

# Factors Affecting Success of Semi-rigid Ureterorenoscopy in Proximal Ureter Stone Treatment

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## ABSTRACT

**Objective:** To evaluate the factors affecting the success of semi-rigid ureteroscopy in proximal ureter stones.

**Study Design:** Descriptive study.

**Place and Duration of Study:** Department of Urology, Nevşehir State Hospital, Turkey between March 2017 and October 2019.

**Methodology:** Patients, who underwent a semi-rigid ureteroscopic lithotripsy (URSL) operation for proximal ureteral stones, were evaluated retrospectively in terms of gender, age, stone side, stone size, stone density, the type of lithotripsy, placement of the stone cone, the type of anesthesia and postoperative stone-free rates, which were recorded. The diameter of the ureter with the stones and the distances of the stones to the ureteropelvic junction (UPJ) were measured. Patients who had stone-free status after the URSL were labelled as group I. Patients whose stones were pushed back during URSL were labelled as group II.

**Results:** The distance of the stone to the UPJ was statistically significantly higher in group I ( $p=0.006$ ). The rate of using stone cone in patients in group I was statistically significantly higher than in patients in group II ( $p=0.001$ ). The rate of stones in the middle ureter in group I was statistically higher than group II ( $p<0.001$ ). The rate of using laser lithotripter in group I was statistically higher than group II ( $p=0.007$ ).

**Conclusion:** Semi-rigid URSL is a useful technique in the proximal ureter stones. The distance of the stone to the UPJ affects the success; and using laser lithotripsy and stone cone increases the success.

**Key Words:** Ureteral stone, Ureterorenoscopy, Laser lithotripsy, Pneumatic lithotripsy.

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## INTRODUCTION

Ureteral stone may cause obstructive uropathy and hydro-nephrosis, which may eventually make renal function deteriorate.<sup>1</sup> The main purpose of ureteral stone treatment is to remove the stone completely with minimal morbidity. Urologists consider many factors, such as location of stone, stone size, patient's age, degree of hydro nephrosis, symptom severity, accompanying bacterial infection, status of solitary kidney, patient expectations and technical equipment, when making treatment decisions.<sup>2</sup> Stones smaller than 5 mm are more suitable for spontaneous passage through the ureter.<sup>3</sup> Proximal ureteral stones are defined as stones which are located above the iliac cross.<sup>4</sup> Proximal ureteral stones were shown to be more difficult to pass spontaneously compared to distal ureteral stones.<sup>5</sup>

With the advances in technology, rigid and flexible ureteroscopy (f-URS) may be used instead of shock wave lithotripsy (SWL), in the treatment of proximal ureteral stones.<sup>6,7</sup> Pneumatic lithotripter and holmium:yttrium-aluminum-garnet (Ho:YAG) laser can be used for intracorporeal lithotripsy.<sup>8</sup>

In this study, the factors affecting the success of semi-rigid ureteroscopic lithotripsy (URSL) in proximal ureter stones were assessed. Proximal ureteral stone treatment is increasingly shifting to ureteroscopic lithotripsy. Knowing the factors that affect the success of ureteroscopic lithotripsy will be useful for the technical option.

The aim of this study was to evaluate the distance between the stone and the UPJ, the diameter of the ureter in the proximity of the stone and the effect of these parameters on the success of the surgical procedure.

## METHODOLOGY

After obtaining the approval of the local Ethics Committee, assessed patients, who had received semi-rigid ureterorenoscopic lithotripsy operation for proximal ureteral stones at Nevşehir State Hospital, Turkey between March 2017 and October 2019, were evaluated. The authors used 9 Fr RZ Mediz-

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intechnik™ ureteroscope, Vibrolith intracorporeal pneumatic lithotripter,™ and Quanta System Litho™ 35 W Holmium:Yag laser for lithotripsy, and Boston Scientific Stone Cone™ stone retrieval coil. The patient data was evaluated retrospectively, and the age, gender, stone side, size of the stone, stone density, lithotripter type (holmium laser / pneumatic), whether a stone cone was used, anesthesia type, and postoperative stone-free rates were recorded. In addition, non-contrast computed tomography (NCCT) images were analysed and the diameters of the ureters in the proximity of the stones and the distance of stones to the UPJ were evaluated. The distance from UPJ to proximal of the stone on the software were measured (Figure 1). General stone-free rates and the effect of the above-mentioned parameters on stone-free rates were evaluated. Evaluation was performed three weeks after operation with ultrasonography and NCCT. Patients, whose operations were successful and whose stone was removed, were classified as successful and named as group I. Patients, whose stones were pushed back during the operation, were classified as unsuccessful and named as group II. Patients with urinary anomalies, urinary infection, multiple ureteral stones and pregnant patients were excluded from the study. The inclusion criteria were: age above 18 years, a sterile urinary system, and <2 cm proximal ureteral stone.

SPSS 17.0 (Chicago, Illinois, USA) was used for analysing the data. Shapiro-Wilk test was used to determine normality. Qualitative variables were shown in numbers with percentages, where quantitative variables in mean with standard deviation and median with inter-quartile range (IQR). Chi-square/Fischer's exact test and Mann-Whitney U-test were used to compare the groups. A p-value of less than 0.05 was considered to show a statistically significant result.

## RESULTS

One hundred and fifty-three patients, who were admitted to the outpatient clinic between March 2017 and October 2019 and diagnosed with proximal ureteral stones, were evaluated. Forty-nine patients were excluded from the study because of missing information at their NCCT images. The mean age of the 104 patients was  $43.8 \pm 12.77$  years. Seventy-five patients (72.1%) were males and 29 (27.9%) were females. Factors affecting the results of the semi-rigid URSL in proximal ureteral stone treatment are shown in Table I. Stone-free rate in patients after operation was 82 (78.8%, group I). In 22 (21.2%) patients, stones were pushed back during the operation (group II). The overall success rate of the operation was 78.8%. There was no statistically significant difference between the groups in terms of stone size, stone density and proximal ureter calibre ( $p = 0.903, 0.338, 0.345$ , respectively). Further, the stone was to the UPJ resulted in a significantly higher successful operation group ( $p = 0.006$ ). The rate of using stone cone in patients in the successful group was significantly higher than in patients in push-back group ( $p = 0.001$ ).

Of the ureter stones, 57 (54.8%) were on the right and 47 (45.2%) on the left side. Of the patients in group I, the stone

was on the right side of 43 (52.4%) patients and on the left side of 39 (47.6%) patients. In group II, the stone was on the right side of 14 (63.6%) patients and on the left side of 8 (36.4%) patients. There was no statistically significant difference between the patients in group I and group II in terms of stone side ( $p = 0.349$ ).

There were 62 (59.6%) stones in the upper ureter and 42 (40.4%) stones in the middle ureter of all the patients. In group I, 40 (48.8%) patients had an upper ureteral stone and 42 (51.2%) had a middle ureteral stone. In group II, all the stones were at the upper ureter. Group I had more stones in the middle ureter than group II ( $p < 0.001$ ).

Holmium laser lithotripsy was used in 68 (65.4%) patients, and pneumatic lithotripsy in 36 (34.6%) patients. In group I, 59 laser lithotripsy (72%) and 23 pneumatic lithotripsy (28%) treatments were performed. In group II, nine laser lithotripsy (40.9%) and 13 pneumatic lithotripsy (59.1%) treatments were performed. The use of laser lithotripsy increased the success of ureteroscopy in proximal ureter stones ( $p = 0.007$ ). In 21 (25.6%) patients, general anesthesia was given and in 61 (74.4%) patients spinal anesthesia was used in group I. In five (22.7%) patients, general anesthesia was given; and in 17 (77.3%) patients, spinal anesthesia was used in group II. There was no statistically significant difference in anesthesia between the groups ( $p = 0.782$ ). D-J stent was placed in 74 (71.2%) patients after surgery.

## DISCUSSION

Ureteral stones are important health problem throughout the world. Patients are admitted to the emergency room and urology outpatient clinics, mostly with renal colic.<sup>9</sup> Medical expulsive therapy, SWL, and ureteroscopy are treatment options.<sup>3,10</sup>

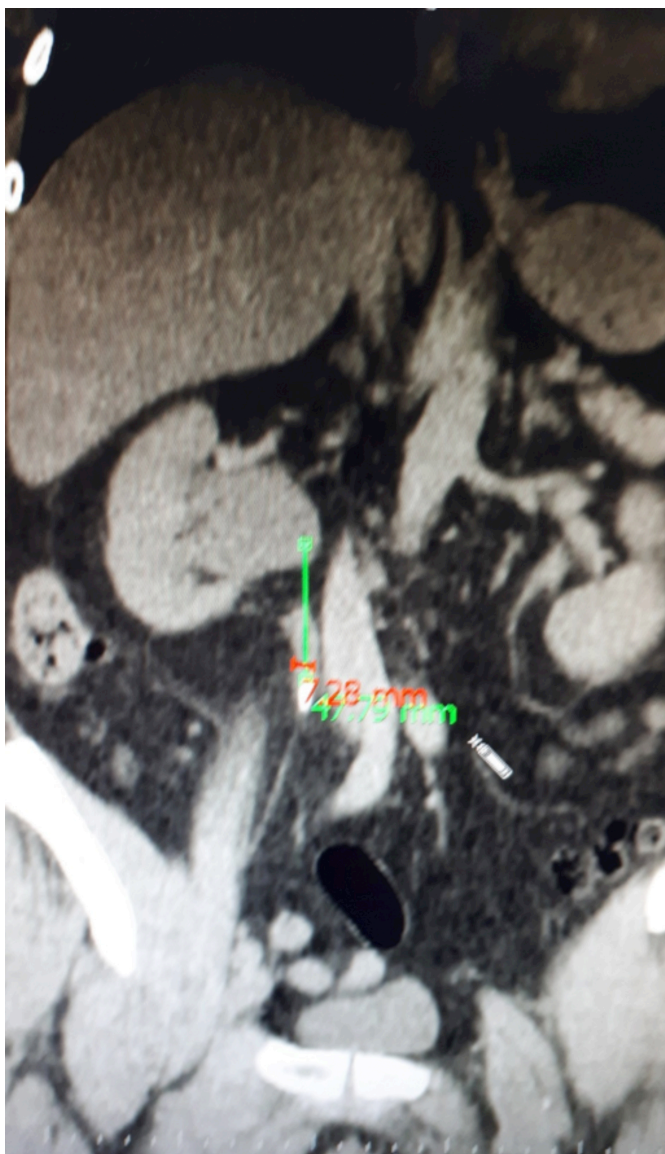
While the first option for proximal ureteral stones was SWL, URSL has come to the fore with the development of technology and the use of semi-rigid and flexible URS with Ho: YAG laser.<sup>10</sup> Considering the success of semi-rigid URSL, the treatment of distal ureteral stones is more successful, but the rate of success in proximal stones increases with the developing technology (98%; 80% respectively).<sup>11</sup> Several studies have been done to find out the factors affecting the success of URSL for proximal ureteral stones.<sup>2,12</sup> Many factors affect the ureteroscopy's success, like age, gender, stone size, stone density, impacted stone history, and lithotripter type (laser or pneumatic).<sup>2,12</sup> Unlike previous studies, the effects of these factors on stone-free rates by measuring the distance to the UPJ and the ureter diameter above the stone by examining the NCCT images were evaluated.

Sen, Sancak, Günlüsoy and Bangash reported that stone size is associated with the success rate of semi-rigid ureteroscopy in proximal ureteral stone.<sup>2,6,10,12</sup>

There are studies that claim the opposite.<sup>13-15</sup> In this study, the size of stones were similar in both the groups ( $p = 0.903$ ). The present study supports the reports of Chen and Cheung.<sup>13,14</sup>

**Table I: Factors affecting the results of the semi-rigid URSL in proximal ureteral stone treatment.**

|   | Group I (n=82)       | Group II (n=22)        | p-value |
|---|----------------------|------------------------|---------|
| Stone density (HU)                        | 716 (410.75-1028.75) | 837.5 (549.75-1035.25) | 0.338   |
| Stone size (mm)                           | 8 (6-11)             | 8 (5.6-11)             | 0.903   |
| Proximal ureter caliber (mm)              | 10 (7-13)            | 10 (9-13.25)           | 0.345   |
| The distance of the stone to the UPJ (mm) | 45.5 (28-70)         | 27.5 (20-41.5)         | 0.006   |
| Stone cone placement (n)                  | 25(30.5%)            | 0(0%)                  | 0.001   |
| Right side (n)                            | 43(52.4%)            | 14(63.6%)              | 0.349   |
| Left side (n)                             | 39(47.6%)            | 8(36.4%)               |         |
| Upper ureter (n)                          | 40(48.8%)            | 22(100%)               | <0.001  |
| Middle ureter(n)                          | 42(51.2%)            | 0(0%)                  |         |
| Laser lithotripsy (n)                     | 59(72%)              | 9(40.9%)               | 0.007   |
| Pneumatic lithotripsy (n)                 | 23(28%)              | 13(59.1%)              |         |
| General anesthesia (n)                    | 21(25.6%)            | 5(22.7%)               | 0.782   |
| Spinal anesthesia (n)                     | 61(74.4%)            | 17(77.3%)              |         |

**Figure 1: Measurement of stone to UPJ distance and proximal ureter width.**

The articles evaluating the effects of stone density measured with the Hounsfield unit are also available in the literature.<sup>16</sup>

Considering that the lithotripsy process will be more difficult in harder stones, failure rates are thought to be higher. In this study, no difference was observed between the two groups in terms of stone density. The results of the present study are similar to those of Sen *et al.*<sup>2</sup>

It was observed that stone side did not affect the success of semi-rigid ureteroscopy. There was no difference in the side of stones, as shown in the Kaygısız and colleagues' study, supports the work of this study.<sup>17</sup>

In order to reach the upper part of the ureter with semi-rigid ureteroscopy, it is thought that general anesthesia will be more suitable as it relaxes the body. However, in this study, it was observed that the preference of general anesthesia for proximal ureter stones did not increase the success of semi-rigid ureteroscopy. Sen *et al.* also reported that the administration of general anesthesia had no effect on semi-rigid URSL success for proximal ureteral stones.<sup>2</sup>

There are many studies showing that using Ho: YAG laser for lithotripsy increases the success of semi-rigid URSL in proximal ureter stones.<sup>2,18,19</sup> Over the time, lithotripter techniques have increased success in proximal ureter stones and decreased complication rates. In this study, Ho:YAG laser lithotripter was seen to be more effective than pneumatic lithotripter. Laparoscopic techniques are applied successfully for large stones for the upper ureter.<sup>17</sup> The use of equipment, such as stone cone to prevent the push-back of the stone to proximal, increased the success of semi-rigid ureteroscopy.

Unlike other studies, the distance to UPJ and the ureter width in the proximity to the stone are evaluated in this study. The closer the stone is to the UPJ, the greater the failure. Therefore, when the stone is closer to the UPJ, it will be better to use stone cone and Ho: YAG laser to increase the success of the surgery. Moreover, if possible, flexible ureteroscopy should be used to reach stones that could be push-back. In this study, the proximal diameter of the ureter proximity to stone was found to be insignificant in terms of its effect on the success of the operation. In this study, D-J stent was placed on the majority of patients. Günlüsoy *et al.* preferred



to put D-J stents on fewer patients;<sup>12</sup> whereas, Şen *et al.* preferred to use D-J stents in more patients.<sup>2</sup>

The biggest limiting factor of this study was retrospective collection of the patient groups which are relatively small sized. The authors believe that prospective studies with a larger group of patients are needed to demonstrate the importance of semi-rigid URSL in the treatment of proximal ureter stones, and the factors affecting the success.

## CONCLUSION

Semi-rigid URSL is a useful technique in the proximal ureter stones. It is useful to use Ho:YAG lithotripsy and stone cone to increase the success of semi-rigid URSL. The distance of the stone to the UPJ affects the success. Considering that failure may be more in stones closer to UPJ, it is useful to perform surgery in centres with flexible ureterorenoscopy.

## ETHICAL APPROVAL:

The present study is approved by the Hacibektaş University Clinical Research Ethical Committee. All procedures performed in this study, involving human participants, were in accordance with the ethical standards of the Institutional and National Research Committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

## PATIENTS' CONSENT:

Since the study is conducted retrospectively, getting the patient consent in person was not applicable. Nonetheless, even before the Ethical Committee application, proper authorisations were taken from Nevşehir State Hospital administration by ensuring the patients' anonymity and protection of the patient data.

## CONFLICT OF INTEREST:

The authors declared no conflict of interest.

## AUTHORS' CONTRIBUTION:

SO: Collaborated in data processing, data analysis, and authored the manuscript.

SO, HK: Conceptualised and designed the study, edited and critically reviewed manuscript.

MCT, SO, NÖK: Initiated, conceptualised and designed the study, edited and critically reviewed manuscript.

CY, HK: Interpreted results and critically reviewed manuscript.

SO, MCT: Collaborated in collection of data and critically reviewed manuscript.

SO, HK, MCT, NÖK: Edited, critically reviewed manuscript and collaborated in quality control. SO: Performed statistical analysis and authored the manuscript.

All authors read and approved the final manuscript.

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