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Operative Technique

# Micro-ureteroscopy for the treatment of distal ureteral calculi in children

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ABSTRACT

*Objective:* The objective of this study was to demonstrate the efficacy and safety of micro-ureteroscopy (micro-URS) in the management of distal ureteral stones in the pediatric population.
*Materials and Methods:* A total of 11 children, who had undergone micro-URS between September 2015 and April 2016 with the indication of distal ureteral calculi in two referral centers, were retrospectively evaluated. The procedures were performed with the patient in the lithotomy position under general anesthesia using the standard URS technique with a micro-ureteroscope that has a caliber of 4.85 Fr all along its length. Demographics, perioperative data, and outcomes were assessed.
*Results:* Right (n = 6) and left (n = 8) ureteral stones were detected in the respective number of patients. The mean age of the children was calculated as 55.1 months (range, 6–161 months). The median stone size was 10.5 mm (range, 6–24 mm). The median operative time was 36.8 min (range, 23–68 min). A double 3 stent was implanted in 3 of 11 patients because of severe edema. As a postoperative complication mild hematuria (Clavien grade 1) was observed in one case and resolved spontaneously. Intraoperative minor or major complication did not occur in any of the cases. The mean hospitalization time was determined as 21.4 h (range, 10–28 h). Stone-free status was accomplished in all patients in the final assessment.
*Conclusion:* The outcomes of our series show that micro-URS can be used safely and effectively in the treatment of pediatric distal ureteral stones. Further prospective and comparative studies comparing instruments of different size are warranted.



Urolithiasis during childhood differs from stone disease observed in adults in terms of etiology, incidence, and natural course [1]. Because of the higher risk of recurrence and fragile anatomical structure in the treatment of pediatric nephrolithiasis, minimally invasive interventions are strongly preferred. Both in children and adults, shock wave lithotripsy (SWL) and ureteroscopy (URS) are the treatment alternatives based on the stone burden and location [2]. Requirement of multiple sessions for complete stone clearance and its application under anesthesia are the main limitations of SWL in children.

In recent years, technologic innovations, such as miniaturization of endoscopic instruments, have allowed safe and more effective application of minimally invasive methods [3]. It has been reported that when ureteroscopes designed for adults are used in the pediatric age group, complications, such as ureteral injury, ischemia, stenosis, and vesicoureteral reflux, may develop more frequently [4]. Various studies have demonstrated that the use of special smaller caliber ureteroscopes in the treatment of ureteral stones in children decreases complication rates [4,5]. Therefore, in pediatric cases, the use of semirigid ureteroscopes, especially those with a small caliber, is recommended [4,6].

Based on the literature, the smallest caliber (4.8 Fr) endoscope that has been used in the management of renal stones via the percutaneous route has also been employed in the treatment of bladder and distal ureteral stones [7,8]. This method used in the management of cases with ureteral calculi has been denoted “micro-URS” [8,9].

In the present study, we aimed to demonstrate the efficacy and safety of micro-URS in the management of distal ureteral stones in the pediatric population. To our best of knowledge this is the first pediatric series of micro-URS reported in the literature.

## 1. Material and methods

After obtaining the approval of the institutional review board, a total 11 children, who had undergone micro-URS between September 2015 and April 2016 with the indication of distal ureteral calculi in two referral centers, were retrospectively evaluated. The data, including patient demographics, perioperative data and postoperative data, were collected prospectively. Preoperatively, the parents and/or children were informed about potential risks of the procedure, and signed informed consent forms were obtained.

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Preoperatively, a routine physical examination and biochemical assessments were performed. Urinary tract infection was investigated with urine cultures in all cases. Plain urinary system radiogram (KUB), ultrasonography, and/or low-dose computed tomography was used as the imaging method. Stone burden was expressed as the measurement of the longest diameter of the stone and for multiple stones, as the sum of all of the diameters of the stones.

### 1.1. Micro-ureteroscopy instruments and technique

Micro-ureteroscope is an instrument, including a shaft with 4.85-Fr size and 1.4-mm lumen (Fig. 1A), an adaptor attached to the proximal side of the shaft and an optic with the size of 0.9 mm providing image quality of 10.000 pixels (PolyDiagnost, Pfaffenhofen, Germany) (Fig. 1). The optic is inserted into the lumen of the shaft through the second lumen of the adapter with 3 lm. The other lumens allow the insertion of the laser fiber (200 μm) and drainage of the irrigation fluid. During the procedure, irrigation was provided using a Y-TUR irrigation set with a pump handle.

With the patient in the lithotomy position under general anesthesia, the procedure was performed by the two experienced surgeons (MMU and AT) using the same standard URS technique with a telescope developed for micro-percutaneous nephrolithotomy [8]. During the procedure, a C-arm fluoroscopy device was set ready for use when necessary. Passage of the optic through the urethra to the bladder and ureteral orifice was easily performed in boys and girls (Fig. 2). Balloon dilation was not needed in any case for access through the ureteral orifice. A guide-wire was used to facilitate the passage in patients with a tortuous ureter. During the procedure, the manual irrigation pump system was used in cases with blurred vision to obtain adequate image quality. Stone fragmentation was accomplished with a 200-μm Ho:YAG laser fiber using the dusting technique with the setting of 6 Hz and a power of 0.6 joules. In patients who need insertion of a double-J (DJ) stent because of severe edema because of stone impaction or ureteral injury, a guide-wire was inserted through the shaft up to the upper urinary tract. Then, a 4.8-Fr DJ stent was inserted over this guide-wire. Pain relief was maintained with parenteral or oral analgesics postoperatively (paracetamol 15 mg/kg per dose).

All of the patients were evaluated on the morning of the first postoperative day and one month later using imaging modalities of KUB and US. The patients were discharged on oral analgesia in consideration of the postoperative clinical manifestations. Two weeks after surgery, DJ stents were removed endoscopically. Postoperative complications were graded using Clavien-Dindo classification system.

## 2. Results

Patient demographics and perioperative data and outcomes are described in Table 1.

Right (n = 6) and left (n = 5) ureteral stones were detected in the respective number of patients. The mean age of the children were calculated as 55.1 months (range: 6–161). The flank pain (5/11), hematuria (5/11), and fever (4/11) related to urinary tract infection were the main presenting symptoms. The median stone size was 10.5 mm (range: 6–24). Upper tract dilation and hydronephrosis were detected in all cases. A double J stent was implanted in 3 of 11 patients because of severe edema intraoperatively. The median operative time was 36.8 min (range: 23–68). As a postoperative complication mild hematuria (Clavien grade 1) was observed in one case and resolved spontaneously. Intraoperative minor or major complication did not occur in any of the cases. The mean hospitalization time was determined as 21.4 h (range: 10–28). Stone-free status was accomplished in all patients in the final assessment. In the first month control visit, residual fragments, hydronephrosis or any sign of urinary tract infection was not detected.

## 3. Discussion

Although pediatric stone disease is rare, its overall incidence is nearly 2–3% [10]. In children, ureteral stones are seen less frequently compared to adults, and they constitute nearly 7% of all urinary stones [11]. During the last two decades, minimally invasive interventions, such as SWL, URS, percutaneous nephrolithotomy, and laparoscopic surgery, which have been applied initially in adults, have been modified for use in pediatric patients [10].

The first use of URS for distal ureteral calculi in children was reported by Ritchey in 1988 [12]. With the miniaturization of ureteroscopes and the development of laser lithotripsy, URS use in the pediatric age group


**Fig. 1.** The micro-ureteroscope, 4.5Fr semirigid ureteroscope and 9.5Fr pediatric cystoscope are set ready on the operating table.