

# Translational Research Urology

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Original Article

## Combined Direct Visual and Imaging Guided Percutaneous Nephrolithotomy: A Novel Technique

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### HIGHLIGHTS

- Our new retroperitoneal mesh embedded technique is safe.
- We can correct hernia and prostatectomy surgery simultaneously.
- Our novel technique is an effective and practical one.
- This new method is strongly suggested to another surgeon.
- Our novel surgery method had no operative duration or further complications.

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### Introduction

Percutaneous nephrolithotomy (PCNL) is the mainstay of endourological nephrolithiasis treatment these days (1, 2). Obtaining secure percutaneous access to the collecting system which is usually done under fluoroscopic guidance and tract dilatation is crucial step toward a successful and safe procedure (3). After successful puncture of the desired calyx, the passage of the guidewire beyond the calyx into the pelvis and ureter provides the most secure

### ABSTRACT

#### Introduction

Percutaneous nephrolithotomy (PCNL) is a common urological procedure. Obtaining secure percutaneous access to the collecting system which is usually done under fluoroscopic guidance and tract dilatation is a crucial step toward a successful and safe procedure. The aim of this study is to introduce a novel technique to modify this procedure.

#### Methods

Combined Direct Visual and Imaging Guided PCNL is performed by using specific 28 Fr dilators with a customized central lumen which accepts a 4.5 F semi-rigid ureteroscope to visually confirm the puncture of target calyx and passing a guidewire. This instrument was passed as a one-shot dilator after the withdrawal of the puncture needle. The rest of the procedure was then carried out in a standard manner. This novel technique was introduced in 12 patients in 2020 in Sina hospital, after completing the informed consent.

#### Results

The mean age was  $53.58 \pm 11.96$  and the average stone size was  $4.1 \pm 0.58$  cm and the average time from insertion of the needle into target calyx until securing a guide-wire inside the collecting system (pelvis, ureter) was 95 seconds (84-107). Fluoroscopy time (total time required to obtain the access but not the whole operation) was averagely  $30.25 \pm 8.01$  seconds. There were no intraoperative or postoperative complications as a result of this technique.

#### Conclusions

Use of the ureteroscope loaded with the dilator and sheath during PCNL, seems to be a feasible and safe technique for dilatation of access tract during one shot PCNL.

**Keywords:** Technique; Percutaneous; Nephrolithotomy; Nephrolithiasis; Iran

position to proceed with access dilatation (4). So many urologists prefer to change it to a stiffer guidewire after the needle is removed to obtain a more rigid rail for insertion of subsequent dilators, many have opted to use balloon dilators (5). Standard practice is advised to pass a guidewire into the ureter as a safety wire or at least have one wire passed beyond the obstructed calyx or stone into the collecting system (in the upper pole calyx for instance) before starting dilating to prevent surgical complications

and access failure due to dislodgement of the wire which could happen during several instruments changes for dilation of the tract and aggravated by kidney movement along with breathing movements. In many instances, large stone bulk occupying the calyx of the infundibulum would impossible to pass the wire further down to the renal pelvis or ureter which would result in a challenging tract dilation and higher rates of access failure due to wire dislodgement (6, 7). At our center (Sina hospital, Tehran University of medical sciences) we have been using miniaturized PCNL in both children and adults using ureteroscope for many years and in few challenging cases we entered the calyx before dilation with the ureteroscope to disintegrate the stone and deploy a wire to proceed further with the dilation to full size; revisions of this technique led to using a modified Amplatz dilator which could hold the ureteroscope inside and be used as a single shot dilator for percutaneous access. Furthermore, the feasibility of percutaneous access tract dilation especially in animal models is shown using a visual dilator system (8), and human studies are required. The aim of this study is to introduce this novel technique to modify PCNL.

### Methods

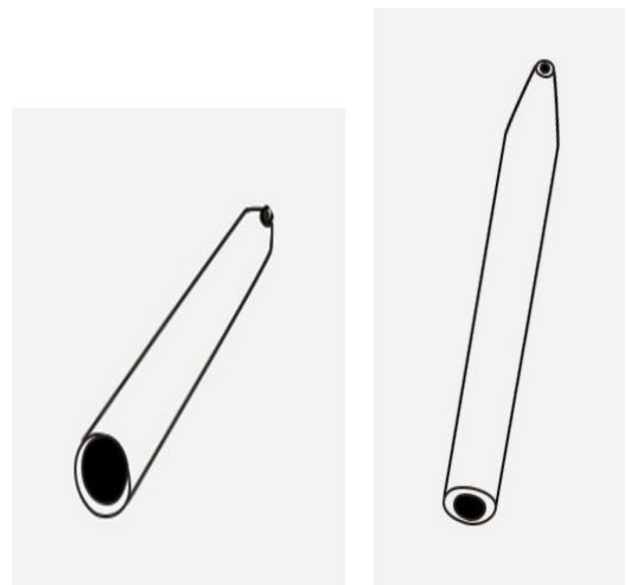
Twelve Patients were recruited in 2020 in Sina hospital, after completing the informed consent. The study was done under the Tehran University of Medical Sciences ethical committee (IR.TUMS.MEDICINE.REC.1398.237). The patients would routinely undergo abdominal computed tomography (CT) scans, urine culture, and routine preoperative laboratory blood tests. PCNL was carried out in a prone position under general anaesthesia by a single surgery team. Retrograde ureteric



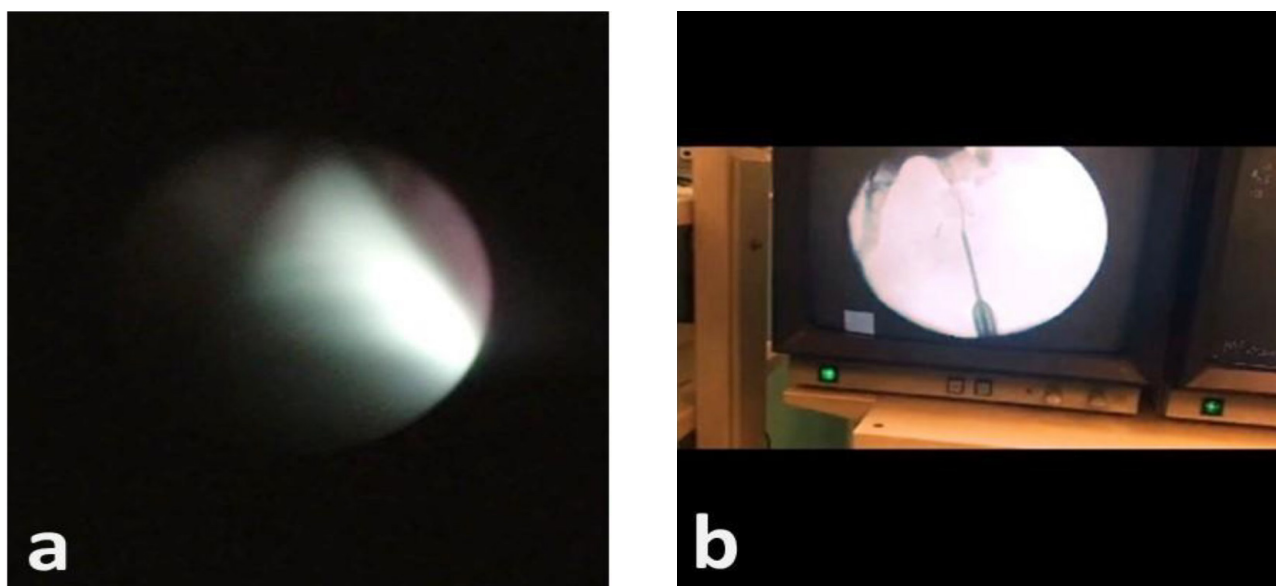
**Figure 1.** Lower calyx puncture, guide wired could not be located beyond the infundibulum of the punctured calyx

catheterization and fluoroscopy helped in defining the calyceal anatomy. The puncture was performed with an 18 G PCNL puncture needle with the standard method. Free flow of urine/saline or antegrade contrast installation through the needle would confirm successful entry and a J tip wire was passed through the needle into the collecting system in challenging cases in which the entire calyx of entry is filled up with the stone or due to certain infundibular anatomy and the wire could not be passed into the pelvis (Figure 1). Then, a pediatric ureteroscope (4.5-6 Fr, R.WOLF) irrigated by saline and preloaded with a specifically designed pencil-shaped plastic dilator (28 Fr) and Amplatz sheath (30 Fr) (Figure 2), were used to pass the tract into the punctured calyx and maneuver another guide wire (0.035 inches) alongside the stone through the infundibulum under direct visual guidance and then fluoroscopic confirmation (Figure 3).

Then this wire and ureteroscope itself were used as the rigid guide and the dilator was advanced gradually and visual confirmation of correct placement of the dilator and the access sheath inside the collecting system was done yet in many instances the surgeon passed the whole dilator kit (ureteroscope plus the dilator) in one shot, keeping the ureteroscope aligned over the wire under direct vision and push the dilator forward at the same time with the other hand. Although all stages could be followed on the fluoroscope before insertion of the nephroscope. The time for access dilation was recorded from the withdrawal of the needle sheath up to point that working sheath. In these cases, a 30 Fr. Amplatz sheath and customized 28 Fr pencil-shaped plastic dilator bearing a central lumen were loaded over a semi-rigid ureteroscope was used as a visually guided dilator. The rest of the procedure was then



**Figure 2.** The new design of dilator



**Figure 3.** The progress of new design access dilation is monitored simultaneously through both endoscopic (a) and fluoroscopic monitors (b)

carried out in a standard manner.

Patients' demographic data such as age, body mass index, preoperative hemoglobin, and creatinine were extracted from hospital documents. Fluoroscopy time was calculated based on fluoroscopic shots during the procedure. The surgeon's satisfaction was evaluated by a visual analog scale after the operation. Hemoglobin drop and creatinine rise was calculated with preoperative and one-day postoperative laboratory data.

### Statistical analysis

Data analysis was done using SPSS (v16) software [Statistical procedures for social sciences; Chicago, Illinois, USA]. Chi-square, Fisher, and Pearson regression tests were used and were considered statistically significant at P values less than 0.05.

### Results

This technique was performed on 12 patients. The mean age was  $53.58 \pm 11.96$  and the mean body mass index was  $26.33 \pm 1.78$ . The average stone size was  $4.1 \pm 0.58$  cm and the average time from insertion of the needle into target calyx until securing a guide-wire inside the collecting system (pelvis, ureter) was 95 seconds (84-107). Fluoroscopy time (total time required to obtain the access but not the whole operation) was averagely  $30.25 \pm 8.01$  seconds. There were no intraoperative or postoperative complications as a result of this technique. One patient needed transfusion postoperatively. One patient needed extensive antibiotic therapy due to fever on the second post-operative day. The guidewire could be successfully passed beyond the obstructed calyx into the ureter or father possible calyx in all cases. There were no failed

accesses. (Table 1).

**Table1.** Patient's demographic data

Variable	Mean (SD)
Age (Year)	53.58 (11.96)
Body mass index (kg/m <sup>2</sup> )	26.33 (1.78)
Fluoroscopy time(second)	30.25 (8.01)
Surgeon's satisfaction (VAS)	8.5 (1.00)
Operation time (min)	68.83 (13.74)
Hb (gr./dl ) drop	0.6 (1.27)
Creatinine (Mgr./dl) rise	0.08 (0.3)

SD: Standard Deviation; VAS: Visual Analogue Scale; HB: Hemoglobin

### Discussion

Obtaining a secure and correctly placed percutaneous access into the renal collecting system is the cornerstone of a successful and uneventful PCNL. Tract dilation is usually attained by multiple passages of exchangeable flexible dilators of the Amplatz type, metallic telescoping dilators of the Alken type, or a single-use inflatable high-pressure balloon (6, 7), while the introduction of percutaneous renal surgery in 1976 by Fernstrom and colleagues (9), any aspect of the operative technique and the endoscopic equipment have been undergoing constants evolution to increase the success rate of the PNL procedure. Currently, balloon dilation is regarded as the most modern and also safest system, though it has the disadvantage of relatively high cost and high failure rate in cases of prior surgery or peri-renal fibrosis (10). Our technique ensures better dilatation to attain a successful procedure to enable safe

dilatation and highlights the importance of those two steps leading to a higher satisfaction rate among surgeons. This was a single institution interventional study about the alternative method for under vision dilatation of access during one-shot PCNL procedure, especially in cases in which the fluoroscopic placements were not successful and there is doubt about the presence of the guidewire in the system. When the needle is proceeding towards the related target, some radiological sign may confirm its correct insertion, and dilation and operative sheath placing are the last steps of the percutaneous tract creation.

A recent meta-analysis by Dehong and his colleagues compared four tract dilation methods for PCNL including Amplatz dilation (AD), metal telescopic dilation (MTD), balloon dilation (BD), and one-shot dilation (OSD) methods (11). Their results showed that one shot dilatation can significantly decrease the duration of fluoroscopy and cease the hemoglobin decrease in comparison with metal telescopic dilatation. Different methods and alternative techniques have been introduced in the literature to attain a better outcome and to pass a perfectly positioned guidewire. Penbegul et al., suggested a novel disposable PCNL set, an Economical One-shot PCNL Set, consisting a single 30-Fr dilator, 30-Fr sheath, and 8-Fr polyurethane dilator, as use of a one-shot dilatation technique during PCNL that has successful results as well as our study (12). Retrograde nephrostomy by Lawson's procedure was reported in 1980 (13). Shi et al., reported that after the renal infundibulum was distended by stimulated diuresis, the kidney was then punctured under the ultrasonography-guidance via the fornix of the target calyx (14). The working channel was dilated using a specially designed pencil-shaped facial dilator. It was shown by Javali et. al., that after successful access to the target calyx, a guidewire was passed through the outer dilator sheath under fluoroscopic guidance into the calyx (15). A semi-rigid ureteroscope was passed percutaneously throughout the puncture wound among the two guide wires, monitoring its steady progress using both the endoscopic as well as the fluoroscopic monitors, till the semi-rigid ureteroscope goes to the correct calyx and the stone was visualized. Then the third guidewire was passed through the operational channel of the semi-rigid ureteroscope, maneuverer by the side of the stone, through the infundibulum, into the pelvis and ureter. After that first two guide wires were then detached and usual tract dilatation was then carried out over the guidewire that was positioned into the ureter, following withdrawing the semi-rigid ureteroscope. The rest of the process was then done in the usual manner. This method was done over 85 patients and in 82 of them, the passing of guidewire into the ureter was successful with a mean time of duration equal to 95 seconds (from ureteroscope to ureter entrance) (15).

In our novel method, the usage of ureteroscope

was only done as the accessory method for guidewire conducting, so ureteroscopy and dilatation were done simultaneously. Another special safety feature of described visually confirmed tract dilation (VC-PNL) is the ability to visualize the different tissues while the dilator is passing through them and minimizing the risk for injury to adjacent organs such as the colon. Besides, we could state that using this technique might reduce radiation exposure in such difficult cases which usually necessitate multiple passages for obtaining a safe tract. Our technique is feasible and easy to learn and contrary to balloon dilation, it does not impose any extra instrument cost to the expenses. The present study has several limitations as it was included relatively few patients and was not included in a control group. Furthermore, no complications about our technique were observed, demonstrating that it is safe to instrument a newly created procedure for better dilatation. As this study is to introduce this technique, it was performed in only a few patients. Further randomized clinical trials with adequate sample sizes are needed to prove this theory.

### Conclusions

Use of the ureteroscope loaded with the dilator and sheath during PNCL, seems to be a feasible and safe technique for dilatation of access tract during one shot PCNL.

### Authors' contributions

All authors contributed equally.

### Acknowledgments

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### Conflict of interest

All authors declare that there is not any kind of conflict of interest.

### Funding

There was no founding.

### Ethics statement

The study was done under the Tehran University of Medical Sciences ethical committee (IR.TUMS.MEDICINE.REC.1398.237).

### Data availability

Data will be provided by the corresponding author on request.

### Abbreviations

AD	Amplatz dilation
BD	Balloon dilation
CT	Computed tomography

MTD	Metal telescopic dilation
OSD	One-shot dilation
PCNL	Percutaneous nephrolithotomy
VC-PNL	Visually confirmed tract dilation

## References

1. Aghamir S, Hosseini S, Gooran S. Totally tubeless percutaneous nephrolithotomy. *Journal of endourology*. 2004;18(7):647-8.
2. Aghamir SMK, Salavati A, Aloosh M, Farahmand H, Meysamie A, Pourmand G. Feasibility of totally tubeless percutaneous nephrolithotomy under the age of 14 years: a randomized clinical trial. *Journal of endourology*. 2012;26(6):621-4.
3. Aghamir SMK, Modaresi SS, Aloosh M, Tajik A. Totally tubeless percutaneous nephrolithotomy for upper pole renal stone using subcostal access. *Journal of endourology*. 2011;25(4):583-6.
4. Eryildirim B, Tuncer M, Camur E, Ustun F, Tarhan F, Sarica K. Renal access in PNL under sonographic guidance: Do we really need to insert an open end ureteral catheter in dilated renal systems? A prospective randomized study. *Archivio Italiano di Urologia e Andrologia*. 2017;89(3):226-31.
5. Sharma GR, Maheshwari PN, Sharma AG, Maheshwari RP, Heda RS, Maheshwari SP. Fluoroscopy guided percutaneous renal access in prone position. *World Journal of Clinical Cases: WJCC*. 2015;3(3):245.
6. Bryniarski P, Stelmach P, Taborowski P, Rajwa P, Adamkiewicz M, Życzkowski M, et al. Percutaneous nephrolithotomy with amplatz and alken dilators: an eight-year single tertiary care centre experience. *Medical science monitor: international medical journal of experimental and clinical research*. 2016;22:4918.
7. Özçift B, Bal K, Dinçel Ç. A comparison of balloon and amplatz dilators in percutaneous nephrolithotomy: a retrospective evaluation. *Turkish journal of urology*. 2013;39(4):226.
8. Shah AK, Xu K, Liu H, Lin T, Xie K, Huang H, et al. The "visual dilator system": initial experimental evaluation of an optical tract dilation technique in percutaneous nephrolithotomy. *Journal of endourology*. 2013;27(7):908-13.
9. Fernström I, Johansson B. Percutaneous pyelolithotomy: a new extraction technique. *Scandinavian journal of urology and nephrology*. 1976;10(3):257-9.
10. Nalbant I, Karakoyunlu AN, Yesil S, Ekici M, Zengin K, Ozturk U, et al. Comparison of dilation methods in percutaneous nephrolithotomy: which one is more successful? *Journal of Laparoscopic & Advanced Surgical Techniques*. 2016;26(6):478-82.
11. Dehong C, Liangren L, Huawei L, Qiang W. A comparison among four tract dilation methods of percutaneous nephrolithotomy: a systematic review and meta-analysis. *Urolithiasis*. 2013;41(6):523-30.
12. Penbegul N, Dede O, Daggulli M, Hatipoglu NK, Bozkurt Y. A novel percutaneous nephrolithotomy (PCNL) set: The 'Economic One-shot PCNL Set' (Ecoset). *Arab journal of urology*. 2017;15(3):199-203.
13. Frattini A, Barbieri A, Salsi P, Sebastio N, Ferretti S, Bergamaschi E, et al. One shot: a novel method to dilate the nephrostomy access for percutaneous lithotripsy. *Journal of endourology*. 2001;15(9):919-23.
14. Shi Y, Liang H-g, Yang X, Hai B, Wang L, Xing Y-f, et al. Ultrasound-guided percutaneous nephrolithotomy with Chinese one-shot tract dilation technique based on stimulated diuresis: A report of 67 cases. *Journal of Huazhong University of Science and Technology [Medical Sciences]*. 2016;36(6):881-6.
15. Javali T, Pathade A, Nagaraj H. A Novel method of ensuring safe and accurate dilatation during percutaneous nephrolithotomy. *International braz j urol*. 2015;41(5):1014-9.

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