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Original Article

Surgery Section

# Outcome of Miniperc Technique in Paediatric Age Group: A Prospective Interventional Study

PERIASAMY PONNUSAMY[1], RAJASEKAR SUNDARAM[2], RAJKUMAR RAMAKRISHNAN[3], GULAKAVARAPU SAMMOHIT[4], SENTHIL KUMAR POOVATHAI[5]



## ABSTRACT

**Introduction:** Reducing the Percutaneous Nephrolithotomy (PCNL) tract size in paediatric patients with renal stones reduces the morbidity associated with the procedure. Miniperc (Mini PCNL) is a modification of standard PCNL using small size instruments.

**Aim:** To evaluate the postoperative outcome of Miniperc technique in the treatment of renal stones in paediatric age group.

**Materials and Methods:** This was a prospective interventional study conducted at the Department of Urology, Govt. Mohan Kumaramangalam Medical College & Hospital, Salem, Tamil Nadu, India from January 2020 to January 2022. There were 25 patients of renal stone disease belonging to paediatric age group (<8 years), operated by a single surgeon with the Miniperc technique. For all the cases 14F-16F sheaths, 12 Fr Nephroscope and 8-9.5 Fr semirigid ureteroscope, pneumatic lithotripsy and 30-Watt Holmium laser as energy sources were used. Stone-Free Rate (SFR), operative time, hospital stay, and complication rates were assessed. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 26.0.

**Results:** The mean age of the children was 5.2±3.2 years and the average stone size was 1.9 cm. Mean operative time was 74 minutes. The mean hospital stay was 1.5 days. The overall SFR was 89.7%, (N=22) which increased after secondary procedures to 94.12% (N=23). Intraoperative bleeding was seen in 3 (12%) patients and postoperative fever in 4 (16%) patients.

**Conclusion:** Miniperc is a promising and safe technique for paediatric renal stone disease management.

**Keywords:** Laser, Lithotripsy, Minimally invasive surgical procedures, Percutaneous nephrolithotomy

## INTRODUCTION

Minimal-access surgery has revolutionised the entire field of urological surgery over the past 50 years. Fundamental advances in optics, illumination, television application, instrumentation, and operative radiology have resulted in the advanced state of the technology [1]. Further to the miniaturisation of surgical instruments, there is progress towards a state of futuristic surgical applications. In literature the reported incidence of renal stones in the paediatric population is 50 cases/100,000 children [2].

Extracorporeal Shock Wave Lithotripsy (ESWL), PCNL, Retrograde intrarenal surgery, laparoscopic and/or robotic approach are the various options for treatment of renal stones in paediatric population [3]. It is challenging for a paediatric urologist to choose appropriate treatment approach which gives high stone clearance rate and low morbidity in managing renal stones in paediatric age group [4]. As per European Association of Urology (EAU) guidelines, ESWL is the initial choice for the management of renal stones in the paediatric age group upto a stone size of 2 cm but when unfavourable factors for ESWL exist and when stone size is greater than 2 cm, EAU recommends PCNL as the therapy of choice [5].

Paediatric kidneys, which are smaller in size, cannot bear the normal PCNL procedure and has a risk of increased morbidity [6]. Jackman SV et al., introduced Miniperc in order to reduce the morbidity associated with standard PCNL [7]. Few recent studies showed that Miniperc is a better treatment modality compared with ESWL, standard PCNL in terms of higher SFR, less auxiliary procedure rates but Shock Wave Lithotripsy (SWL) has lesser complications [8-11]. The purpose of this study was to share the experience with the Miniperc technique in paediatric age group and to assess its safety and acceptability in the paediatric age group.

## MATERIALS AND METHODS

A prospective interventional study was conducted at the Government Mohan Kumaramangalam Medical College and Hospital, Salem, Tamil Nadu, India from January 2020 to January 2022. Institutional Ethics Committee (IEC) {GMKMC&H/114/IEC/2019-17(4)} approval was obtained for this study. Informed consent was obtained from all the parents of the patients.

A total of 25 paediatric patients diagnosed with renal calculus who underwent Miniperc form the sample population. The major complaints for which surgery was contemplated were pain abdomen, failed previous ESWL, large stone burdens, and parents of the patients who asked for single-session treatment.

**Inclusion criteria:** Patients with age <8 years, Stone Hounsfield Units (HU) <1400 HU, bilateral stone disease, recurrent stone formers, and previous failed PCNL/ESWL were included in the study.

**Exclusion criteria:** Patients with abnormal calyceal anatomy, urosepsis, single functioning kidney, age >8 years were excluded from the study.

A detailed history was documented, the specific history of any stone disease or metabolic disorders in the family was asked for. All were subjected to investigations starting with routine haematological investigations, serum uric acid, serum calcium, serum phosphate, Thyroid profile in view of any inborn errors of metabolism. Urinary routines such as complete urine examination, urine culture, and sensitivity were performed. Radiological investigations such as X-ray Kidney Ureter Bladder (KUB), ultrasound KUB, contrast-enhanced Computed Tomography (CT) KUB were performed to know the stone characters and to identify the anatomy of the pelvicalyceal system for planning puncture and establishing percutaneous tract. Postoperative complications were graded by Clavian-Dindo classification [12]. Postsurgery radiological screening was done on day 1 with USG KUB. Parents were informed and counselled about auxiliary procedures, various management options were discussed for any residual stones if present. Review CT/USG KUB was done after one month and after three months.

**Miniperc technique:** The technique was performed under general anaesthesia with caudal block, with the administration of intravenous antibiotics one hour before the procedure. All the patients were placed initially in low lithotomy position and were subjected to semirigid ureteroscopy using 6-7.5F semirigid ureteroscope, 4 Fr ureteric catheter was placed in the PCS on the affected side [Table/Fig-1]. Retrograde pyelogram was done for all patients using low molecular weighted Iodine based contrast to delineate the calyceal anatomy and to know the position of the stone.

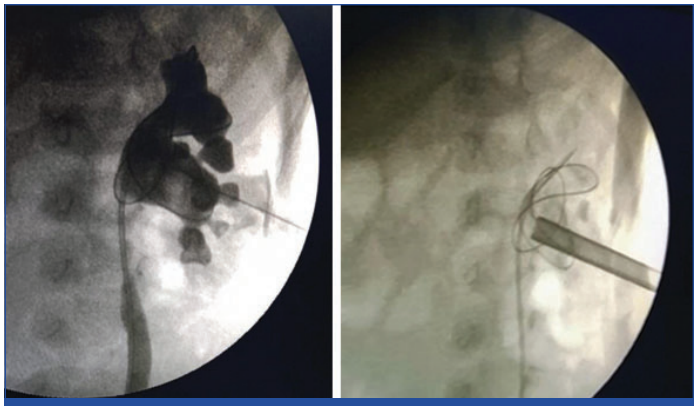
**[Table/Fig-1]:** Surgeon operating on paediatric patient with left renal stone using Miniperc technique.

Patients were then turned to prone/or maintained in supine position based on surgeon's choice. Desired calyx was punctured with PCN needle, tract was dilated with serial coaxial dilators and a 14 Fr working sheath was placed under fluoroscopy guidance. A 12 Fr rigid Karl storz Nephroscope [Table/Fig-2], Olympus 8-9.5 Fr semirigid ureteroscope were used for all the cases. Energy sources used for breaking the stone were pneumatic lithoclast, 30-watt SPHYNX Holmium laser with 275 and 375 micron laser fibres with energy settings of 0.8-1.5 J at 10-15 Hz for fragmentation. Big fragments (>3 mm) were removed by grasper. Stone clearance was assessed with fluoroscopy [Table/Fig-3] and 5F DJ stent was placed finally in antegrade fashion, which was removed after four weeks. Nephrostomy tube of suitable size was used to drain the kidney and removed accordingly after 2-3 days.

**[Table/Fig-2]:** A 12 F Karl Storz nephroscope with metal dilators and their sheaths.

## STATISTICAL ANALYSIS

All statistical tests were performed with 5% level of significance. SFRs were tested using Chi-square test. SPSS version 26.0 was used to perform the hypothesis tests.



**[Table/Fig-3]:** Fluoroscopic images showing lower calyceal puncture with guidewire and placement of 14 F.

## RESULTS

There were 18 boys and seven girls. All underwent one session of single tract PCNL using Miniperc technique. Mean age was 5.2±3.2 years; 18 patients (72%) had stones in left kidney and seven patients (28%) had stones in the right kidney. History of open surgery was recorded in one patient (4%), previous ESWL in four (16%), and Miniperc in one (4%).

Solitary stones were present in the majority. Stone size varied from 0.9-2.9 cm (mean=1.9 cm). There were no statistically significant differences with SFR regarding stone characters [Table/Fig-4].

| Variables | N (%) | SFR (%) |
|---|---|---|
| **Stone size (cm)** | | |
| <2.0 | 16 (64) | 14 (87.50) |
| >2.0 | 9 (36) | 8 (88.88) |
| p-value | 0.9 | |
| **Stone site** | | |
| Pelvis | 14 (56) | 14 (100) |
| Calyceal | 8 (32) | 7 (87.50) |
| Pelvicalyceal | 3 (12) | 3 (100) |
| p-value | 0.7 | |
| **Stone number** | | |
| Solitary | 19 (76) | 17 (89.47) |
| Multiple | 6 (24) | 5 (83.33) |
| p-value | 0.9 | |
| **Stone side** | | |
| Left | 18 (72) | 17 (94.44) |
| Right | 7 (28) | 7 (100.00) |
| p-value | 0.6 | |
| **Sex** | | |
| Male | 18 (72) | 16 (88.88) |
| Female | 7 (28) | 6 (85.71) |
| p-value | 0.8 | |
| **History of previous procedures** | | |
| ESWL | 4 (16) | 3 (75.00) |
| PCNL | 1 (4) | 1 (100) |
| Open surgery | 1 (4) | 1 (100) |
| p-value | 0.7 | |

**[Table/Fig-4]:** Effect of various factors on Stone Free Rates (SFR).
p-value was obtained among various stone characteristics between no. of patients and SFRs (ex- for stone size greater than 2 cm, eight out of nine patients got complete stone clearance)

Pneumatic lithotripters and 30-watt Holmium YAG laser were used for fragmentation of 14 and 11 cases and in eight cases both were used as per surgeon's choice. Mean operative time was 74 minutes. It was calculated starting from ureteroscopy for ureteric catheterisation till placement of nephrostomy tube.

No intraoperative complications were faced. Postoperative complications like fever (grade 2a Clavian Dindo) were seen in four cases. Intraoperative bleeding was noted in three cases which did not require any blood transfusion. For all cases with bleeding, nephrostomy tube of bigger size was inserted, clamped and removed after three days. The mean hospital stay was 1.5 days.

All stones which were less than 3 mm in size were considered insignificant. Overall SFR was 89.7% (N=22), and the remaining patients had residual stone fragments which needed auxiliary procedures. Two (8%) patients needed ESWL as residual stone was more than 5 mm. In one patient significant residual stone burden was present. Parents were counselled regarding auxiliary Miniperc procedure and the patients were taken up for surgery after one month and achieved complete clearance. None of the patients had recurrences.

## DISCUSSION

The aim in the treatment of paediatric stone disease is to attain complete clearance of the stone, treating any infection if present, and correction of any congenital/metabolic disorders and prevent recurrence [13]. Even though all the stone treatment modalities are applicable for paediatric age group, EAU recommends ESWL as the main modality in treating stones ≤2 cm [14]. However, due to its high redo procedure and less clearance rates, ESWL is being replaced by PCNL in recent times [15].

Though the advantages of traditional PCNL are more in terms of clearance rates, it is still associated with significant complications in paediatric population such as uncontrolled and alarming haemorrhage attributed to using large instruments in smaller kidneys [16]. Standard PCNL when performed with an endoscope of smaller size via a percutaneous tract is termed as minimally invasive PCNL or Miniperc. This novel percutaneous access technique was developed by Jackman SV et al., using a 13F peel-away sheath and reported 85% SFR for 11 procedures in seven children with a mean age of 3.4 years [17]. Another small series on Miniperc was done successfully with a mean stone burden of 1.5 cm with SFR of 70-95% [18-20]. In the present study, on 25 patients of mean age 5.2 years and mean stone size of 1.9 cm, the SFR was 22 (89.7%).

The SFR in this study was comparable with other studies done on Miniperc in children. Bilen CY et al., reported 90% SFR using 14F Miniperc in children with mean age of 6.3 years [21]. Wang F et al., also reported 97.2% SFR in children aged under three years [22]. All procedures are performed with a single puncture, single tract using 14F-16F sheaths depending on stone size.

In this study, the mean operative time was (74 minutes) comparable to that reported by Abdeldaeim HM et al., (80.33 minutes) [23]. In another study on 26 cases of Miniperc done, the operative time reported was 71.08 minutes [24]. This was considered as the drawback of Miniperc, associated with reduced field visibility and the requirement for lengthy lithotripsy procedure to obtain small fragments suitable for extraction through the small sheath. However, they reported 19.2% of cases with stones size 3-4.8 cm [24].

There are a few recent studies on Miniperc. Soliman T et al., compared Miniperc with SWL in a Randomised Controlled Trial (RCT) and concluded that Miniperc has better SFR, lower auxiliary and retreatment rates [8]. However, operative time, fluoroscopy time, hospital stay and blood transfusion rates were more with Miniperc. Gao X et al., in a meta-analysis concluded that Miniperc offers a significantly higher SFR, lower auxiliary procedure and retreatment rate, but SWL was associated with fewer complications [9]. In a retrospective study, PCNL, done using standard instruments, was compared with PCNL done with Miniperc instruments in paediatric patients with renal stones [10]. The study concluded that Miniperc technique resulted in significantly less pain and a lower dosage of analgesics. In another RCT, Perri D et al., compared retrograde intrarenal surgery and Miniperc for renal stones between 10-and 20-mm using Thulium fibre laser and concluded that one treatment is superior to the other one according to stone position [11].

Main aim of Miniperc is to reduce complications such as blood loss, postoperative pain, length of hospital stays and maximum clearance of stone in single setting. In this study, the surgeons encountered bleeding during intraoperative period in three (12%) but it was not alarming and did not require any transfusion. Most of the studies reported no blood transfusion [12,25-27]. However, one study required blood transfusion in 15% cases who used 14F sheath for those cases [28]. Small tract of the procedure with high intra pelvic pressure might lead to pyelovenous-lymphatic backflow which gets complicated by systemic dissemination of bacteriuria and causes postoperative fever [29]. In this study, four (16%) patients had postoperative fever which settled with i.v. antibiotics and antipyretics. In this study, the instruments were smaller than the access sheath to allow good leakage of irrigation fluid and contents without applying pressure.

### Limitation(s)

It was a single-centered study and conducted on limited patients. There was no comparison with other modalities such as ESWL, RIRS and standard PCNL.

## CONCLUSION(S)

Miniperc is a promising and safe technique in treating paediatric renal stone disease. It has no major blood loss and lesser postoperative complications. Urologists must employ this technique in the treatment of renal stones in the paediatric age group.

## REFERENCES


[1] Morgenstern L. George Berci: Past, present, and future. Surgical Endoscopy. 2006;20(S2).
[2] Sas DJ, Hulsey TC, Shatat IF, Orak JK. Increasing incidence of kidney stones in children evaluated in the emergency department. J Paedia. 2010;157(1):132-37.
[3] Desai MR, Ganpule AP, Mishra S. Percutaneous nephrolithotomy for pediatric urolithiasis. J Urol. 2010;26(4):549.
[4] Casale P, Grady RW, Joyner BD, Zeltser IS, Kuo RL, Mitchell ME, et al. Transperitoneal laparoscopic pyelolithotomy after failed percutaneous access in the pediatric patient. J Urol. 2004;172:680-83.
[5] Tekgül S, Dogan HS, Hoebeke P, Kocvara R., Nijman R, Radmayr Chr, et al. Guidelines on Pediatric Urology Uroweb; 2014. Available from: http://Urology_LR.pdf. [Last accessed on 2014 Aug 31].
[6] Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. Eur Urol. 2007;51:899-906.
[7] Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW, et al. The "mini-perc" technique: A less invasive alternative to percutaneous nephrolithotomy. World J Urol. 1998;16:371-74.
[8] Soliman T, Sherif H, Sebaey A, Mohey A, Elmohamady BN. Miniperc vs Shockwave lithotripsy for average-sized, radiopaque lower pole calculi: A prospective randomized study. J Endourol. 2021;35(6):896-901.
[9] Gao X, Hu X, Wang W, Chen J, Wei T, Wei X. Mini-percutaneous nephrolithotomy versus shock wave lithotripsy for the medium-sized renal stones. Minerva Urol Nephrol. 2021;73(2):187-95.
[10] Mahajan AD, Mahajan SA. Comparison of mini-percutaneous nephrolithotomy by standard and miniperc instruments in pediatric population: A single-center experience. J Indian Assoc Pediatr Surg. 2021;26(6):374-79.
[11] Perri D, Berti L, Pacchetti A, Morini E, Maltagliati M, Besana U, et al. A comparison among RIRS and MiniPerc for renal stones between 10 and 20 mm using thulium fiber laser (Fiber Dust): A randomized controlled trial. World J Urol. 2022;40(10):2555-60.
[12] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205-13.
[13] Koh C, Shenoy MU. Paediatric renal stone disease: Investigation and management for the paediatrician. Paediatrics and Child Health. 2022;32(7):247-52. Doi: 10.1016/j.paed.2022.04.002.
[14] Tekgul S, Dogan HS, Erdem E, Hoebeke P, Kocvara R, Nijman JM, et al. Guidelines on Paediatric Urology. Available from:.org/wp-content/uploads/EAU-Guidelines-Paediatric-Urology-2015. pdf. [Last accessed on 2015 Mar 01].
[15] Smaldone MC, Corcoran AT, Docimo SG, Ost MC. Endourological management of pediatric stone disease: Present status. J Urol. 2009;181:17-28.
[16] Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA. Campbell-Walsh Urology. Philadelphia, United States of America: Elsevier Saunders; 2007.
[17] Jackman SV, Hedican SP, Peters CA, Docimo SG. Percutaneous nephrolithotomy in infants and preschool age children: Experience with a new technique. Urology. 1998;52:697-701.

[18] Wah TM, Kidger L, Kennish S, Irving H, Najmaldin A. MINI PCNL in a pediatric population. Cardiovasc Intervent Radiol. 2013;36:249-54.
[19] Yan X, Al-Hayek S, Gan W, Zhu W, Li X, Guo H, et al. Minimally invasive percutaneous nephrolithotomy in preschool age children with kidney calculi (including stones induced by melamine-contaminated milk powder). Pediatr Surg Int. 2012;28:1021-24.
[20] Bhageria A, Nayak B, Seth A, Dogra PN, Kumar R. Paediatric percutaneous nephrolithotomy: Single-centre 10-year experience. J Pediatr Urol. 2013;9:472-75.
[21] Bilen CY, Koçak B, Kitirci G, Ozkaya O, Sarikaya S. Percutaneous nephrolithotomy in children: Lessons learned in 5 years at a single institution. J Urol. 2007;177:1867-71.
[22] Wang F, An HQ, Li J, Tian CY, Wang YJ. Minimally invasive percutaneous nephrolithotomy in children less than three years of age: Five-year experience in 234 cases. Urol Int. 2014;92:433-39.
[23] Abdeldaeim HM, El Gebaly O, Said M, Zahran AR, Abouyoussif T. Mini percutaneous nephrolithotomy versus retrograde flexible ureterorenoscopy in the treatment of renal calculi in anomalous kidneys. Archivio Italiano di Urologia e Andrologia. 2021;93(2):167-72.
[24] Daw K, Shouman AM, Elsheemy MS, Shoukry AI, Aboulela W, Morsi HA, et al. Outcome of mini-percutaneous nephrolithotomy for renal stones in infants and preschool children: A prospective study. J Pediatr Urol. 2015;86:1019-26.
[25] Zeren S, Satar N, Bayazit Y, Bayazit AK, Payasli K, Ozkeçeli R, et al. Percutaneous nephrolithotomy in the management of pediatric renal calculi. J Endourol. 2002;16:75-78.
[26] Zeng G, Zhao Z, Zhao Z, Yuan J, Wu W, Zhong W, et al. Percutaneous nephrolithotomy in infants: Evaluation of a single-center experience. Urology. 2012;80:408-11.
[27] Zeng G, Jia J, Zhao Z, Wu W, Zhao Z, Zhong W, et al. Treatment of renal stones in infants: Comparing extracorporeal shock wave lithotripsy and mini-percutaneous nephrolithotomy. Urol Res. 2012;40:599-603.
[28] Bilen CY, Gunay M, Ozden E, Inci K, Sarikaya S, Tekgul S, et al. Tubeless mini percutaneous nephrolithotomy in infants and preschool children: A preliminary report. J Urol. 2010;184:2498-502.
[29] Zhong W, Zeng G, Wu K, Li X, Chen W, Yang H, et al. Does a smaller tract in percutaneous nephrolithotomy contribute to high renal pelvic pressure and postoperative fever? J Endourol. 2008;22:2147-51.

**PARTICULARS OF CONTRIBUTORS:**
1. Professor, Department of Urology, Govt Mohan Kumara Mangalam Medical College, Salem, Tamil Nadu, India.
2. Senior Assistant Professor, Department of Urology, Govt Mohan Kumara Mangalam Medical College, Salem, Tamil Nadu, India.
3. Associate Professor, Department of Urology, Govt Mohan Kumara Mangalam Medical College, Salem, Tamil Nadu, India.
4. Postgraduate Student, Department of Urology, Govt Mohan Kumara Mangalam Medical College, Salem, Tamil Nadu, India.
5. Senior Assistant Professor, Department of Urology, Govt Mohan Kumara Mangalam Medical College, Salem, Tamil Nadu, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**
Dr. Rajkumar Ramakrishnan,
Associate Professor, Department of Urology, 3rd Floor, Pmssy Block, Govt Mohan Kumara Mangalam Medical College Hospital, Salem 636001, Tamil Nadu, India.
E-mail: drrrajkumaruro@gmail.com

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