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Original Research Article

Super vs. Mini Percutaneous Nephrolithotomy in 1–2 cm Renal Stones: A Retrospective Comparative Study

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Conflict of interest: Nil

Abstract:

Background: Percutaneous nephrolithotomy (PNL) is a standard surgical approach for managing renal calculi. Miniaturized techniques like Mini-PCNL reduce morbidity, while Super-mini PCNL (SMP) incorporates suction to improve stone clearance and visibility. However, comparative evidence between these techniques remains limited. Objective was to evaluate the safety and efficacy of Super-PCNL versus Mini-PCNL in patients with renal stones sized 1–2

Methods: This retrospective comparative study was conducted at a single tertiary care centre. Medical records of 50 patients who underwent PCNL for renal calculi measuring 1–2 cm between June 2022 to June 2025 were reviewed. Patients were categorized into two groups based on the procedure performed: Mini-PCNL (n=25) and Super-PCNL (n=25). Preoperative, intraoperative, and postoperative parameters were analysed. Statistical analysis was performed using the independent t-test, with $p < 0.05$ considered significant.

Results: Baseline characteristics were comparable between the groups. No significant differences were observed in puncture sites, calyces accessed, operative time, WBC count, hemoglobin drop, or postoperative hemoglobin levels. However, the Super-PCNL group demonstrated significantly better outcomes in terms of shorter stone clearance time, fewer days of IV analgesic use, faster pain relief, reduced hospital stay, shorter duration of hematuria, and earlier nephrostomy tube removal ($p < 0.05$).

Conclusion: Super-PCNL offers improved postoperative recovery and patient comfort compared to Mini-PCNL, without compromising efficacy. It is a safe and effective technique for managing medium-sized renal stones.

Keywords: Super-mini PCNL, Mini-PCNL, renal calculi, retrospective study.

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Introduction

Percutaneous nephrolithotomy (PNL) remains a widely used technique for managing renal calculi, achieving high stone clearance rates of approximately 85%.[1] The primary goal is complete stone removal with minimal morbidity. Tract size significantly influences complications such as bleeding and postoperative pain.[2] Miniaturized techniques like ultra-mini PCNL and micro-PCNL have reduced tract size but raised concerns regarding stone fragment clearance and intrarenal pressure. [3,4] Super-mini PCNL (SMP) was developed to overcome these limitations by improving visualization and incorporating suction for efficient fragment evacuation.[5] Despite increasing clinical adoption, comparative data between SMP and Mini-PCNL for stones 1–2 cm remain limited. This retrospective study aims to evaluate their safety and efficacy in this clinically important group with the primary objective was to compare the stone-free rate, while secondary outcomes included operative time, haemoglobin drop, intra- and postoperative complications, no of days requiring i.v pain killers, length of hospital stay, Duration of haematuria and the proportion of patients managed with totally tubeless PNL.

Study Design: Retrospective, single-centre, comparative observational study

This retrospective study was approved by the Institutional Ethics Committee (IEC) of Gayathri

Vidya Parishad Institute of Health Care & Medical Technology, Visakhapatnam.

Study Population: Medical records of patients who underwent PCNL for renal calculi measuring 1–2 cm at Gayathri Vidya Parishad Institute of Health Care & Medical Technology, Visakhapatnam between June 2022 and June 2025 were reviewed after fulfilling the inclusion and exclusion criteria.

Inclusion Criteria

- Age ≥18 years
- Renal stones measuring 1–2 cm
- Underwent Mini-PCNL or Super-PCNL
- Complete medical records available

Exclusion Criteria

- Incomplete records
- Congenital renal anomalies
- Coagulopathy
- Active untreated urinary tract infection
- Patients lost to follow-up

Sample Size: This retrospective study included all consecutive patients who underwent Mini-PCNL or Super-PCNL for renal calculi measuring 1–2 cm at our institution between June 2020 and June 2025. The sample size was based on the number of eligible cases available in the hospital records during the study period, and no formal sample size calculation was performed.

Methodology: Patients were divided into two groups based on the surgical procedure performed:

- **Group A:** Mini-PCNL
- **Group B:** Super-PCNL

All procedures were performed by experienced consultants following standardized institutional protocols. Preoperative Evaluation**:** Records of All patients underwent: CBC, renal function tests, coagulation profile**,** Urine culture**,** Ultrasound KUB and X-ray KUB**,** Non-contrast CT KUB were observed. Operative Procedure: Performed under general anaesthesia in prone position and Ureteric catheterization under fluoroscopy Mini-PCNL: 16.5 Fr sheath with 12 Fr nephoscope, Super-PCNL: 15 Fr sheath with integrated suction system Lithoclast used for stone fragmentation Stone clearance confirmed fluoroscopically DJ stent and nephrostomy tube placed. Operative Evaluation**:** The parameters were taken from the hospital records which includes: Operative time, Stone clearance time, Hemoglobin drop, WBC count, Duration of IV analgesic use, Time to complete pain relief, Duration of hematuria, Hospital stay and time to nephrostomy tube removal.

Data Analysis: Statistical analysis was performed using SPSS Version 24**.** Quantitative data were summarized as means and standard deviations, and comparisons were made using the student's t-test. A p-value < 0.05 was considered statistically significant.

Results

Mean age of the Mini PNL group was 49.8 ± 12.76 years and Super PNL group was 49.6 ± 15.57 years, which were almost similar and not significant

An independent t-test was conducted to compare continuous variables between the Mini PERC and Super PERC groups, each consisting of 25 patients.

There was no significant difference in the number of puncture sites between the Mini PERC and Super PERC groups (1.12 ± 0.33 vs. 1.12 ± 0.33; $t = 0$, $p = 1.000$). Similarly, the number of calyces accessed was not significantly different ($p = 0.110$), although the Super PERC group showed a higher mean (1.64 ± 0.76) compared to Mini PERC (1.32 ± 0.63).

The total operative time was slightly longer in the Mini PERC group (74.4 ± 16.55 minutes) than the Super PERC group (67.08 ± 22.38 minutes), but the difference was not statistically significant ($p = 0.915$). However, the stone clearance time was significantly longer in the Mini PERC group (47.68 ± 14.74 minutes vs. 43.16 ± 20.31 minutes; $t = 2.128$, $p = 0.039$).

Pain-related outcomes significantly favoured the Super PERC group. The number of days requiring IV painkillers was significantly higher in the Mini PERC group (2.32 ± 0.63) compared to Super PERC (1.72 ± 0.61; $t = 3.419$, $p = 0.001$). Similarly, days required for complete pain relief were significantly greater in the Mini PERC group (2.32 ± 0.69 vs. 1.80 ± 0.71; $t = 2.631$, $p = 0.011$).

Length of hospital stay was significantly longer in the Mini PERC group (2.84 ± 0.85 days) compared to the Super PERC group (2.08 ± 0.81 days; $t = 3.231$, $p = 0.002$). The Mini PERC group also had a significantly longer duration of haematuri**a** (0.96 ± 0.46 vs. 0.48 ± 0.59 days; $t = 3.236$, $p = 0.002$) and Percutaneous Nephrostomy Tube removal time (1.64 ± 0.64 vs. 1.12 ± 0.44 days; $t = 3.357$, $p = 0.002$).

There was no significant difference between the groups in terms of postoperative haemoglobin (Mini PERC: not provided; Super PERC: 12.28 ± 1.64; $p = 0.870$), WBC count ($p = 0.381$), or haemoglobin drop ($p = 0.185$)

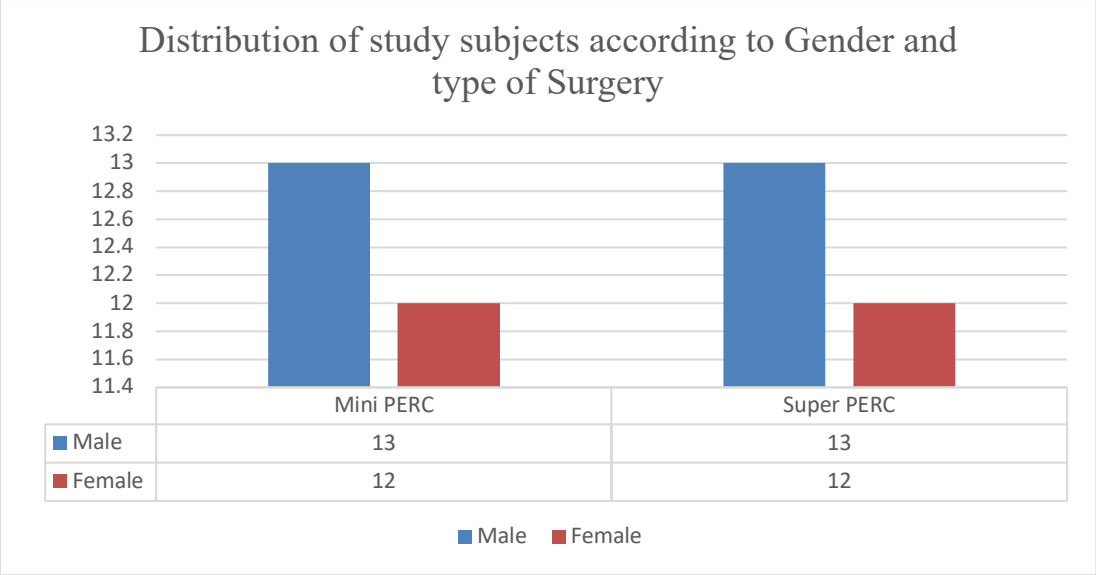

Figure 1

Table 1: Distribution of study subjects according to independent t-Test Comparing Continuous Variables Between Two Groups

	MINI PERC(n=25)	SUPER PERC(n=25)	t	P Value
Variables	Mean ± sd	Mean ± sd		
Number Of Puncture Sites	1.12±0.33	1.12±0.33	0	1
Calyces Accessed	1.32±0.63	1.64±0.76	-1.627	0.11
Total Operative Time in Minutes	74.4±16.55	67.08±22.38	1.315	0.915
Stone Clearance Time in Minutes	47.68±14.74	43.16±20.31	2.128	**0.039**
Days Of Iv Painkillers	2.32±0.63	1.72±0.61	3.419	**0.001**
Days Required for Complete Pain Relief	2.32±0.69	1.8±0.71	2.631	**0.011**
Days of Hospital stay	2.84±0.85	2.08±0.81	3.231	**0.002**
WBC Count	10476±2170.5	9853.6±2766.68	0.885	0.381
Haematuria Duration in Days	0.96±0.46	0.48±0.59	3.236	**0.002**
Days of Percutaneous Nephrostomy Tube (PCN) REMOVAL	1.64±0.64	1.12±0.44	3.357	**0.002**
Post Op Hb	12.21±1.27	12.28±1.64	-0.164	0.87
Hb Drop	0.13±0.3	0.04±0.11	1.355	0.185

Discussion

This retrospective comparative study evaluated the outcomes of Super-mini PCNL (Super PERC) and Mini-PCNL (Mini PERC) in patients with renal stones measuring 1–2 cm, with a focus on stone clearance and perioperative outcomes. The findings of the present study demonstrate that both techniques provide comparable efficacy in terms of stone clearance; however, Super PERC offers significant advantages in postoperative recovery parameters.

Our observations are consistent with previous studies suggesting that miniaturized PCNL techniques achieve similar stone-free rates compared to standard PCNL while reducing morbidity and hospital stay [1,2]. In the present study, patients who underwent Super PERC had significantly shorter stone clearance time, reduced analgesic requirements, faster pain resolution, shorter duration of hospitalization, and reduced hematuria duration. These benefits may be attributed to the integrated suction mechanism in Super PERC, which improves endoscopic visibility, maintains lower intrarenal pressure, and facilitates efficient evacuation of stone fragments [3,5].

In contrast to Mini PERC, which primarily relies on passive irrigation and may lead to residual fragment migration, Super PERC utilizes active suction technology. This feature not only enhances stone clearance but also helps in maintaining low intrapelvic pressure, potentially reducing the risk of postoperative infectious complications [6]. The concept of Super PERC, first described by Zeng et al., highlighted its safety and efficacy in patients with moderate stone burden [5], and our findings support these observations in a real-world retrospective setting.

Furthermore, patients in the Super PERC group demonstrated significantly improved postoperative recovery, including fewer days of intravenous analgesic requirement, earlier pain relief, and shorter hospital stay. These findings are in agreement with the study by Liu et al., which reported better postoperative outcomes with Super PERC compared to Mini PERC [8]. The earlier removal of nephrostomy tubes and reduced duration of hematuria observed in our study further emphasize the advantages of Super PERC in enhancing patient recovery and reducing hospital resource utilization.

Despite these differences in postoperative outcomes, no significant differences were observed between the two groups with respect to operative time, number of puncture sites, calyces accessed, or hemoglobin drop. These findings suggest that both techniques are technically comparable and can be safely performed in experienced hands.

However, the retrospective nature of the study introduces certain inherent limitations, including the possibility of selection bias and lack of randomization. Additionally, the study was conducted at a single centre with a relatively small sample size, which may limit the generalizability of the findings. Long-term outcomes such as stone recurrence, quality of life, and stent-related symptoms were not assessed. Therefore, further large-scale, prospective, multicentre studies are warranted to validate these findings and establish long-term benefits.

Conclusion

Super Perc (Super PCNL) is a safe, effective, and accessible technique for managing renal stones (10–20 mm), offering significant advantages over standard mini PCNL, including reduced stone clearance time, analgesic use, hospitalization, and earlier recovery markers. With no need for expensive equipment and a comparable learning curve, its wider adoption is recommended. Further large-scale studies are warranted to validate these findings.

Limitations: This study is limited by its retrospective design, which is subject to selection bias, its single-centre nature, relatively small sample size, and the absence of long-term follow-up data.

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