

## FLEXIBLE URETEROSCOPIC LASER LITHOTRIPSY- AN OVERVIEW AND ASSESSMENT OF THE OUTCOME. A SINGLE CENTER CROSS SECTIONAL STUDY

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### ABSTRACT

This is a cross sectional analytic study based on retrospective data collection concerning flexible ureteroscopic laser lithotripsy (FURSL). This study was conducted on 83 adult patients with renal stones. The study was performed by a single researcher in the department of urology at Medicano hospital in Erbil taking in consideration the preoperative, peroperative and postoperative data analysis. Cases with single and multiple renal stones of diameters 7 to 13.6 mm scattered within the renal calyces were managed by FURSL. Access sheath insertion had no influencing affect in decreasing the operative time. 43.9% of stones was fragmented successfully and 45.1% were extracted by dormia. Complications were insignificant in general apart from fever. Only 9.8% of cases had trivial intracalyceal bleeding. No case was converted to open exploration. Technical complication was noted in two cases namely one incident with fiberoptic damage and one failed deflection.

### INTRODUCTION

Management of the Lower calyceal renal stones and stones in the mid and upper calyces that had failed medical or ESWL therapy were challenging in the era before the innovation of flexible ureterorenoscopy. Thanks to the great and ever progressive medical technology advances that takes place in the field of endourology and RIRS surgery.<sup>[1]</sup>

Technical advances in the deflection mechanism and flexibility, light weight handling, improved chip on the tip high quality digital camera. Advances in the accessory flexible ureteroscopic tools namely access sheaths quality, hydrophilic guide wires, tip-less Dormia baskets have led to dramatic ease in the flexible ureteroscopic insertion as well as stone handling. Improvements in the LASER technology systems as well as innovation of the fine small caliber LASER fibers that aided flexibility of the ureteroscope as well as better delivery of the LASER power have played important roles in the success of the RIRS surgery.<sup>[2]</sup>

Better training skills including systematic simulation training have led to an improved ergonomics, hand-eye coordination and hence mastering of the flexible ureteroscopy procedure.<sup>[3,4]</sup>

All such improvements have led to more efficacy in the renal stone management and the ability to manage larger renal stones reaching up to 20 mm by the expert hands as well as lowering the complications and improved cost effectiveness and better stone free rates (SFR).<sup>[5]</sup>

The aims of the current study are to focus on the technical as well as the postoperative outcomes and complications of the flexible ureterorenoscopic Laser lithotripsy.

### METHODS

To achieve the aim of the current study, across sectional design was adopted.

This study was conducted in the department of urology at Medicano hospital in Erbil-Kurdistan region – Republic of Iraq based on preoperative, intraoperative and postoperative data collection for 83 cases with renal stone to whom FURSL was conducted for period between June 2019 to September 2022.

### Ethical approval

An approved consent from each case was taken after full discussion.

### Study setup

Cases included in the study were exclusively adults of both genders. Their ages ranged between 18 to 70 years. Pediatric patients as well as pregnant females with renal stones were excluded from the study. The involved cases had renal stones with sizes ranged between 7mm to 15 mm. FURSL was decided for every case. Every case with renal colic or previously diagnosed renal stones with or without medical therapy or previous intervention whether ESWL, Ureteroscopy or renal exploration surgery was interrogated individually by clinical approach followed by the relevant lab studies including urine examination, renal function tests and complete blood count evaluation. Imaging studies included ultrasound evaluation of the urinary system. The involved cases with renal stones situated in the upper, middle or the lower calyces were requested to do native spiral Computerized tomography scan of the abdomen (CT-scan). A thorough discussion regarding the mode of the treatment including the benefits and drawback of the FURSL procedure was conducted.

### Procedures

Each case enrolled in the study had proper preoperative medical and lab evaluations. Preoperative preparation including fasting for 6 hours. Bowl and bladder emptying prior to the procedure.

The procedures were conducted under general anesthesia with endotracheal intubation and full abdominal relaxation.

Endoscopy procedure for every case was started by urethra-cystoscopy using Storz 19F rigid cystoscope. The ureteric orifices were identified, then a 3F Terumo, flimsy blunted end guidewire was advanced via the ureteric orifice up to the renal pelvis under fluoroscopic monitoring. A pointed tip 9.5F 45 Cm long ureteral access sheath was introduced under fluoroscopic guide via the ureter following the insertion of the ureteric guide wire in its lumen then the trocar was removed.

Storz flexible Uretero-reno-scope (Storz 11278AU1 Flex-X<sup>2</sup> Flexible Ureteroscopy). Introduced via the ureteric access sheath under direct vision using full HD Storz Camera, aided with fluoroscopic monitoring. Normal saline utilized as an irrigant fluid. Careful

inspection of the calyceal system of the kidney performed for the localization of the stone.

Dornier 30 Watt LASER device was used for the lithotripsy. A 272 micrometer core ultra-thin flexible laser fiber was used. Lithotripsy procedures were conducted using dusting and fragmentation techniques. Small pieces were extracted using Dormia basket. A double J stent was inserted via the ureter for each case at the end of the procedure.

### Data collection

The collected data from the involved cases included age, sex, primary or recurrent stone, single or multiple, size of the stone, location of the stone inside the kidney whether upper pole, mid pole, renal pelvis, lower calyceal stone, side whether right or left kidney, previous intervention including shock wave lithotripsy (ESWL), uretero-lithotripsy, open surgery or no previous intervention.

Technical data included bladder distension or emptying prior to insertion of the access sheath, access sheath application, mode of the Laser power either dusting or fragmentation, fate of the stone whether fragmentation or extraction or no change. Complications were recorded including post-operative fever, bleeding, sepsis, ureteral injury, or no complication. The time of the procedure was recorded.

The data were managed using Excel 2016 software and the SPSS 17 software. The means of the numeric data related to the age, stone size and the operative time were obtained using SPSS 17 statistics. Frequencies and means of the other obtained data were managed. Significant correlations between the access sheath insertion and the operative time, number of stones and operative time, location of stones and the outcome of the procedure were made using Pearson-Chi square.

## RESULTS

The current study included 82 Cases. Almost two thirds of them 67% were females. In general the mean age was 37 years and ranged between 18-70 years. The means for both genders are about the same. The table demonstrates that about half of the male cases were in their forties. Table 1.

**Table 1: Demographic characters of the studied cases.**

Age group (years)	Male (27)		Female (55)		Total (82)	
	No.	%	No.	%	No.	%
< 20	2	7.4	--	--	2	2.4
20-29	8	29.6	18	32.7	26	31.7
30-39	3	11.1	11	20.0	14	17.1
40-49	13	48.2	14	25.5	27	32.9
≥ 50	1	3.7	12	21.8	13	15.9
Range	18-50		20-70		18-70	
Mean	35		38		37	

Table.2 categorizes medical data records concerning the renal stones highlighting the followings: The occurrence whether primary or recurrent stones, stone number, size, location, site, and prior surgical history.

Recurrent stones were slightly higher than primary stones among both gender reflecting that it was 52.4% recurrent stones and 47.6% primary stones.

Analysis of stone number data showed that males 70.4% had one renal stone compared to female cases 56.4%. Single stone constituted 61% while the multiple stones constituted 39% among total cases.

Stone diameters for both genders were approximate. It was ranged between 7mm to 12mm in the male group

and 7mm to 13.6mm in the female group. The mean diameter in both genders was 10mm

Results related to intra-renal location of stones showed that about half of all stones 46.3% were located in the middle calyx. This also applies to the female group, while the male group 51.9% is located on the upper calyces.

Data on previous surgical history revealed that the overall 45.1% had undergone shock wave lithotripsy, 18.3% had undergone ureteroscopy, 90.2% of cases had received previous medical therapy and 31.7% had received no previous treatment.

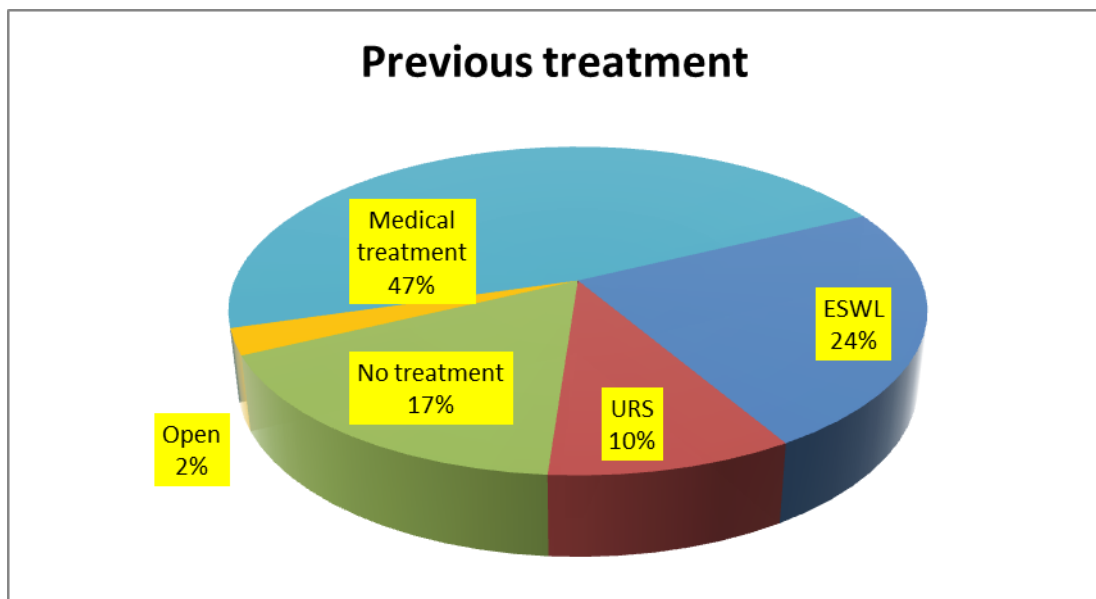


Figure 1: Previous treatment.

Table 2: Medical data records.

Medical History		Male (27) 33%		Female (55) 67%		Total (82)	
		No.	%	No.	%	No.	%
occurrence	Primary	13	48.1	26	47.3	39	47.6
	Recurrent	14	51.9	29	52.7	43	52.4
No.	Single	19	70.4	31	56.4	50	61.0
	Multiple	8	29.6	24	43.6	32	39.0
Stone diameter (mm)	Range	7-12		7-13.6		7-13.6	
	Mean	9.8		10.0		10.0	
Stone Site	Upper	14	51.9	9	16.4	23	28.0
	Mid	6	22.2	32	58.2	38	46.3
	Lower	7	25.9	14	25.4	21	25.7
Side	Right	16	59.3	35	63.6	51	62.2
	Left	11	40.7	20	36.4	31	37.8
Previous therapy	None	11	40.7	15	27.2	26	31.7
	ESWL	12	44.4	25	45.5	37	45.1
	URS	3	11.1	12	21.8	15	18.3
	Open	1	3.7	3	5.5	4	4.9
	Medical therapy	23	85.1	51	92.7	74	90.2

Table 3 Perioperative data records for the cases. Access sheaths were used in 100% of men and 78.2% of women. Comparison between access sheath insertion and operative time using Pearson chi-square was 0.684.

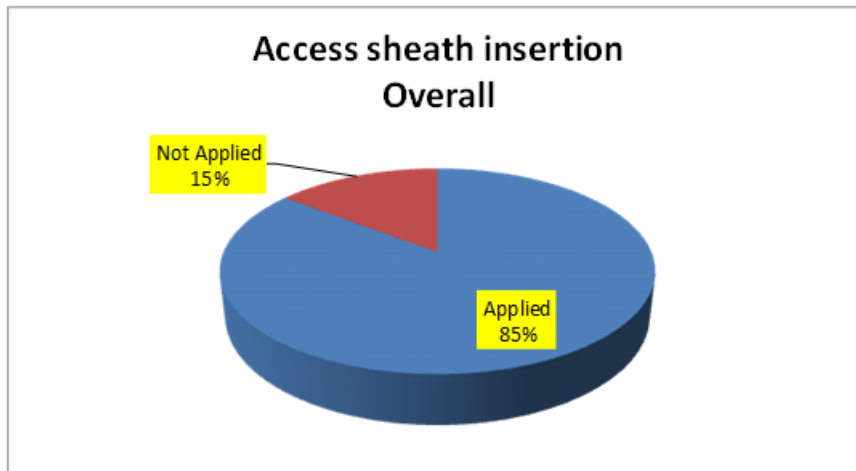


Figure 2: Access sheath insertion.

By observing the data reflecting the outcome of FURS lithotripsy. It was revealed that SFR was 43.9% , 45.1% of the stones were removed by fine tip less dormia basket, and 11% of the cases had stone fragments. Stone

migration noticed in 11% of the cases, more in the male group than in the female group 22.3% vs. 5.5%, respectively.

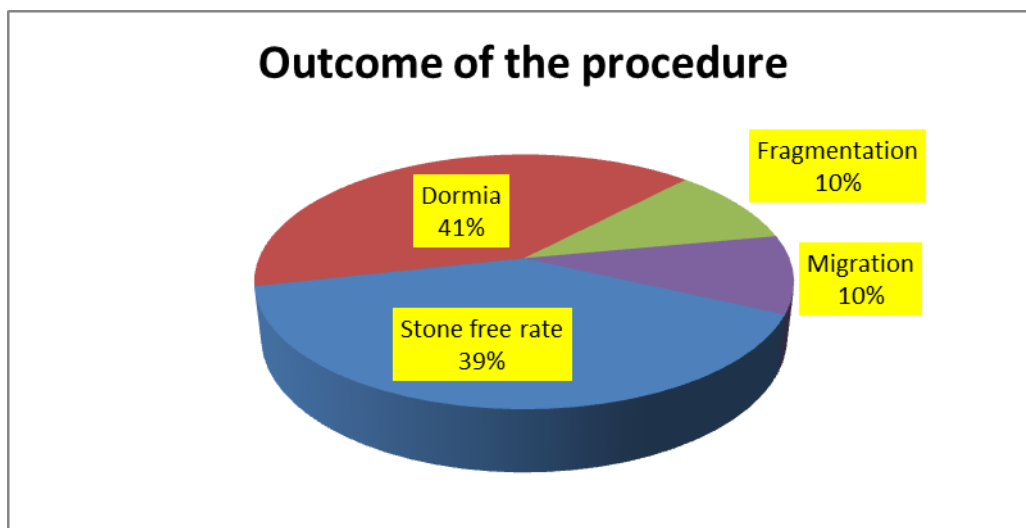


Figure 3: Outcome of the procedure.

The mean time for the FURSL procedure for both genders was 26 minutes and it was approximate for the two gender groups 24.9 minutes for the males, 26 minutes for the females.

**Complications**

51.2% of the total cases had complications. Intra calyceal bleeding was reported in 9.8% of cases and was almost identical in both cases. Only one female participant had sepsis 1.2%. Fever occurred in 25.6% of all cases and was higher in the male group than in the female group (37.9% vs. 20.5%).

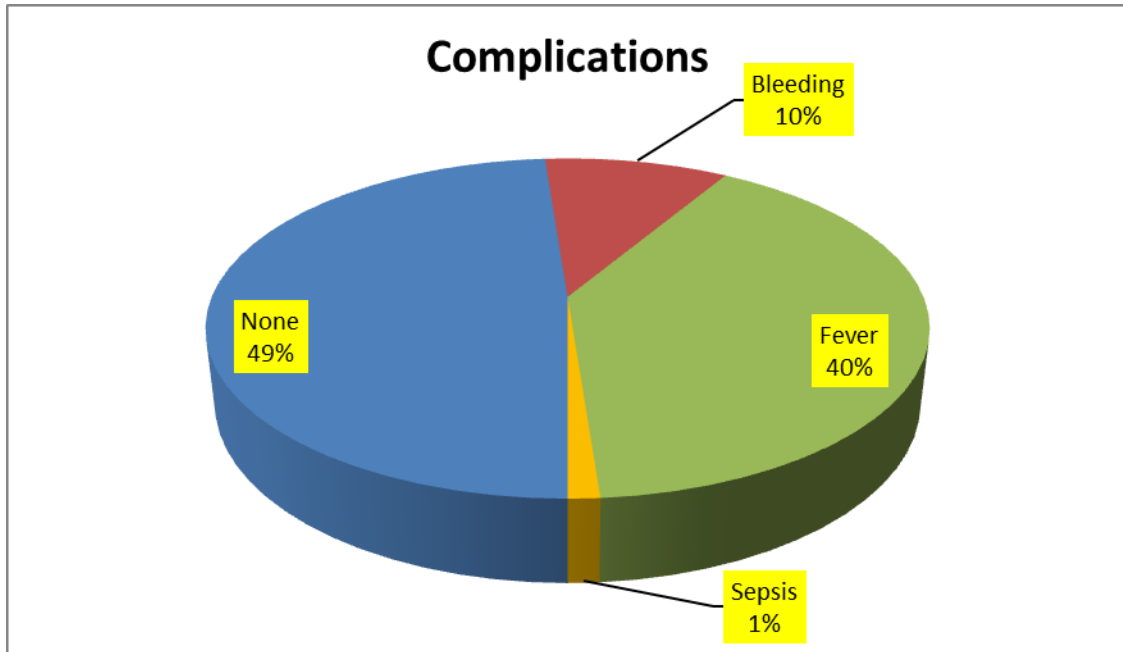


Figure 4: Complications.

Technical complications: included damage of the ureteroscope sheath by the laser beam in only one procedure in women 1.2%. We had failed ureteroscopy

deflection during surgery for one 1.2%. Laser fiber damage encountered in one male case.

Table 3: Perioperative data records.

Perioperative Notes		Male (27) 33%		Female (55) 67%		Total (82)	
		No.	%	No.	%	No.	%
Access Sheet	Present	27	100	43	78.2	70	85.4
	Absent	--	--	12	78	12	14.6
Stone fragmentation	Stone free rate SFR	11	40.7	25	45.4	36	43.9
	Extract	10	37.0	27	49.1	37	45.1
	Migration	6	22.3	3	5.5	9	11.0
Time consumed (min.)	Range	10-40		15-45		10-45	
	Mean	24.9		26		26	
Complications	None	11	40.7	29	61.7	40	48.8
	Injuries	--	--				
	Bleeding	2	7.4	6	10.9	8	9.8
	Open	--	--				
	Sep	--	--	1	1.8	1	1.2
	Fever	14	51.9	19	34.5	33	40.2
	Sepsis	--	--	--	--		
Technical problems	Fiberoptic damage	0	0	1	1.8	1	1.2
	Failed deflection	0	0	1	1.8	1	1.2
	Camera damage	0	0	0	0	0	0
	Broken dormia	0	0	0	0	0	0
	Laserfiber damage	0	0	1	1.8	1	1.2

**DISCUSSION**

As shown in Table 1, the study was exclusively conducted with 82 adult male and female cases. Since this was a single-center study, the number of cases was limited. FURS lithotripsy is still uncommon in urological centers in Iraq. Mastering this technique requires thorough, extensive training.<sup>[6,7,8,9]</sup>

Pediatric FURSL has not been performed in our center because conducting such a complex procedure at pediatric age requires thorough experience and the appropriate equipment available.<sup>[10]</sup> which we still lack.

Almost half of the patients had recurrent renal stones. Among this group approximately (45.1%) reported previous treatment with ESWL, (18.3%) of whom had previously undergone semi rigid ureteroscopic

lithotripsy, and (31.7%) of them had not previously over-intervention. A high proportion of cases had stones previously managed by ESWL is mainly attributed to its popularity and is still considered the first-line treatment regimen for kidney stones due to its high clearance rate, low cost, relatively low complications, and lack of need for anesthesia.<sup>[11]</sup>

Lower calyceal stones and retained upper and middle calyceal stones, especially of relatively large sizes have a low success rate with shockwave lithotripsy compared to laser ureteroscopic lithotripsy. In a study by Amr M. Mansour et al. found that the success rate of ESWL in the treatment of inferior calyceal stones is approximately (68.3%) compared to other locations.<sup>[12]</sup> The reason we have chosen FURS was to manage stones in the middle or lower calyx because of the deflecting ability and the availability of laser lithotripsy technology for a patient who had prior treatment attempts, which is a strong indication for FURS.<sup>[13]</sup>

Ureteral access sheath UAS was used in all male cases and 78% of female cases. FURS was successfully inserted gently over a Teflon guide wire under combined direct vision and fluoroscopic guidance to monitor progress through the ureter to the renal pelvis. This is a routine technical step at our center for applying UAS during FURS, as it is routine practice at many centers.<sup>[14]</sup>

A correlation between the insertion of the access sheath and the operation time using Pearson-Chi square was insignificant. i.e. did not decrease the operation time.

Huang Jian et al. However, a 2018 meta-analysis study found that the use of UAS during ureteroscopy did not affect SFR, operative time, hospital stay, or intraoperative complications, but significantly increased the incidence of postoperative complications Rate. Therefore our observation matches Huang's observation.<sup>[15]</sup>

Vincent De Coninck concluded that UAS it can be reserved for stone patients with difficult access to the ureter or with increased risk of infectious complications of treatment, and as a possible adjunct in difficult surgical conditions due to low irrigant outflow.<sup>[16]</sup>

This marked discrepancy between our observations and the previously mentioned analytical studies can be attributed to the relatively small sample size in our study.

Only one significant technical problem occurred in our case, specifically the patient, in the form of damage to the fiber optic bundle, and thus blurred vision with black spots at the end of the procedure. This complication is relatively common and can happen due to the thermal effect of the laser beam or forced yaw maneuvering.<sup>[17,18]</sup>

Flexible uretero-nephroscopy is a safe procedure with minimal complications compared to PCNL and open

renal surgery. Almost half of the cases (48.8%) had no complications. 61.7% of female cases had no complications. While 40.7% of male cases had no complications. This percentage is relatively higher than the results of other studies conducted at global centers

In Masatsugu Komori et al. Studies evaluating the complication rate of the flexible uretero- renoscopy during the learning curve found an overall complication rate of approximately 13.6%. This may be due to better training, experience and availability of more cases than our single center study.<sup>[19,20,21,22]</sup>

Fever is the most common complication observed among the studied cases. However this inflict was trivial and controlled by simple short term use of Antipyretics (Acetaminophen). The overall percentage with fever was 25.6%. This is comparable to results from similar studies. The low rate of 0.1% for sepsis was also comparable. This is due to proper aseptic techniques and proper antibiotic coverage before, at induction and after the procedure.<sup>[23,24]</sup>

Bleeding complications occurred in 9.8% of cases. These were minor from the holmium laser effect and the flexible ureteroscopy manipulation and were all self-limited and did not require blood transfusion. This ratio is also comparable to the Xianghu Dream in 2019.<sup>[25]</sup>

The procedure time varies from 10 to 45 minutes. There was a strong correlation  $P = 0.001$  between time and number of stones.<sup>[26]</sup>

There was no significant relationship between time and stone size. A study by Timothy Chuster highlighting factors associated with complications in Ureteroscopy stated that there is a strong correlation between the operation time and the complications.<sup>[27]</sup>

There was no significant relationship between the location of stones in the kidney and fate,  $P=0.19$ . There is a strong correlation between size and complications 0.001. this matches the related studies.<sup>[28,29]</sup>

Technical complications: Flexible ureteroscope is a delicate tool requiring careful handling and experience with careful approach during the procedure. Hence it is vulnerable for damage.<sup>[30]</sup> These were minor including one case with damage ureteroscope sheath, one failed deflection and one case with damage to Laser fiber.

## CONCLUSION

The flexible ureterorenoscopic lithotripsy (FURS) is an excellent technique for the management of renal stones with modest sizes scattered in the upper, mid and lower calyceal renal stones with good outcome and minimum morbidity. Thorough continuous learning and experience for the urologists are required to master this technique. A proper selection of the cases with optimum indications and proper handling of the flexible ureterorenoscope and

utilization of the Laser are of prime importance for the success of the FURSL procedure.

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