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# Should ureteroscopy be considered as the first choice for proximal ureter stones of children?

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**Abstract. – OBJECTIVES: In this study, we aimed to analyze the ureter stones that had been treated using rigid ureteroscopy and pneumatic lithotripsy without mechanically dilating the ureteral orifice.**

**PATIENTS AND METHODS: Records of 110 patients who had undergone rigid ureteroscopy and pneumatic lithotripsy due to ureteral stone between February 2005 and May 2011 were retrospectively analyzed. The location and size of the stone and additional anomalies in the urinary tract on the preoperative direct urinary system (DUS) X-Ray, urinary system ultrasonography (USG), intravenous pyelography (IVP) if performed, and computed tomography (CT), were found from the records of the patients.**

**RESULTS: The mean age of the patients was 5.2 (range 1-17 years). 74 (67.2%) of the patients were males and 36 (32.8%) were females. A total of 115 rigid ureteroscopies were performed on 110 patients. 72 (65%) of the stones were located in the lower ureter, 21 (19%) were located in the middle part of the ureter, and 17 (15.4%) were located in the upper ureter. The mean stone size was determined as 7.5 mm (range 5-15). The mean stone size was determined as 7.4 mm in the lower ureter, as 8.3 mm in the middle ureter, and 8.4 mm in the upper ureter. No difference was found between the sizes of the stones in different locations ($p$ = 0.121). The stone free rate was found as 92.2% for all ureteral stones. The total stone free rate according to the location of the stones was determined as 79.2% in the upper ureter, as 94.4% in the middle ureter and 93,8% in the lower ureter ($p$ = 0.022). The total complication rate was 7.6%. Complication rates were 7.2%, 4.1% and 10.7% for the lower, middle and upper ureter, respectively ($p$ = 0.411) (Table I). No difference was found in terms of complication rates according to location of the stone in the ureter. No major perioperative or postoperative complications developed. A double J stent was inserted in 36 (32%) patients for 2-3 weeks.**

**CONCLUSIONS: We suggest that rigid ureteroscopy may be considered as the first choice for treatment of not only distal-middle ureter stones, but also for proximal ureter stones.**

*Key Words:*
Ureteroscopy, Pediatric, Ureter stones.

## Introduction

Children constitute approximately 1% of all patients suffering from urinary stones. However, 100% of these children are under high risk for recurrence. For this reason, metabolic studies and treatment of stones have gained importance in order to prevent recurrence of stones[1].

Ureteral stones constitute 20% of urinary system stones[2]. In the past, these stones used to be left to pass spontaneously; this situation has changed today through the use of minimally invasive treatment modalities. Management of both childhood and adulthood stones has changed with the introduction of ESWL (electro shock wave lithotripsy) in 1980[3]. However, ureteroscopy (URS) has gradually taken the place of ESWL for treatment of pediatric upper urinary system stones and is becoming the standard treatment option today[4]. URS was first described by Ritchey et al in 1988[5].

URS is being used as the first choice of treatment or an alternative to ESWL in ureteral stones in all locations[6]. Excellent outcomes have been obtained with very low complication rates through the use of flexible ureteroscopes and laser probes[7,8]. However, due to the non-durability of these devices and the high expenses of the equipment, their use in underdeveloped countries is limited[7].

In this sudy, we aimed to analyze the ureter stones that had been treated using rigid ureteroscopy and pneumatic lithotripsy without mechanically dilating the ureteral orifice.

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**Table I.** Treatment success and complication rates according to location of the stone in the ureter.

| | Upper ureter stones | Middle ureter stones | Distal ureter stones | All | *p* value |
|---|---|---|---|---|---|
| Stone free rate | 79.2% | 94.4% | 93.8% | 92.2% | 0.022 |
| Complication rate | 10.7% | 4.1% | 7.2% | 7.6% | 0.411 |

## Patients and Methods

Records of 110 patients who had undergone rigid ureteroscopy and pneumatic lithotripsy because of ureteral stones between February 2005 and May 2011 were retrospectively analyzed. Age, gender, urinanalyses, urinary cultures, renal function tests and radiological assessment findings were obtained from the patient files. The location and size of the stone and additional anomalies in the urinary tract on the preoperative direct urinary system (DUS) X-Ray, urinary system ultrasonography (USG), intravenous pyelography (IVP) if performed and computed tomography (CT), were found from the records of the patients. All the patients were additionally analyzed in terms of the metabolic status. All the patients were routinely given antibiotic prophylaxis preoperatively, interventions were performed under general anesthesia, and saline was used as irrigation fluid.

Surgical procedures were performed using a 7.5 rigid ureteroscope (Karl Storz, Tuttlingen, Germany) with a guide wire (0.035 mm in thickness) or with guidance of a ureteral catheter (3-5F). Having passed the ureteral orifice with the guide wire, the ureteroscope was advanced towards the medial and the orifice was entered through the gap formed between the catheter and the orifice. Ureteral dilation was not performed on any of the patients. In the cases in which the ureteral orifice could be only be passed with difficulty, the ureter was entered by passing between the two guide wires following insertion of the double guide wires into the ureter. No patient underwent active balloon dilation in order to dilate ureteral orifice. The lithotripsy procedure was performed using the pneumatic lithotriptor (Vibrolith, Elmed, Ankara, Turkey). Destruction of the urinary calculi was continued until all the stone pieces had been disintegrated into pieces 3 mm or smaller. Stone pieces with remarkable diameters were removed using the stone grasping forceps and basket catheter, or they were left in the urinary bladder.

Smaller stone pieces were left for spontaneous passage. In case of intraoperative edema, mucosal injury or ureteral perforation, a double J (DJ) catheter or ureteral catheter was inserted by the surgeon in appropriate patients. Ureteral catheter was removed on the first day and double J (DJ) catheter was removed 3-4 weeks after the procedure. Patients were evaluated with DUS X-Ray performed on the postoperative 1. day. Patients who did not develop any complications after the procedure were discharged after a 24-hour follow-up period. Patients who were requested to return for Outpatient Clinic control were evaluated by urinary examination, renal function tests, direct urinary system X-Ray and USG, CT, IVP and/or renal scintigraphy, if needed. Switching to open surgery in the course of the procedure, or patients who were detected to have residual stones (whose stones had completely migrated to the kidney or whose broken stone pieces were > 3 mm) were accepted as treatment failure. When the body temperature was above 38.5°C and there was growth of the pathogenic microorganisms in the urinary cultures obtained intraoperatively, infection was accepted to have developed and antibiotherapy was administered for 7-10 days. Afterwards, they were controlled by urinanalysis and urinary cultures. Short standing subfebrile fever was not recorded as a complication.

### Statistical Analysis

The Statistical Package for Social Sciences (SPSS, Chicago, IL, USA) Version 13.0 program was used for the statistical analysis. The results were interpreted with descriptive statistics, and the treatement success and complication rates according to the location of the stone in the ureter were compared using the qui-square test and the stone sizes were compared using the Kruskal-Wallis test. A $p$ value of $< 0.05$ was accepted as statistically significant.

## Results

The mean age of the patients was 5.2 (range 1-17 years). 74 (67.2%) of the patients were males and 36 (32,8%) were females. A total of 115 rigid ureteroscopies were performed on 110 patients.

Stones were located in the left ureter in 62 (56%) patients and in the right ureter in 43 (39%) patients, and bilaterally in 5 (4.5%) patients. When the medical histories of the patients were evaluated, 11 (10%) had a history of having passed a kidney stone, 14 (3.6%) had a history of ESWL, 6 (5.4%) had a history of endoscopic ureteral stone treatment, 4 (3.6%) had a history of open surgery, and 5 (4.5%) had at least two of them. The vast majority of the patients had been referred to our Clinic from secondary healthcare institutions. One (0.9%) patient had elevation of serum creatinine levels, 2 (1.8%) patients had hematuria and 1 (0.9) patient had dysuria. Of the stones, 72 (65%) were located in the lower ureter, 21 (19%) were located in the middle ureter and 17 (15,4%) were located in the upper ureter. The mean size of the stones was determined as 7.5 mm (range 5-15 mm). The mean stone size was found as 7.4 mm in the lower ureter, 8.3 mm in the middle ureter and 8,4 mm in the upper ureter. No difference was found between the sizes of the stones in different locations ($p$ = 0.121). The stone free rate was found to be 92.2% for all ureteral stones. The total stone free rate according to location of stones was determined as 79.2% in the upper ureter, 94.4% in the middle ureter, and 93.8% in the lower ureter ($p$ = 0.022). The total complication rate was 7.6%. The complication rates were 7.2%, 4,1% and 10.7% for the lower, the middle and the upper ureter, respectively ($p$ = 0.411) (Table I).

No difference was determined in terms of complication rates according to location of the stone in the ureter. Peroperative complications included infection (n=2, 1.8%), mucosal injury (n=3, 2.7%), ureteral perforation (n=6, 5.4%), macroscopic hematuria (n=4, 3.6%) and ureteral extravasation (n=3, 2.7%). While open surgery was performed in 1 of 6 patients who had developed ureteral perforation in the course of the procedure, 5 were treated with DJ stent. Ureteral obstruction did not develop in the late follow-ups of the patients.

All the patients who had developed ureteral perforation were diagnosed intraoperatively. While open surgery was performed in 1 of 6 patients who had developed ureteral perforation in the course of the procedure, 5 were treated with DJ stent. Ureteral obstruction was not detected on the postoperative controls of the patients who had been treated with DJ catheter. The patients whose stones could not be fully cleared were referred to ESWL or follow-up programs depending on the location and size of the stone. Five patients who had not passed their urinary stones by the time of the follow-ups, underwent a second URS. While the histories of two of these patients were unproblematic, there was a history of endoscopy for 1 patient and ESWL for 2 patients, and one had experienced infection. Thirty-six patients (32%) underwent insertion of DJ catheter for 2-3 weeks in order to prevent stone burden, strain strase formation and to relieve the ureteral orifice edema, hematuria and drainage. Stone analysis could not be performed due to technical problems.

## Discussion

While ESWL was the first choice of treatment for ureteral stones in the 2001 Guideline of European Association of Urology, both ESWL and URS were presented as the first choice of treatment in the 2010 guideline[6,9]. However, as calcium oxalate and cystine stones are resistant to ESWL treatment, ureteroscopy is considered as the first choice for treatment of these stones. Furthermore, ureteroscopy is rapidly becoming the first acceptable treatment option for treatment of kidney stones besides distal and middle ureter stones[10].

Comparative studies on URS and ESWL were first performed by Dominic et al[11] They reported the success rate as 94% and 43%, respectively, in the first randomized study comparing URS and ESWL.

Minevich et al[12] compared the success rates of URS and ESWL in treatment of ureter stones. They used intracorporeal pneumatic lithotripsy along with URS. While the success rate was reported as 94% with URS, it was 42% after the first session and 64% after the second session with ESWL.

High success rates and low complication rates have been reported in a gradually increasing manner in recent years in the treatment of pediatric ureter stones. In one of the early researches conducted by Schuster et al[13], the stone free rates were reported as 92% and 100% following first and second procedures. In a literature review of Schuster et al[13], the success rate of ureteroscopy was reported to be between 84% and 100% for ureter stones[10,14-18]. Ureteral stricture was reported as 1%, ureteral perforation was reported as 1.3% and transient vesico-ureteral reflux (VUR) was reported as 3.6% in this review. While ureteral stones constituted the majority of the cases, kidney stones were seen at a rate of only 3-33%.

When comparing the success rates, ureteral stones are usually divided into those below the pelvic brim (distal-middle ureter stones) and above the pelvic brim (upper urinary tract). We also used the same classification when comparing the success rates of ureteral stone treatment. Al-Busaidy et al[19], Bassiri et al[20], Raza et al[21], and Thomas et al[10] reported the success rates as 93%, 88%, 79.3% and 88%, respectively, in their studies conducted with rigid ureteroscopy (Table II). No major complications were reported in these studies. The success rates were determined as 93.8% and 94.4% in the distal and middle ureter stones, respectively, and the mean success rate was determined as 92.2%. Despite minor complications such as infection (n=2, 1.8%), mucosal injury (n=3, 2.7%) and ureteral perforation (n=6, 5.4%), macroscopic hematuria (n=4, 3.6%) and ureteral extravasation (n=3, 2.7%) in the course of the surgical procedure, no major complications were reported (Table II). Our high success rate and low complication rate were consistent with those in the literature.

The second group in the ureteroscopic ureter stone treatment (upper urinary tract stones-proximal ureter and renal calculi) was the group in which the success rate was relatively lower compared to the first group. However, in many studies, the success rate in treatment of proximal ureter stones has been reported to be close to the rate in the distal-middle ureter stones. Minevich et al[12], Smaldone et al[17], Cannon et al[22], Corcoran et al[23], and Caione et al[24] reported success rates of 98%, 91%, 76%, 88% and 66.7%, respectively, in upper urinary system stones (proximal ureter and renal calculi) in their studies conducted with rigid and flexible URS (Table III). No major complications were reported in these studies. In our study, the stone free rate was determined as 79.2% and this was consistent with the literature.

The high stone free rate of ureteroscopy in a single session is the major advantage of ureteroscopic stone surgery. The stone free rate in a single session has varied between 77% and 100% in many peidatric ureteroscopy series[13,19,25-29]. The stone free rate in a single session was found as 87% and the rate of repeated procedures was found as 4.5% in our series. The vast majority of the patients are subjected to anesthesia only once due to the low number of repeated procedures. However, ESWL should be performed more than once accompanied by anesthesia in the pediatric age group. The difficulty of anesthesia in children, the increase in the risk potential due to repetaed

**Table II.** Results of rigid URS for stones below the iliac brim (distal-middle ureter calculi) in children.

| Study | No. children | Mean age (years) | Stone size (mm) | Fragmentation | Ureteral orifice dilation (%) | Stone free (%) | Complications (%) |
|---|---|---|---|---|---|---|---|
| Al-Busaidy et al[11] | 43 | 6.2 | 12.6 | EHL | 8.1 | 93 | Ureteral perforation - 4<br>Ureteral stricture - 2<br>Fever/VUR - 12 |
| Bassiri et al[13] | 66 | 9 | 8 | USL, EHL, PL | 37.9 | 88 | Renal colic - 1.5<br>Gross hematuria - 16.7<br>Pyelonephritis - 4.5 |
| Raza et al[12] | 35 | 5.9 | 9.4 | PL, EHL, HL | 3.9 | 79.3 | Ureteral stricture - 2<br>Fever - 10<br>Ureteral perforation - 6 |
| Thomas et al[10] | 29 | 7.8 | 6 | HL | 2.3 | 88 | Extravasation -1 |
| This study | 110 | 5.2 | 7.5 | PL | 0 | 94.1 | Infection - 1.8<br>Ureteral Perforation - 5.4<br>Macro Hematuria -3.6<br>Etravasation - 2.7 |

EHL: electrohydraulic lithotripsy; HL: holmium laser; PL: pneumatic lithotripsy.

**Table III.** Results of rigid and flexible URS for stones above the iliac brim (upper tract calculi) in children.

| Study | No. children | Mean age (years) | Stone size (mm) | Fragmentation | Ureteral orifice dilation (%) | Stone free (%) | Complications (%) |
|---|---|---|---|---|---|---|---|
| Minevich et al[15] | 58 | 7.5 | n/a | EHL, HL | 30 | 98 | Ureteral stricture - 1.3 |
| Smaldone et al[14] | 100 | 13.2 | 8.3 | HL | 70 | 91 | Ureteral perforation - 4.2 |
| | | | | | | | Ureteral stricture - 1 |
| Cannon et al[16] | 21 | 15.1 | 12.2 | HL | 81 | 76 | 0 |
| Corcoran et al[17] | 47 | 9.4 | 10.2 | HL | 91 | 88 | Ureteral perforation - 9 |
| Caino et al[18] | 37 | 7.4 | 7 | USL | 0.7 | 66.7 | Hematuria and flank pain - 4 |
| This Study | 110 | 5.2 | 7.5 | PL | 0 | 79.2 | Infection - 1.8 |
| | | | | | | | Ureteral perforation - 5.4 |
| | | | | | | | Macro Hematuria-3.6 |
| | | | | | | | Extravasation-2.7 |

EHL: electrohydraulic lithotripsy; HL: holmium laser; PL: pneumatic lithotripsy.

procedures and the low stone free rate of ESWL are among factors rendering ureteroscopy superior. The requirement of anesthesia in ESWL for each session is a significant disadvantage.

The subject of whether dilation of the ureteral orifice should routinely be performed or not during ureteroscopy in children is conflicting. Different results have been reported in different studies. While Shroff and Watson[26] advocated that balloon dilation was unnecessary, Jones et al[30] recommended it. While Busaidy et al[19] stated that they rarely needed mechanical dilation, El-Assmy et al[31] and Gedik et al[32] reported that balloon dilation was unnecessary. Furthermore, Hubert and Palmer[33] described passive dilation using a double J catheter, and Soygur et al[34] described the hydrolic dilation of the ureteral orifice.

We performed neither passive nor mechanical dilation in our cases. The ureter was entered between the double guide wire in cases in which passing the ureteral orifice or the intramural ureter was difficult. We consider that active or passive dilation is unnecessary. As this practical approach would eliminate the additional cost for ballooon dilation, we consider that it would increase the maintainability of ureteroscopic surgery in underdeveloped and developing countries. This practice would eliminate the need of balloon dilation and reduce the appearance of VUR development, despite its low frequency during ureteroscopy[13].

## Conclusions

We consider that rigid ureteroscopy is safe and effective in a single session without requiring active or passive dilation in the treatment of not only distal-middle ureter stones, but also in proximal ureter stones and, thereby, may be taken into consideration as the first choice of treatment.

### Conflict of Interest

None declared.

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