

# Comparison of single-step renal dilatation and serial renal dilatation in percutaneous nephrolithotomy: A retrospective case-control study

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## Abstract

**Background:** Access to the pelvi-calyceal system and subsequent dilatation of the tract are among the initial important steps in percutaneous nephrolithotomy (PCNL). In this study, we share our experience with single-step renal dilatation when compared to multiple serial renal dilatation in PCNL.

**Materials and Methods:** This is a retrospective study wherein 35 patients who underwent PCNL by single-step renal dilatation by appropriate size Amplatz Dilator were compared with 35 patients who underwent multi-step serial renal dilatation using serial metallic Alken dilators. These patients were analyzed on the basis of demographic profile, total intra-operative time, fluoroscopic time, intra-operative and postoperative complications, stone clearance, requirement of blood transfusion, duration of hospital stay, and follow-up.

**Results:** There were no significant differences in the demographic profile among the patients in these two groups. The mean total operative duration and fluoroscopic duration were less in single step renal dilatation group, and these have been found to be statistically significant ( $P < 0.05$ ). There were no statistically significant differences in the rates of other complications – incomplete stone clearance, bleeding and hematoma formation, requirement of blood transfusion, duration of hospital stay, and follow-up.

**Conclusion:** Operative duration and rate of radiation exposure are significantly less in PCNL by single-step renal dilatation; however, there is no statistically significant difference in the rates of other complications.

**Keywords:** Percutaneous nephrolithotomy, renal tract dilatation, serial, single step

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## INTRODUCTION

After its first description in 1976 by Fernström and Johansson, percutaneous nephrolithotomy (PCNL) has now become the standard of care for the management of renal stone disease.<sup>[1,2]</sup> It is a minimally invasive technique associated with higher success rate and lower complications

for the efficient management of renal calculi >2 cm in diameter, staghorn calculi, and larger lower calyceal calculi.<sup>[3,4]</sup>

Gaining access to the pelvi-calyceal system by renal puncture and subsequent dilatation of the tract is a crucial

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and challenging step in this procedure and is conventionally done by one of the following three techniques – serial Alken metal telescope dilators, semi-rigid Amplatz sequential fascial dilators, and single-step balloon dilator.<sup>[1,5]</sup> The reusable metal telescopic dilators are economical, and there is less blood loss because of the tamponade effect on renal parenchyma by metal dilators. Sequential fascial dilators are disposable, and there is possibility of more blood loss as the tamponade effect is lost during sequential exchange of these fascial dilators. Both these serial and sequential multi-step dilators are time-consuming and lead to increased radiation exposure by increased fluoroscopic time.<sup>[5]</sup> Single-step balloon dilator was developed to provide a single-step dilatation and avoid the complication of bleeding, but it is not reusable and hence costly.<sup>[5]</sup>

In this study, we compared single-step renal dilatation by directly using the appropriate size Amplatz dilator and multi-step renal dilatation by Alken dilator during PCNL.

## MATERIALS AND METHODS

Thirty-five patients who underwent PCNL by single-step renal dilatation using the appropriate size Amplatz dilator at our institute between January 2017 and December 2018 were retrospectively compared with 35 patients who underwent PCNL multi-step renal dilatation by Alken dilators during the same period. The study was approved by the Institutional Ethical Committee, and appropriate written and informed consent was taken by all the patients included in this study. The inclusion criteria were age more than 14 years, stone size more than 2 cm and/or multiple renal calculi. Patients with coagulation disorders and pregnant patients were excluded from this study.

There were 35 patients in each group; these groups were not matched. All patients were admitted, and complete blood count, renal function test, serum electrolytes, and coagulation profile were done for all of them.

### Surgical technique

Under general anesthesia, first, cystoscopy and retrograde placement of ureteric catheter was done in supine lithotomy position, and then, the patient was turned to the prone position. After delineation of the pelvi-calyceal system by retrograde injection of contrast, the desired calyx was punctured by two part 18 G PCNL needle and guide wire was placed. In patients of single-step dilatation group, the appropriate-sized Amplatz dilator was slowly advanced by applying constant pressure under fluoroscopy guidance followed by the access sheath. In patients of multi-step dilatation group, serial Alken metallic

dilators were used for renal dilatation till the appropriate size. Then, appropriate size nephroscope was used, and stone disintegration was done by ballistic energy from the lithotripter. After the procedure, an appropriate-sized DJ stent and a nephrostomy tube were placed.

### Statistical analysis

The parameters compared were demographic profile, total intra-operative time, fluoroscopic time, intra-operative and postoperative complications, stone clearance, requirement of blood transfusion, duration of hospital stay, and follow-up. The total operative duration was calculated from the time of cystoscopy to completion of the procedure, i.e., to the time when nephrostomy tube was secured to the skin. The fluoroscopic time was also calculated. Stone clearance was assessed by plain X-Ray KUB on the first postoperative day. Peri-operative and postoperative complications were assessed using the Modified Clavien–Dindo grading system. The tests used were Student's *t* test and Chi-square test. *P* < 0.05 was considered statistically significant.

## RESULTS

### Demographic details

The demographic characteristics are summarized in Table 1. There were no statistically significant differences in demographic profiles among the two groups.

### Intra-operative and postoperative details

Intraoperative and postoperative details are summarized in Tables 2 and 3. The mean total operative duration and fluoroscopic duration were less in single-step renal dilatation group, and these have been found to be statistically significant (*P* < 0.05). Two patients in single-step group and three patients in multi-step group had incomplete stone clearance; however, this was not found to be statistically significant. There was no significant blood loss or peri-renal hematoma in any patients in either group. Blood transfusion was required in two patients – one in each group. A total of four patients had Grade 1 complications (Modified–Clavien Classification) – two in each group. There were no other complications and no deaths.

**Table 1: Demographic characteristics of the patients**

|                          | Single-step renal dilatation | Multi-step serial renal dilatation |
|--------------------------|------------------------------|------------------------------------|
| Total number of patients | 35                           | 35                                 |
| Age (years)              |                              |                                    |
| Mean                     | 38.5                         | 40                                 |
| Range                    | 16-62                        | 18-60                              |
| Males                    | 23                           | 17                                 |
| Females                  | 12                           | 18                                 |

**Table 2: Intra-operative characteristics of the patients**

|                                       | Single-step renal dilatation | Multi-step serial renal dilatation | P       |
|---------------------------------------|------------------------------|------------------------------------|---------|
| Total duration (min)                  |                              |                                    |         |
| Mean                                  | 65                           | 105*                               | 0.00056 |
| Range                                 | 45-110                       | 75-120                             |         |
| Fluoroscopic time (min)               |                              |                                    |         |
| Mean                                  | 15                           | 50*                                | 0.00045 |
| Range                                 | 10-20                        | 30-80                              |         |
| Intra-operative bleeding and hematoma | 0                            | 0                                  | 0       |
| Other complications                   | 0                            | 0                                  | 0       |

\*Statistically significant, i.e.,  $P < 0.05$ **Table 3: Postoperative characteristics of the patients**

|                                  | Single step renal dilatation | Multiple step serial renal dilatation |
|----------------------------------|------------------------------|---------------------------------------|
| Incomplete stone clearance       | 2                            | 3                                     |
| Requirement of blood transfusion | 1                            | 1                                     |
| Complications                    |                              |                                       |
| Grade 1                          | 2                            | 2                                     |
| Grade 2                          | 0                            | 0                                     |
| Grade 3                          | 0                            | 0                                     |
| Hospital stay (days)             |                              |                                       |
| Mean                             | 3                            | 3.5                                   |
| Range                            | 2-5                          | 3-5                                   |

The mean hospital stay was 2–5 days in single step dilatation group and 3–5 days in multiple step dilatation group. All patients have no complaints on follow-up.

## DISCUSSION

PCNL is the gold standard management for renal stones and has undergone and still undergoing several modifications. Gaining access into the pelvi-calyceal system and dilatation of the tract are the important initial steps in PCNL and various techniques are in use – multistep dilatation by serial metallic Alken dilators and by serial fascial Amplatz dilators.<sup>[1,5]</sup> Bleeding is a major feared complication of PCNL during multi-step serial dilatation as the tamponading effect of the dilator on renal parenchyma is lost during exchange of dilators. Another source of concern for both the patients and the operative team is the radiation exposure. Hence, there are ongoing efforts to shorten the total operative time, thereby decreasing the radiation exposure and also to minimize blood loss.

Single-step renal dilatation techniques have been introduced to tackle the above two complications. Single-step balloon dilatation was safe and effective; however, being disposable, it is costly and not in routine use now.<sup>[1]</sup> In 2001, Frattini *et al.*, in their study on 78 patients undergoing PCNL, concluded that single-step renal dilatation is safe and is associated with significantly less radiation exposure and cost.<sup>[1,6]</sup> In 2003, Goel *et al.* compared single-shot renal tract dilatation by Webb target dilator with multistep sequential dilators and found that Webb target dilator

is safe and takes significantly less time; however, it has limitations when there is no associated hydronephrosis and its available size (26 Fr).<sup>[7]</sup> Amjadi *et al.* and Suelozgen *et al.* have also reported significantly less operative and radiation exposure time with single-step dilatation and comparable stone clearance rates.<sup>[1,8,9]</sup> In a recent study, Girisha *et al.* concluded that single-step renal dilatation is safe, effective, and is associated with significantly lesser operative and radiation exposure time.<sup>[1]</sup> Similar conclusions were reported by Nour *et al.* in their study; the rates of bleeding and other complications being the same with single-step renal dilatation and serial dilatation.<sup>[5]</sup>

In the present study, we found that total operative time and radiation exposure were significantly less in the single-step renal dilatation group; stone clearance rates and bleeding and other complications being comparable in both groups. However, this study has its limitations. The two groups were not matched, and present study sample size calculation was not done. Moreover, this is a single-center study and has been done over a short period of time. Larger, multicenter studies would be required to draw efficient conclusions.

## CONCLUSION

Single-step renal dilatation is safe, effective, economical, and has less operative time and radiation exposure. There are no specific complications related to this procedure, and bleeding and stone clearance rates are also comparable to conventional serial dilatation methods.

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## Conflicts of interest

There are no conflicts of interest.

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