ORIGINAL ARTICLE

# EFFICACY OF MINI-PERCUTANEOUS NEPHROLITHOTOMY (MINI-PCNL) FOR RENAL STONES IN CHILDREN

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## ABSTRACT

**OBJECTIVE:** This study aimed to determine whether mini-percutaneous nephrolithotomy is effective for treating lower-pole renal stones in children.

**MATERIALS AND METHODS:** This descriptive case series study was conducted at the Department of Urology, Khyber Teaching Hospital, Peshawar, from July 2021 to January 2022 (following approval of the study protocol by the Institutional Ethical Review Committee) and included 148 pediatric patients with a single lower-pole renal stone measuring 1.5 to 2 cm. Patients with prior renal surgery, multiple lower-pole renal stones, renal nephropathies, or anatomical abnormalities of the upper and lower renal systems were excluded. A pediatric urologist performed mini-PCNL on each patient in the prone position under general anesthesia. After injecting contrast (Urograffin) into the ureteric catheter, the renal tract was visualized using a fluoroscope.

**RESULTS:** The mean age and SD in this study were 9.75 ± 3.075. The baseline stone size mean and SD were 1.65 ± 0.17. Of the patients, 81 (54.7%) were younger than 10 years old, and 67 (45.3%) were older than 10 years. There were 45 female patients (30.4%) and 103 male patients (69.6%). According to rates and percentages indicating the effectiveness of mini-percutaneous nephrolithotomy in treating pediatric lower pole renal stones, 113 patients (76.4%) had their stones removed.

**CONCLUSION:** Based on its stone clearance rate and the absence of major complications, this study demonstrates that mini-PCNL is a safe and effective treatment for lower-pole renal stones in children.

**KEY WORDS:** Children, Percutaneous Nephrolithotomy, and Renal Stone

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## INTRODUCTION

Renal stones are among the most prevalent illnesses in Pakistan and are associated with higher rates of morbidity, mortality, and societal economic burden. [1-3] Treatment options for kidney stone disease include open surgery, laparoscopic procedures, extracorporeal shockwave lithotripsy, ureteroscopy, percutaneous nephrolithotomy, pharmaceutical treatments, and conservative measures. [4] The majority of patients with renal stones now receive extracorporeal shockwave lithotripsy (ESWL), which has revolutionized the treatment of renal calculi. [5] While the role of lower-pole anatomy in treatment remains debated, stone size appears to be a crucial predictor of ESWL outcomes. [6-8] Following ESWL, stone-free rates in the lower pole have been reported at 60%; however, some studies indicate that stone clearance can reach 91.1%. [9] The use of percutaneous nephrolithotomy (PCNL) as the primary therapeutic option for lower calyx calculi is growing. In skilled hands, it has a high success rate and few complications. Reports of PCNL's effectiveness in clearing stones range from 74.8% to 92.8%. PCNL yields higher stone-free rates for lower-pole renal calculi but is associated with more complications and longer hospital stays. [10]

The most recent guidelines from the European Association of Urology (EAU) state that PCNL should be the preferred treatment for both large renal calculi (>20 mm) and smaller stones (10–20 mm) in the lower pole when four variables make ESWL unfavorable. There have been reports of excellent stone-free rates (SFR) ranging from 76% to 98% after PCNL. PCNL remains a challenging surgical procedure and can have serious side effects that may reduce its effectiveness. [11, 12] Lower-pole renal stones are treated with PCNL. There are no clear guidelines in our setting regarding which procedure to perform for a given patient, and when we reviewed the literature, we found that success rates for the two procedures varied. As a result, patients undergo various procedures on a regular basis, which increases their morbidity, anxiety, and financial stress. My study compares the efficacy and complications of PCNL for lower-pole renal stones measuring 1.5 to 2 cm. If our results show that PCNL is more

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effective than ESWL, we will recommend further research before endorsing it as the first-line treatment for lower-pole stones of this size.

## MATERIALS AND METHODS

We conducted this documentary review of data in the Department of Urology, Khyber Teaching Hospital, Peshawar, from July 2021 to January 2022, after approval of the study protocol from the Institutional Ethical Review Committee Approval No. 558/DME/KMC, dated 08/04/2025 by collected and analyzing the record of 148 pediatric patients (ages 1–14) who had a single lower pole renal stone measuring 1.5–2 cm. Individuals with a history of renal surgery, multiple lower-pole renal stones, renal nephropathies, and upper and lower renal system anatomical anomalies were not included. With an efficacy rate of 74.8% for PCNL, the sample size was determined using the WHO sample size calculator with a 95% confidence interval. [10]

Every patient's history, physical examination, and a standard series of tests were recorded on a pro forma. Children went through Mini-PCNL while they were in the prone position and underwent general anesthesia. After infusing contrast (urograffin) through the ureteric catheter, the renal tract was visualized on fluoroscopy. An 18 Fr Amplatz sheath was inserted into the tract to obtain the final access after the tract had been percutaneously accessed and dilated with metallic Alken dilators up to 18 Fr. Swiss Pneumatic Lithoclast performed lithotripsy, and a rigid pediatric nephroscope measuring 16 Fr was used in each case to visualize and remove stones. To ascertain the stone clearance and any remaining fragments, fluoroscopic images were taken. A 14 Fr 60 nephrostomy tube and a double J stent (DJS) were inserted at the conclusion of the procedure. After 24 to 48 hours, the nephrostomy tube was removed, and four weeks later, the DJS was removed. All patients received normal doses of antibiotics and analgesics for the first 24 hours after surgery. On the second postoperative day, the patients were discharged. A follow-up visit was recommended for all patients two weeks after surgery, and the effectiveness of the intervention was assessed by evaluating ultrasound results for stone-free status. A single skilled CPSP radiology fellow performed all radiological procedures. A pre-made pro forma contained all the previously listed data, including name, age, gender, and address. To control for confounders and bias in the study outcomes, strict exclusion criteria were applied.

SPSS-23 was used to analyze the data. For quantitative characteristics such as age and baseline stone size, the mean + SD was computed. For categorical factors such as gender and efficacy, frequencies and percentages were computed. A P-value of less than 0.05 was considered significant.

## RESULTS

The mean age and standard deviation were 9.75 ± 3.075 years. The baseline stone size mean and SD were 1.65 ± 0.17 cm. Of the patients, 81 (54.7%) were younger than 10 years, and 67 (45.3%) were older than 10 years (Table I). There were 45 female patients (30.4%) and 103 male patients (69.6%). See Table II for details. According to efficacy frequencies and percentages, 113 individuals (76.4%) had their stones removed (Table III).

**Table No 1: Distribution of patients according to age (n=148)**

| Age (years) | No. of Patients | %age |
|---|---|---|
| ≤10 | 81 | 54.70 |
| >10 | 67 | 45.30 |
| Total | 148 | 100.0 |

**Table No 2: Distribution of patients according to gender (n=148)**

| Gender | No. of Patients | %age |
|---|---|---|
| Male | 103 | 69.60 |
| Female | 45 | 30.40 |
| Total | 148 | 100.0 |

**Table No 3: Efficacy of mini PCNL for renal stones in children (n=148)**

| Efficacy | No. of Patients | %age |
|---|---|---|
| Yes | 113 | 76.40 |
| No | 35 | 23.60 |
| Total | 148 | 100.0 |

## DISCUSSION

A 4.85 F all-seeing needle is used to perform Micro-PCNL, also known as Microperc, a recently described minimally invasive PCNL approach. The latter has a three-way connector that allows the insertion of a 272 $\mu$m laser fiber, a 0.9- or 0.6-mm-diameter micro-optic, and a saline irrigation tube. This modified needle has an outside diameter of 1.6 mm (4.85 F). Fifteen adults were the first to try this novel technology. The average stone size and operating time were 30.4 mm and 101.4 minutes, respectively. Eleven individuals achieved total stone clearance after surgery. This approach has since been used to treat kidney stones in children. Renal stones are a prevalent illness in Pakistan. Renal stones are linked to increased morbidity, mortality, and societal economic burden. [2, 3] Numerous techniques, including open surgery, laparoscopic, extracorporeal shockwave lithotripsy, and ureteroscopy, are used to treat kidney stone illnesses. Medical interventions, conservative measures, and percutaneous nephrolithotomy. [4]

Men are more likely than women to develop stones, and the types of stones vary slightly between the sexes. The reported frequencies of stone types in children differ slightly from those in adults, but the effects are roughly equivalent for both sexes. [13] According to the National Health and Nutrition Examination Surveys, periodic surveys of the US population, the prevalence of stones has been rising in both sexes over the past 30 years. [14] Nearly

12% of white men and 6% of white women reported having had a kidney stone in the seventh decade, according to the most recent poll; the rate among African Americans is less than half that of Caucasians, but it has been rising. [15]

The majority of patients with kidney stones now undergo extracorporeal shockwave lithotripsy (ESWL), which has revolutionized the treatment of renal calculi.5. While the lower pole's anatomical features are debated in terms of therapy, stone size appears to be a crucial factor in predicting the outcome of ESWL. [6-8] Following ESWL, lower pole stone-free rates have been reported to be 60%, but other studies have reported stone clearance of up to 91.1%, which is nearly consistent with our results, which showed that 113 patients (76.4%) had stone removal. [9, 10]

The use of percutaneous nephrolithotomy (PCNL) as the primary treatment for lower calyx calculi is increasing. In skilled hands, it has a high success rate and few complications. According to reports, PCNL can remove stones in 74.8% to 92.8% of cases.[10] This range is nearly consistent with the results of this investigation, which showed that 113 individuals (76.4%) had their stones removed.

PCNL has a higher stone-free rate for lower-pole renal calculi, but it also carries a higher complication rate and longer hospital stays. When ESWL is contraindicated, PCNL is recommended as the preferred treatment for large renal calculi (>20 mm) and for smaller stones (10–20 mm) of the lower renal pole, per the most recent European Association of Urology (EAU) guidelines. [3] There have been reports of excellent stone-free rates (SFR) ranging from 76% to 98% after PCNL, which is nearly consistent with the results of this investigation, which showed that 113 individuals (76.4%) had their stones cleared. [4]

Wang et al. reported findings from 247 renal units in 234 patients younger than 3 years who underwent mini-PCNL. [16] Each procedure used a single tract, comprising 245 14 F tracts, 1 16 F tract, and 1 12 F tract. Stone burden was 1-2 $cm^2$ in 191 instances, >2 $cm^2$ in 30 cases, and <1 $cm^2$ in 26 cases. Operating time ranged from 21 to 62 minutes, with a mean of 32.5 minutes. According to the report, the complete stone-free rate was 240 renal units (97.2%). The results of this investigation are discordant with those of another mini-PCNL study, which found SFR rates of 90.8% in stone burden < 20 mm and 76.3% in stone burden > 20 mm. [17]

The mean age of the 60 patients in the study was 12.90±3.16 years, with 19 (31.7%) under age 10 and 41 (68.0%) aged 11 to 18 years. Of the 60 patients, 16 (26.7%) were female and 44 (73.3%) were male. In pediatric patients with renal stones, stone clearance occurred in 56 (93.33%) and postoperative hematuria in 4 (6.66%) after micro PCNL. [18] Similar results were achieved in a recent study conducted at the Hayat Abad Medical Complex in Peshawar. [19] The current study's stone-free rate (SFR) was 76.40%, lower than the 80.6% reported in the Baydilli et al. study. [20] Our SFR is similar to the results reported in a study by Ahmad et al. [21] Another study reported 94.5% SFR, which was significantly greater than our study. [22]

There is currently little information available on cost-benefit analysis and patient-centered outcomes, both of which require attention in light of current treatment alternatives. Lastly, there is disagreement over how to assess outcomes, particularly for Mini-PCNL, which complicates comparisons between treatment approaches. A classification scheme for Mini-PCNL was published by Somani et al. [23] If the results meet a predetermined standard, the development of future care pathways will undoubtedly benefit.

## CONCLUSION

Given its stone clearance rate and the absence of major complications, this study showed that mini-PCNL is a safe and effective treatment for lower-pole renal stones in children. Therefore, we recommend that mini-PCNL be used as a first-line treatment for lower-pole renal stones in children.

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**Authors Contribution:**

Following authors have made substantial contributions to the manuscript as under

| Authors | Conceived & designed the analysis | Collected the data | Contributed data or analysis tools | Performed the analysis | Wrote the paper | Other contribution |
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| Ahmad T | ✓ | ✓ | × | × | ✓ | × |
| Ali M | ✓ | × | ✓ | ✓ | ✓ | × |
| Muhammad S | ✓ | ✓ | × | × | × | ✓ |
| Ali S | ✓ | × | ✓ | ✓ | ✓ | × |
| Ullah I | ✓ | ✓ | × | × | × | ✓ |
| Ullah E | ✓ | × | ✓ | ✓ | ✓ | × |

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

**Ethical Approval:**

**This Manuscript was approved by the Ethical Review Board of Khyber Teaching Hospital, Peshawar. Vide No.565/IREB/KTH, Dated 18/04/2025**