

Comparison of two different renal access techniques in one-stage percutaneous nephrolithotomy: triangulation versus “eye of the needle”

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BACKGROUND: Two primary methods used to create appropriate percutaneous renal access under fluoroscopic guidance are the triangulation technique (TT) and the “eye of the needle” (EN) technique. To the best of our knowledge, no study has yet compared the EN versus TT renal access methods that precede one-stage dilatation during percutaneous nephrolithotomy (PCNL).

OBJECTIVES: Compare effects of renal access techniques on the stone-free rate of one-stage PCNL, and the influence on outcomes.

DESIGN: Retrospective cross-sectional study.

SETTINGS: Tepecik Training and Research Hospital, Turkey.

PATIENTS AND METHODS: The records of patients with renal stones larger than 2 cm in diameter who underwent PCNL in our hospital between January 2008 and September 2017 were retrieved. Patients who had undergone one-stage PCNL with the EN renal access technique (EN group) were compared with patients who had undergone one-stage PCNL with the TT renal access technique (TT group).

MAIN OUTCOME MEASURES: Operative time, stone size, access location, stone side, length of hospital stay, Hounsfield unit (HU), fluoroscopy time, change in hemoglobin level, complications (modified Clavien classification) and stone-free rate.

SAMPLE SIZE: 195.

RESULTS: Of 272 records, 195 met inclusion criteria. The one-stage PCNL stone-free rate and other outcomes did not differ significantly between the EN (n=91, 46.7%) and TT groups (n=104, 53.3%).

CONCLUSION: According to our study, renal access for one-stage PCNL can be achieved using either the EN or TT technique. The renal access technique used does not independently affect the complication rate.

LIMITATIONS: Retrospective, small sample size, and no comparison of body mass index.

CONFLICT OF INTEREST: None.

Recent advances in both technology and equipment have rendered percutaneous nephrolithotomy (PCNL) the most appropriate surgical choice for renal stone treatment.¹ Such surgery is safe when treating large renal stones.² One of the most important steps of PCNL is gaining access to the renal collecting system before dilatation.³ This step is frequently associated with complications.⁴ Various studies found that one-stage dilatation was as safe and effective as the conventional standard technique.⁵⁻⁸ A one-stage dilatation technique is advantageous in terms of having a short operation time and reduced exposure to radiation.⁵⁻⁸ Previous studies reported that conventional dilatation in PCNL using the triangulation technique (TT) or “eye of the needle” (EN) technique can achieve proper percutaneous renal access under fluoroscopic guidance.^{9,10} Making the first puncture with the EN technique may reduce the likelihood of injury.¹¹ However, the TT can reduce parenchymal trauma and bleeding due to excessive torque reduction.¹⁰ To the best of our knowledge, no study has yet compared the EN and TT renal access methods that precede one-stage dilatation during PCNL. In the present study, we compared the effects of two different renal access techniques on the stone-free rate of one-stage PCNL. We also investigated the influence of both techniques on outcomes.

PATIENTS AND METHODS

The records of patients with renal stones larger than 2 cm in diameter who underwent PCNL in our hospital between January 2008 and September 2017 were retrieved. Patients who did not undergo preoperative or postoperative non-contrast abdominal tomography and who had undergone previous renal surgery were excluded. Other exclusion criteria were multiple access and any renal abnormality. Patients who had undergone one-stage PCNL with the EN renal access technique (EN group) were compared with patients who had undergone one-stage PCNL with the TT renal access technique (TT group). The groups were compared in terms of operative time, stone size, access location, stone side, length of hospital stay, Hounsfield unit (HU), fluoroscopy time, change in hemoglobin (Hgb) level, complications (scored using the modified Clavien classification), and stone-free rate.

All PCNL surgeries were performed by two experienced endourologists (each of whom had treated at least 100 cases). All PCNL surgeries were performed under general anaesthesia. An open-ended urethral catheter was placed and advanced to the renal pelvis or the upper ureter with the patient in the supine lithotomy position. After placing the catheter, the pa-

tient was placed in the prone position and the kidney accessed using an 18-gauge metal needle under C-arm fluoroscopic guidance. A guide wire was inserted into the collecting system via the lumen of the needle.

One-stage PCNL was then performed using an Amplatz dilatation set. Following facial dilatation using a 10-F dilatator, the caliceal entrance was directly accessed using a 28 F-30 F facial dilatator. In the EN technique, the C-arm was placed in the 30° position and an 18-gauge access needle positioned so that the targeted calix, the needle tip, and the needle hub were in line with the collimated image, thus presenting as an ‘eye of the needle’ on the monitor (**Figure 1**). The surgeon then sought to access the posterior calix and the relatively avascular Brodel line.

In the triangulation approach to accessing the calyx, two separate points were identified at the C-arm positions of 90° and 30° and a third point then identified in the caudal direction. Calix access was achieved using an 18-gauge needle, with the orientation of the puncture line dictated by the vertical and oblique C-arm positions (**Figure 2**). The surgeon then sought to access the posterior calix and the relatively avascular Brodel line. The endourologists used either the two renal access techniques as needed. The TT is preferred at the rib bone, on old areas of scarring and in areas with a need for high-level access. The EN technique is preferred to inferior renal localization and in midpolar access to which the renal pelvis is want to completely discharged.

In PCNL patients who underwent non-contrast-enhanced computed tomography (NCCT) in the first postoperative month, those with residual stones ≤ 2 mm in diameter were considered stone free. The Hgb levels were measured 24 hours preoperatively and 24 hours postoperatively (Hgb change: preoperative – postoperative levels [mean and standard deviation in g/dL]). The stone surface area (SSA) was the maximum diameter \times width $\times \pi \times 0.25$. The hospital stay time was calculated from the day prior to surgery to the day of discharge. The mean stone HU value was calculated based on preoperative NCCT images; the region of interest (ROI) for each stone at three levels (upper, middle and lower) was calculated; the average ROI was then obtained. The duration of fluoroscopic imaging throughout the operation was obtained from C-arm fluoroscopic machine recordings for each patient. Stone localization was not used because stones were located in multiple calyces. Hence, access localization was compared instead of stone localization. Preoperatively, urinary sterility was confirmed in all patients and prophylactic antibiotics prescribed.

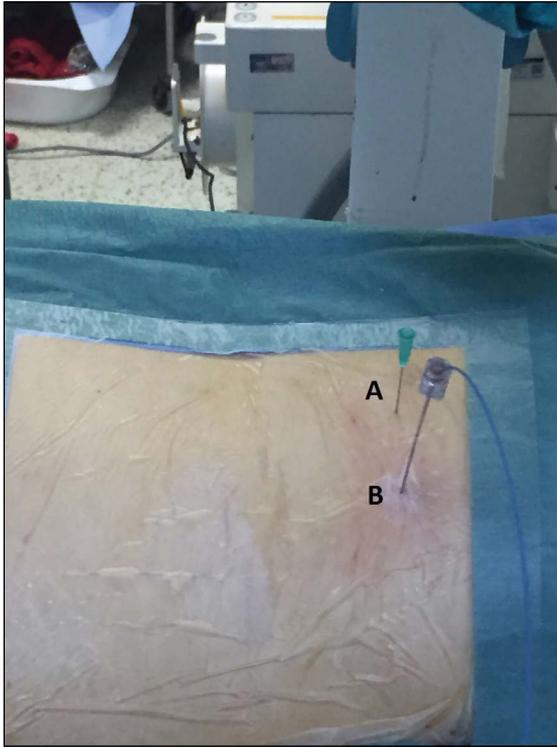


Figure 1. The “eye of the needle” (EN) technique.



Figure 2. The “triangulation” technique (TT).

Data were evaluated with IBM SPSS software (ver. 22.0; IBM SPSS, Armonk, NY, USA). The *t* test, Mann–Whitney *U* test, two-proportion *Z*-test, Fisher–Freeman–Halton test and the chi-squared test were used as appropriate. A *P* value <.05 was considered statistically significant.

Patients who did not undergo preoperative or postoperative non-contrast abdominal tomography (27 cases) and who had undergone previous renal surgery (16 cases) were excluded. Other exclusion criteria were multiple access (22 cases) and any renal abnormality (12 cases). TT is preferred at the rib bone, on old areas of scarring and in areas with a need for high-level access (11 rib upper).

RESULTS

We retrieved the medical records of 272 patients. The 195 who met inclusion criteria consisted of the EN group of 91 (46.7%) and the TT group of 104 (53.3%). Excluded patients included 27 who did not undergo preoperative or postoperative non-contrast abdominal tomography, 16 who had undergone previous renal surgery, 22 with multiple access, and 12 with renal abnormalities. The mean age of all patients was 49.3 (13.4) years; 117 (60%) patients were male (**Table 1**). We found no difference in the stone side, gender or stone surface area between the groups. The one-stage PCNL stone-free rate and outcomes did not differ significantly between the EN and TT groups (**Table 2**). There was no statistically significant difference between the groups in terms of complications according to the modified Clavien classification (**Table 3**).

DISCUSSION

In 2001, Frattini et al were the first to report that the kidney could be accessed using an Amplatz dilator during one-stage renal dilatation.⁵ Most recent studies have reported that one-stage renal dilatation is safe and effective for accessing the kidney collection system.^{12–14} One-stage PCNL with Amplatz dilators has been used routinely in our clinic over the past 10 years. Amirhassani et al reported that the stone-free and complication rates did not differ between one-stage and conventional renal dilatation.¹³ Li et al found that one-stage dilatation was safer and more effective than conventional dilatation; the complication rate was lower and the fluoroscopic time shorter.¹⁴

Abdallah et al compared the TT and EN techniques using a biological model.¹⁵ The mean fluoroscopic time was shorter when the EN technique was employed, but the techniques did not differ significantly in terms of either the number of punctures required or the total op-

erative time.¹⁴ Tepeler et al found that PCNL could be safely performed using either access technique, but the TT was associated with less blood loss because the access tract was better aligned with the infundibulum, reducing the need for high-level torque.¹⁰ In the present study, there was a difference of opinion between the two endourologists in terms of the preferred route for renal access. The first preferred TT, which is based on the idea that bleeding is decreased because less power is applied, as reported by Tepeler et al.¹⁰ The second

Table 3. Comparison of TT and EN groups by modified Clavien classification (MCC) complications.

MCC complications	EN (n=91)	TT (n=104)
Grade 1		
Fever	5	7
Grade 2		
Blood transfusion	5	8
Urinary tract infection requiring additional antibiotics	3	5
Grade 3a		
Double-J stent placement for urine leakage > 24 h (local anaesthesia)	1	2
Grade 3b		
Pneumothorax	1	1
Grade 3c		
Double-J stent placement for urine leakage > 24 h (urethral stone, general anaesthesia)	1	2
Grade 4		
Pulmonary embolism (requiring intensive-care unit stay)	0	1
Urosepsis	1	1
Grade 5		
Death	0	0

preferred the application of EN using two axes, which is based on the idea that the targeted infundibulum is accessed without deviation, which provides the shortest distance between the skin and the infundibulum. However, we found no significant difference in terms of either fluoroscopic time or the change in the Hgb level between the two techniques.

We found no statistically significant difference in the operative time with one-stage PCNL. Similarly, In their study of 40 patients, who were subject to either EN or TT technique, Tepeler et al found no significant difference in operative time.¹⁰ Abdallah et al reported that both techniques were associated with similar learning curves, and that the TT was associated with a longer fluoroscopic screening time.¹⁵ However, we suggest that the EN technique may be superior to TT in terms of fluoroscopic time, but the difference did not reach statistical significance in the present study.

The modified Clavien system is frequently used to evaluate complications after urological surgery.¹⁶⁻¹⁸ Tefekli et al were the first to use a modified Clavien system to evaluate surgical outcomes after PCNL.¹⁸ Several complications developed during renal entry and dilatation.¹⁸ Tepeler et al found that the complication rate was somewhat higher in the EN group,

Table 1. Demographic data on patients (n=197).

Variable	EN (n=91)	TT (n=104)	P value
Stone surface area (mm ²)	516.1 (364.2)	494.1 (473.5)	.719 ^a
Age (years)	50.4 (12.6)	47.4 (14.4)	.123 ^a
Access location			
Upper pole	14 (15.4)	16 (15.4)	.973 ^b
Midpolar	46 (50.5)	51 (49.0)	
Lower pole	31 (34.1)	37 (35.6)	
Stone side (R-L)			
Left	46 (50.5)	59 (56.7)	.388 ^b
Right	45 (49.5)	45 (43.3)	
Gender			
Female	40 (44.0)	38 (36.5)	.292 ^b
Male	51 (56.0)	66 (63.5)	

^at test; ^bPearson's chi-squared test.

Table 2. Perioperative variables and surgical outcomes.

Variable	EN (n=91)	TT (n=104)	P value
Complications (Modified Clavien classification)	17 (18.7%)	27 (26%)	.220 ^a
Hospital stay time (days)	2 (2-14)	2 (2-16)	.978 ^b
Hounsfield unit	973.5 (321.1)	1050.1 (311.7)	.093 ^c
Operative time (minutes)	100 (45-200)	102.5 (40-245)	.242 ^b
Fluoroscopic time (minutes)	2.5 (70-11.5)	2.4 (.70-14.6)	.592 ^b
Hemoglobin change (preop-postop Hgb) (g/dL)	1.6 (-0.80-8.70)	1.8 (-0.90-5.80)	.109 ^b
Stone free rate	67 (73.6%)	74 (71.2%)	.700 ^a

Date mean (standard deviation), median (minimum-maximum) or number (percent).

^aFisher-Freeman-Halton test; ^bMann-Whitney U-test; ^ct test.

but the difference was not statistically significant.¹⁰ In our study, we compared complications between the groups using the Clavien system, and found no significant difference. The short hospitalisation time and the early return to daily life are significant economic advantages afforded by PCNL.¹⁹ We found no significant difference in length of hospital stay between the EN and TT groups.

The fact that our study was retrospective in nature

and included only a small number of patients are the principal limitations of the work. Also, we did not compare of body mass index. In summary, the renal access technique used does not independently affect the complication rate. Both renal access techniques can be used safely by experienced endourologists in one-stage PCNL. Our results require confirmation in prospective randomised studies or observational studies with more patients.

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