over the time

While evaluating four older models of 7.5Fr F-URS, Pietrow and coworkers reported an average number of 15.3 passages before registering breakdown of 20 optical fibres.[2] The chip-on-the-tip technology of ODF-URS (URF-V) based on image transmission from distal sensor to proximal processor through a single wire, successfully replaces fragile optical fibres system of conventional F-URS. After 60 procedures, no major alterations of endoscopic images were reported.

Fatigability phenomenon represents a major concern to the urologists and an important matter. Pietrow reported 50.3 passages before losing 25° of active deflection.[2] In this study, concerning ODF-URS (URF-V), 168 instrument passages performed before losing 58° and 19° of the active deflections (down and up), respectively, clearly demonstrate the superiority of this device. Afane *et al*. reported relatively unchanged luminosity and irrigation flow during consecutive applications as well as 2% to 28% active deflection deterioration per procedure. The need for repair remains extremely high, occurring after 3 to 13 h of use. Lower pole access was involved in up to 24% of cases.[3] Busby *et al*. emphasized the prolonged approach of lower calyx as a main cause for decrease in maximal active deflection.[4] In our series, 19 patients (31.6%) underwent successful treatment of upper tract tumors or calculi situated in lower calyx.

Major malfunctions occurred while using conventional flexible ureteroscopes usually result in the necessity to replace it, consisting most frequently in fractures, perforations, severe damages to optical system and major deflection losses. In a

Table 3: Indications and experience with (ODF-URS) URF-V

Treatment indications (procedure)	
Renal calculi	37
UUT-TCC	23
Laser utilization (procedure)	
Renal calculi	31
UUT-TCC	9
Total hrs in UT	90.5
Laser utilization in lower pole	
Renal calculi	16
UUT-TCC	3
Instruments passawges	
Average No. used	2.8/procedure
Average time (minute)	32.2
Loss of deflection	
Up	19
Down	58
Average maneuverability score	
First 30 procedures	3.68
Second 30 procedures	2.89
Average procedure difficulty	
1st 30 procedures	2.12
2nd 30 procedures	2.83
Visibility	No change
Pre-operative DJ stent (overall)	
Yes	32 (53.3%)
No	28 (46.7%)

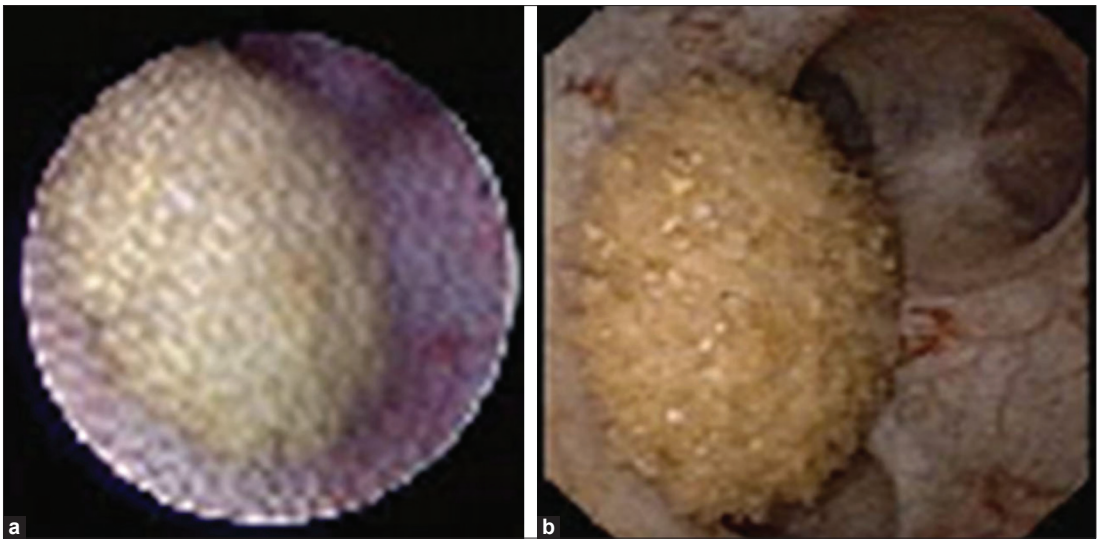

Figure 2: The image quality using (a) conventional F-URS compared to (b) URF-V

prospective randomized study, Monga *et al*. evaluated durability of seven models of F-URS, and reported the fact that ACMI DUR-8 Elite displayed longest functioning period (494 min) and largest number of procedures (14.4) performed without any need for repair.[5] In another study, User *et al*. compared six types of F-URS and found no statistically difference between them, in spite of the apparently more reliable ACMI DUR-8 Elite. They reported that between 10 and 34 procedures were performed before a malfunction requiring major repair occurred.[6] Considering that ODF-URS (URF-V) was used for 5430 min (90 h and 30 min) during 60 procedures with no need of repair, progresses in terms of durability seems to be obvious. Main causes of flexible ureteroscope repair were represented by loss of deflection, perforation of inner lining by laser fiber, and breakdown of optical fibers.[5, 6, 7] In our series, ODF-URS (URF-V) was broken while approaching a lower calyx stone at an extremely acute infundibulo-pelvic angle. Several technical tricks and accessory instruments were presented during a number of studies aiming to prolong F-URS functionality. Kourambas *et al*. reported that routine use of ureteral access sheath might reduce aggressions to F-URS, mean operative time as well as costs of the interventions.[8] In our study, we used an access sheath (12/14 Fr) in all of the procedure. In order to protect working channel, Seto *et al*., proposed introducing 200-μm laser fiber through a previously inserted 2Fr catheter. Although deflection of F-URS did not seem to diminish, irrigation flow was however reduced.[9] In the present study, we registered the most significant loss of deflection and irrigation flow when inserting 365-μm laser fiber, used in only 9 cases (22.5%) of lithotripsy involving pelvic stones.

Bagley *et al*., underlined the fact that stone retrieval devices composed of nitinol-based wire technology are able to secure fragments from most peripheral calices.[10] Among our stone patients, we successfully used the nitinol tipless basket in 81% of the cases. In order to prevent fatigability phenomenon that occurred during extensive use of F-URS, it is recommended to reduce lower calyx working time. Consequently, Pasqui and coworkers recommend calculi relocation and then laser fragmentation in renal pelvis or upper calyx.[11] We applied this technique in 43.7% of lower calyx stones.

The large diameter of ODF URS (URF-V) tip 8.4Fr is considered a major disadvantage. We did not report difficulties in passing uretero-pelvic junction (UPJ) even with preoperative placement of DJ stent. Nevertheless, this was clearly a dilemma in narrow caliceal infundibulum. Humpreys and coworkers[12] reported that digital flexible ureteroscope was unable to fully explore the renal collecting system in some patients due to ureteral stricture and lack of adequate deflection for lower calyx; however, conventional ureteroscope was able to access the entire collecting system. The material costs were not discussed in this work since no comparative devices were included, however, purchase cost for this device is 60,000 euro with replacement cost of 25,000 euro.

Main drawback of this work is being a mono-centric which was done in cross- sectional manner with several limitations, for example: all procedures were done by a single urologist, which might have an impact over loss of deflection and thereafter on durability. However, only a few reports have been published up to date relating to overall durability and maneuverability of this device after use for clinical purposes, which is probably due to recent introduction in the market.

CONCLUSION

ODF-URS (URF-V) proved to be a reliable device during a six-month single center clinical trial, displaying a good

diagnostic and therapeutic success rate in UUT-TCC and renal lithiasis. Despite slight decrease over the time, the active deflections remained excellent after 60 procedures; therefore, it showed the superior durability of this device. Although occasionally displaying accessibility limitations related to its larger caliber, ODF-URS (URF-V) generally demonstrated a good maneuverability. Due to digital technology, it provided high-quality endoscopic images, and consequently improved diagnostic and therapeutic abilities. Future studies will need to determine long-term performances and costs of this device.

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REFERENCES

1. Traxer O, Dubosq F, Jamali K, Gattegno B, Thibault P. New-generation flexible ureterorenoscopes are more durable than previous ones. Urology 2006;68:276-9.
2. Pietrow PK, Auge BK, Delvecchio FC, Silverstein AD, Weizer AZ, Albala DM, *et al*. Techniques to maximize flexible ureteroscope longevity. Urology 2002;60:784-8.
3. Afane JS, Olweny EO, Bercowsky E, Sundaram CP, Dun MD, Shalhav AL, *et al*. Flexible ureteroscopes: a single center evaluation of the durability and function of the new endoscopes smaller than 9Fr. J Urol 2000;164:1164-8.
4. Busby JE, Low RK. Ureteroscopic treatment of renal calculi. Urol Clin N Am 2004;31:89-98.
5. Monga M, Best S, Venkatesh R, Ames C, Lee C, Kuskowski M, *et al*. Durability of flexible ureteroscopes: a randomized, prospective study. J Urol 2006;176:137-41.
6. User HM, Hua V, Blunt LW, Wambi C, Gonzales CM, Nadler RB. Performance and durability of leading flexible ureteroscopes. J Endourol 2004;18:735-8.
7. Mitchell S, Havranek E, Patel A. First digital flexible ureterorenoscope: Initial experience. J Endourol 2008;22:47-9
8. Kourambas J, Byrne RR, Preminger GM. Does a ureteral access sheath facilitate ureteroscopy? J Urol 2001;165:789-93.
9. Seto C, Ishiura Y, Egawa M, Komatsu K, Namiki M. Durability of working channel in flexible ureteroscopes when inserting ureteroscopic devices. J Endourol 2006;20:223-6.
10. Bagley DH, Huffman JL, Lyon E. Flexible ureteropyeloscopy: diagnosis and treatment in the upper urinary tract. J Urol 1987;138:280-5.
11. Pasqui F, Dubosq F, Tchala K, Tligui M, Gattegno B, Thibault P, *et al*. Impact on active scope deflection and irrigation flow of all endoscopic working tools during flexible ureteroscopy. Eur Urol 2004;45:58-64.
12. Humphreys M, Miller NL, Williams JC Jr, Evan AP, Munch LC, Lingeman JE. A new world revealed: Early experience with digital ureteroscopy. J Urol 2008;179:970-5.

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