Research and Reports in Urology

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Is "Open Stone Surgery with Intraoperative Nephroscopy" a Better Alternative to Percutaneous Stone Removal for Complex Kidney Stones in Resource-Constrained Rural Settings?: A Retrospective Observational Cohort Study

Joy Narayan Chakraborty, Renchamo Kikon

Department of General Surgery, Zion Hospital, Dimapur, Nagaland, India

Correspondence: Joy Narayan Chakraborty, Email urochakraborty@gmail.com

Research and Reports in Urology downloaded from https://www.dovepress.com/
For personal use only.

Introduction and Importance: Advances in endourology have greatly reduced open stone surgeries (OSS) worldwide. However, in some rural areas of developing countries, PNL for large, complex stones is not feasible due to limited resources and lack of angioembolisation. We share our experience in such cases.

Materials and Methods: Using STROCSS 2025 and PROCESS 2023 checklists, we outlined objectives and reported a case series. From January 2012 to June 2023, 2241 patients had surgery for urinary stones at a rural hospital: 286 PNL, 1625 URS, 281 RIRS, and 49 OSS. We retrospectively analysed demographic data, stone burden, surgical techniques, and outcomes.

Outcomes: There were 23 men and 26 women, aged 31 to 66 (average: 52 years). CSB was included in 46 patients (93.8%), and CSB with PUJ obstruction in 3 patients (6.12%). Procedures were pyelolithotomy (26.53%), extended pyelolithotomy (38.77%), and pyelolithotomy with lower calyceal nephrotomy (24.48%). Mandatory intraoperative nephroscopy was used to remove calyceal stones. Complete stone-free status was achieved in 47 cases (95.9%) at discharge and 3-month CT. Two patients (4.08%) had residual fragments needing RIRS at 3 months. The mean operative time was 88.67 min (70–120), and hospital stay averaged 5.87 days (5–8). The follow-up period averaged 24.48 months (24–30). Intraoperative complications occurred in 10.20%, and significant postoperative complications in seven cases (14.28%), including sepsis, urinary leakage, chest effusion, and wound issues.

Conclusion: Single-session OSS with Nephroscopic clearance can achieve a higher stone-free rate. Although the morbidity of OSS is considerably higher than that of PNL, it may be safe and effective for managing complex stone burdens in resource-constrained rural areas of developing countries.

Keywords: complex renal stones, open stone surgery, rural kidney stones, intraoperative nephroscopy, case series, calycotomy

Introduction

The global incidence and prevalence of urolithiasis are steadily rising, creating a need for safe, effective, and affordable treatment options.[1] This worldwide trend is now nearly the same in both developing and developed countries.[2] The surgical management of urolithiasis has experienced significant shifts from open stone surgery (OSS) to endourologic approaches, including ureteroscopy (URS), percutaneous nephrolithotomy (PNL), and endoscopic combined intrarenal surgery (ECRIS). Consequently, even for more complex stones once thought to require OSS, they are now often treated with endourological techniques. However, OSS still plays a crucial role in managing some cases with a complex stone burden (CSB), especially in resource-limited rural areas of lower- and middle-income countries. While the use of OSS has decreased to approximately 2% in most developed countries, it remains at 21% in developing nations.[3,4]

https://doi.org/10.2147/RRU.S564070
Received: 2 October 2025
Accepted: 25 December 2025
Published: 8 January 2026

© 2026 Chakraborty and Kikon. This work is published and licensed by Dove Medical Press Limited. The full terms of this license are available at https://www.dovepress.com/terms.php and incorporate the Creative Commons Attribution – Non Commercial (unported, v4.0) License (http://creativecommons.org/licenses/by-nc/4.0/). By accessing the work you hereby accept the Terms. Non-commercial uses of the work are permitted without any further permission from Dove Medical Press Limited, provided the work is properly attributed. For permission for commercial use of this work, please see paragraphs 4.2 and 5 of our Terms (https://www.dovepress.com/terms.php).

This retrospective study aims to describe and analyse our experience with OSS, focusing on indications, outcomes, complications, techniques used, and the stone-free rate in a rural, resource-limited setting.

Materials and Methods

Patients

This retrospective, non-randomised cohort study is registered with the Research Registry [Enrolment number: 10972, January 13, 2025] and conducted according to the standard PROCESS 2023 checklist[5] and the STROCSS guidelines[6] to establish the main objectives and report our case series. AI was not used in the research or manuscript development for this study. Although this is a retrospective study of human subjects who have already undergone surgical treatment and followed standard national and international guidelines, an institutional review board (IRB) approval was obtained before data collection (No. ZHRC/RP/0012/15052023). We strictly adhered to the principles outlined in the Declaration of Helsinki for studies involving human subjects.

Between January 2012 and June 2023, 2241 patients underwent surgical intervention for urolithiasis at a rural hospital with limited endourologic equipment and no angioembolisation facility. Among them, 286, 1625, 281, and 49 patients underwent PNL, URS, RIRS, and OSS, respectively. RIRS was introduced at our centre in 2018. Therefore, 49 patients underwent OSS; the surgical approach was selected based on the surgeons' experience and with patients' informed consent. Our IRB does not require patient consent for retrospective data review; however, for using photographs, we have obtained patients' consent in the prescribed format embedded in the preoperative consent form. We retrospectively evaluated the patients' data using R statistical software, focusing on patient characteristics, stone burden and distribution, surgical indications, types of OSS used, operative details, outcomes, and complications.

Inclusion Criteria

We included patients with CSB who underwent OSS with (a) a Cumulative Stone Diameter (CSD) exceeding 5 cm, (b) rotation anomalies, (c) concurrent PUJ obstruction, and (d) those likely to require multiple tracts for better stone clearance. Patients who completed at least 24 months of follow-up were included in the analysis. Notably, because there was no angioembolisation facility at this remote rural hospital, we did not perform PNL on CSB cases that are likely to need multiple tracts and carry a higher risk of bleeding; these cases are routinely referred to higher centres. CSB encompasses various high-stress bearing situations with complexities, such as large staghorn stones or multiple calyceal stones behind infundibular stenosis or calyceal diverticulum, and concomitant horseshoe or ectopic kidney. A well-informed patient is one who opts to undergo OSS and (a) refuses referral to an advanced facility at a distant city for socio-economic reasons, (b) wants to achieve a single-session, higher stone-free rate, and (c) understands the pros and cons of OSS. Exclusion criteria include (a) patients with a single or partial staghorn stone that can be safely managed with PNL with a single lower calyceal tract, (b) patients choosing endourologic treatment at an advanced referral centre, (c) those willing to undergo multiple operative interventions if necessary, and (d) those with uncorrected coagulopathies. Four representative images of complex staghorn stones are shown in Figures 1 and 2 (peripheral bulky) and Figures 3 and 4 (pyelic bulky).

Preoperative Preparation

Besides a detailed history and examination, all patients were evaluated for any haematologic or internal diseases. Radiologic evaluations included renal ultrasound, non-contrast computed tomography (NCCT) of the kidney-ureter-bladder (KUB) area, and either intravenous urography (IVU) or CT urography. We estimated CSD (in cm) on NCCT. Stone categorisation was done according to Al-Kohlany et al[7] and Silverio et al.[8] Urine cultures were routinely obtained. Patients with positive cultures were treated with antibiotics for one week to achieve and document a negative urine culture status before the operation.

In contrast, patients with negative cultures were given second-generation cephalosporins as prophylaxis. None of our cohorts had any previous stone analysis or metabolic workup report. Demographic data of our patient group is summarised in Table 1.

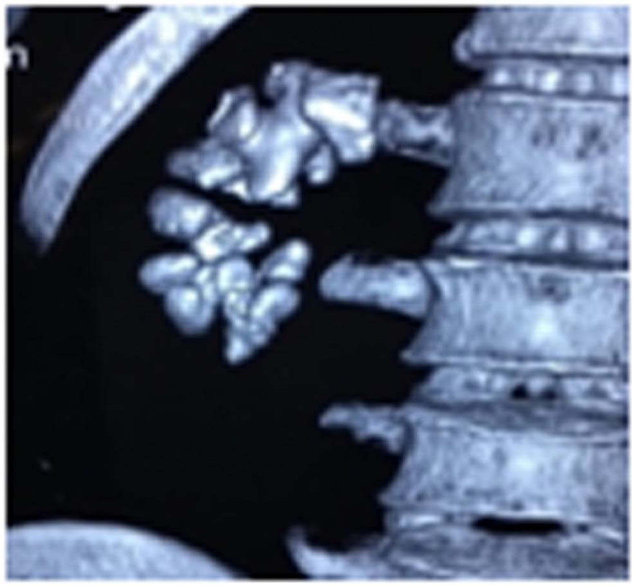

Figure 1 Plain CT image showing "Peripheral bulky" staghorn.

Figure 2 Extracted stone.

Technique of OSS

A detailed description of various open surgical techniques, such as standard and extended pyelolithotomy, is beyond the scope of this article and can be found in standard textbooks. However, we highlight the key modifications we adopted to make OSS less invasive and to achieve a higher stone-free rate (SFR). The surgical approach was determined based on the surgeons' experience and with the patients' informed consent. We employed an extraperitoneal subcostal approach with intraoperative Nephroscopic lithotripsy (IONL). This technique involves using a modified flank position, where the upper torso is positioned anteriorly at a 45-degree angle to the operating table The incision extends from one inch below and anterior to the tip of the twelfth rib to the anterior subcostal area in a transverse line, one inch from the costal margin. The kidney was fully mobilised. To adequately expose the renal pelvis, we carefully approached the renal hilum from the

Figure 3 X-ray image showing "Pyelic bulky" staghorn.

Figure 4 Extracted stone with measurement.

anterior aspect. This required meticulous dissection of the perirenal fat, avoiding any inadvertent injury to the vessels, and careful isolation and retraction of the hilar vessels.

For partial staghorn stones, we preferred pyelolithotomy (PL) alone [point "a" to "b" in Figure 5]. In contrast, we selected extended pyelolithotomy (EPL) for the treatment of complete or giant staghorn calculi. Additionally, a pyelo-calycotomy with lower pole nephrotomy (PC) [Figures 6 and 7] was necessary in some cases to achieve wider intrarenal exposure, especially in those with an intrarenal pelvis and thinned-out lower pole parenchyma. For PC, a pair of angled haemostats was navigated through the pyelotomy incision up to the lower calyx and used to divide the overlying parenchyma along Brodel's white line [Figures 8 and 9]. The cut parenchymal plane was checked for bleeding vessels, which were either coagulated or closed with 4–0 polyglactin sutures. Notably, we preferred to use a PC when the

Table 1 Patient Demography, Stone Features, Location & Morphology

Patient Features	No. of Cases (%)	Stone Features	No. of Cases (%)	Stone Location& Morphology	No. of Cases (%)
No. of Patients	49	**CSD cm** (Range)	7.07 (5.2–10.04)	**Stone morphology**	
No. of Kidneys	49	**Stone number**		Partial Staghorn	15 (30.61)
Mean patient Age (years) ± SD (Range)	52 ± 8.50 (31–66)	Multiple	44 (89.79)	Complete Staghorn	31 (63.26)
Sex: Male/Female	23/26	Single	05 (10.20)	Giant Staghorn	03 (6.12)
Mean serum Cr (mg/dl) ± SD (Range)	1.11 ± 0.27 (0.8 −2.3)	**Stone nature**		**Stone location**	
No. of patients with UTI	02	De novo	41 (83.67)	Pelvicalyceal	19 (38.77)
		Recurrent	08 (16.32)	Multiple calyceal	30 (61.22)
		Stone density			
		< 700 HU	08 (16.32)		
		>700 HU	41 (83.67)		

Notes: Staghorn Stone classification [Al-Kohlany et al] [7]: Borderline: pelvis + one calyx, Partial staghorn: pelvis + at least two calyces (minimum 40% of PCS), Complete staghorn (filling the entire calyceal system or minimum 80% of it); Giant staghorn [8]: >10 cm diameter, and > 5 cm in thickness, with equal distribution throughout the PCS with dilated PCS.

Abbreviations: CSD, Cumulative Stone diameter; UTI, Urinary tract infection; HU, Hounsfield Unit.

pyelotomy incision was insufficient to remove a giant staghorn. This approach is particularly beneficial for delivering the lower margin of a large staghorn, which is critical for removing the entire stone mass. In most PC cases, the lower pole parenchyma was often thin and atrophic, and we did not encounter any significant haemorrhage.

In the case of a branched staghorn with multiple infundibulo-calyceal extensions, we, as a first step, removed the central pyelic portion of the stone mass. The perirenal area was carefully packed, and the irrigation fluid was continuously suctioned off. We then used cross-table fluoroscopy to assess the extent of calyceal burden. An intraoperative nephroscopy with or without nephrolithotripsy (IONL) (using an 18 F nephroscope) was performed through the pyelotomy incision, enabling a thorough examination and removal of all remaining calyceal stones [Figure 10]. For stone fragmentation, we used a pneumatic lithotripter when required. We did not require hilar clamping, radial nephrolithotomy or anatrophic nephrolithotomy in any of our patients.

A completion fluoroscopy was performed to assess the degree of stone clearance. Finally, the renal collecting system was closed, leaving a double-J stent in place. An external drainage tube was left in the perinephric space. An X-ray of the KUB area and renal ultrasound were performed in all cases before discharge. The external drain was removed on the 3rd postoperative day (when the drainage amount was <30 mL), followed by urethral catheter removal after one day. Patients were advised to come for stent removal after three weeks.

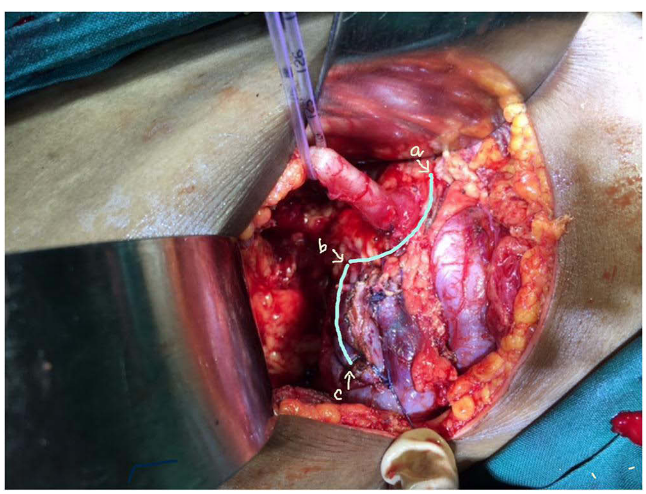

Figure 5 Intraoperative image: Dotted line indicates the proposed incision along the pelvis and lower calyx (**a** and **b**) Pyelotomy alone, (**b** and **c**) Lower pole calycotomy.

 https://doi.org/10.2147/RRU.S564070

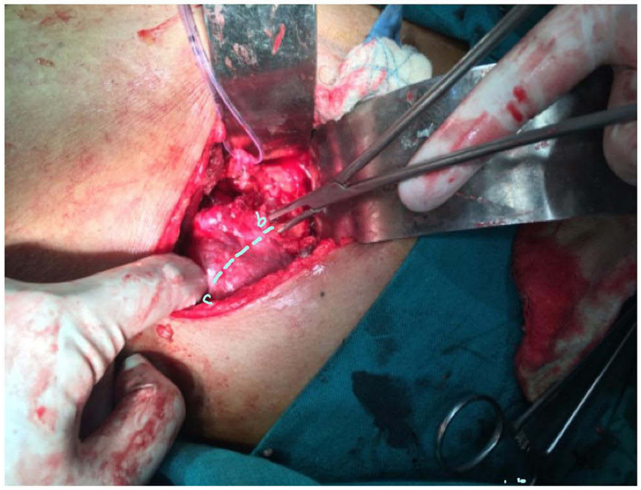

Figure 6 Intraoperative image: Placing a curved haemostat along the lower calyx through the pyelotomy incision to act as a guide for nephrotomy.

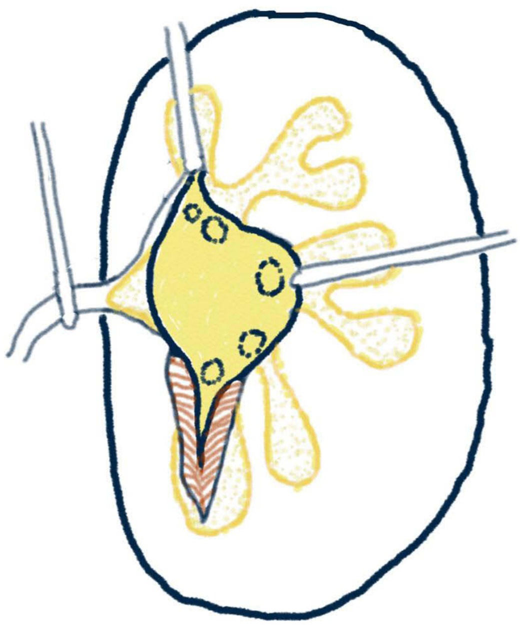

Figure 7 Schematic diagram of preparation for lower pole calycotomy with a curved haemostat passed through the pyelotomy incision.

Follow-up Protocol

The first follow-up was conducted three weeks after the initial assessment, and subsequent follow-ups were scheduled every three months during the first year and then every six months for the following year. We enquired about the time taken to return to normal activities at the first visit and advised an abdominal NCCT scan to evaluate the stone status. Creatinine, complete blood count, urinalysis and renal ultrasound were obtained during all the follow-ups. Patients with complete stone clearance on CT at three months were considered stone-free. Residual fragments > 4 mm were considered clinically significant (CSRF), whereas those < 4 mm were deemed to be insignificant (CIRF).

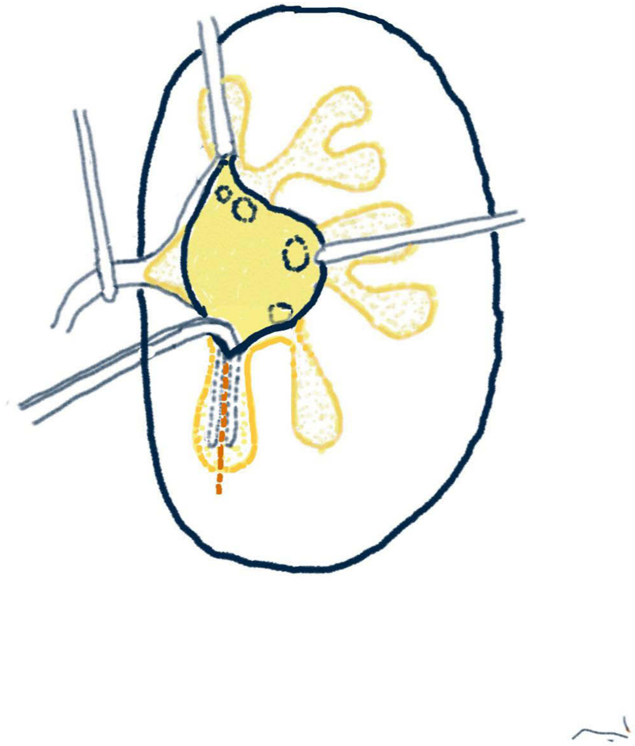

Figure 8 Schematic steps of lower pole calycotomy with nephrotomy of the overlying thinned-out parenchyma.

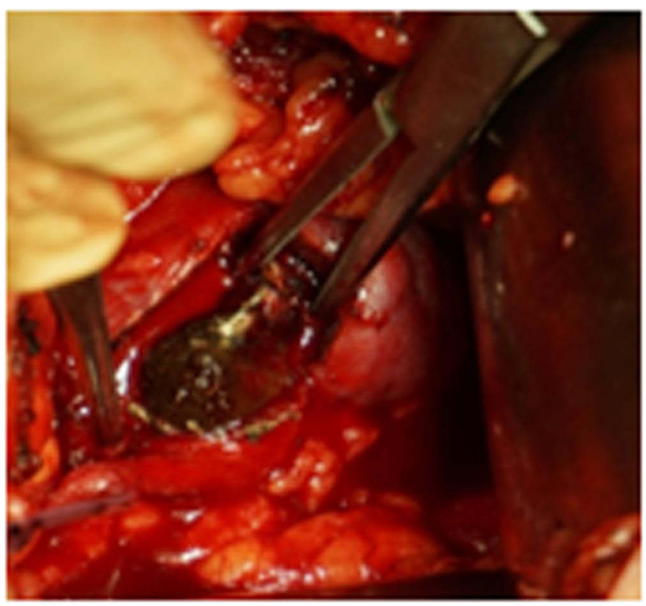

Figure 9 Intraoperative image: Lower pole nephrotomy and stone removal.

Outcomes

There were 23 men and 26 women, aged 31 to 66 (mean age: 52 years). The mean CSD (range) was 7.07 (5.2–10.04) cm, and the mean stone volume (range) was 67.69 (38.89–108.75) cm^3. The numbers of complete, partial, and giant staghorn calculi were 31,15, and 3, respectively. Patient demographics, stone features, location, and morphology are listed in Table 1.

Figure 10 Intraoperative nephroscopy.

Serum creatinine was normal in all but two patients. The mean creatinine value (range) was 1.11 (0.8–2.3) mg/dl.

The main indications include CSB in 46 patients (93.8%) and stones with PUJ obstruction in 3 patients (6.12%). Examples of CSB that are difficult to treat with MIS are shown in Figure 1. The operative techniques selected were mainly pyelolithotomy (PL) in 13 patients (26.53%) and extended pyelolithotomy (EPL) in 21 (38.77%). A more invasive procedure, Pyelocalycotomy (PC) with lower pole nephrotomy, was required in 12 patients (24.48%). Three patients (6.12%) needed Pyelolithotomy with dismembered pyeloplasty (PL + PP). The mean (range) incision length was 12.02 (11–14) cm. Table 2 presents the operative techniques used in our series.

We achieved a complete stone-free status in 47 (95.91%) cases, both at discharge and at the three-month follow-up CT. Only 2 (4.08%) patients had clinically significant residual fragments (CSRF) (9 mm and 8 mm) that required RIRS at 3 months. However, two cases of stone recurrence were observed during the 24-month follow-up. A stone analysis report was available in 34 cases, revealing that 26 stones were calcium oxalate dihydrate stones, while 8 were struvite calculi.

We did not observe any Clavien-Dindo grade 4 or 5 complications after surgery. Intraoperative complications (peritoneal breach with hydroperitoneum) were recorded in one patient (10.20%). The mean decrease in haemoglobin levels was 1.21 g/dL (range 0.8–1.9). Significant postoperative complications occurred in only seven patients (14.28%), including septicaemia, prolonged urinary leakage, chest effusion, and wound issues. Urine leakage was typically present for the initial 48 to 72 hours in all cases, except for two patients (8.16%) who experienced prolonged leakage lasting two weeks, requiring extended catheterisation. Cases of prolonged ileus and chest effusion were managed conservatively. One case of septicaemia required ICU management for 3 days before recovery. There were no instances of delayed massive haemorrhage requiring intervention, and overall, two patients (4.08%) needed a perioperative blood transfusion.

Table 2 Surgical Techniques Used in OSS

Technique of OSS	No. of cases (%)
Pyelolithotomy	13 (26.53)
Extended pyelolithotomy	21 (38.77)
Pyelo-calycotomy with lower pole nephrotomy	12 (24.48)
Pyelolithotomy + Pyeloplasty	03 (6.12)

Table 3 Operative Complications

Complications	No. of Cases (%)
Intraoperative Complications	
Peritoneal breach	01 (2.04)
Postoperative Complications	
Sepsis	01 (2.04)
Wound complications	02 (4.08)
Prolonged ileus	01 (2.04)
Persistent leakage > 2 weeks	02 (4.08)
Transudative pleurisy	01 (2.04)
Total	08 (16.32)

Notes: There were no incidences of vascular, pleural, ureteral injury, PUJ avulsion or perinephric collection. Total transfusion requirements: 02 (4.08%).

The mean operative time (range) was 88.67 minutes (70–120 minutes). The average hospital stay (range) was 5.87 (5–8) days. At 12 months of follow-up, we did not observe any secondary PUJ obstructions or flank hernias. The mean (range) follow-up period was 24.48 (24–30) months. Postoperative complications of our patient group are summarised in Table 3.

Discussion

Worldwide, there is a steady increase in urolithiasis cases, with some regional and sociodemographic differences; this creates a significant burden and cost for healthcare systems.[9] Current urologic practice mainly relies on endourologic techniques. The consensus is that most complex stones, including partial and complete staghorn stones, should be primarily treated with PNL. Additionally, an approach combining PNL and RIRS may also be an appropriate alternative.[10] OSS or laparoscopic surgery should generally be avoided. Still, it may be considered for patients where less invasive methods are unlikely to achieve complete stone removal with a reasonable and practical number of procedures. Common indications include a CSB with failure of SWL or endourological treatments, as well as anatomical abnormalities such as infundibular stenosis, renal caliceal diverticulum, and ureteropelvic junction obstruction.[11] Consequently, the number of articles featuring OSS or its comparison with endourological procedures has decreased to only case reports, case series, or reviews over the last two decades.

The philosophy of urolithiasis management defines success as the ability to achieve the highest SFR using the least invasive modality while preserving renal function. Although present guidelines favour OSS only in specific situations, it remains unclear what constitutes the "acceptable, reasonable or practical number" of endourological procedures before proceeding to OSS, especially in resource-constrained countries.[12] Therefore, despite being more invasive and less common in daily practice, OSS still plays a vital role in countries with limited resources, especially in rural areas, where general surgeons continue to make significant contributions to kidney stone management.[3]

Individualising diagnosis and treatment is crucial for effective stone management, and this depends on the patient's specific circumstances.[10] On social media, patients most often mention the need for multiple operative sessions (45%), surgery-related pain (43%), and the recovery period (42%).[13] Arguably, multiple endourologic sessions are a better option for CSB compared to OSS, provided the patient agrees to multiple sessions and resources are available to address complications.[14] However, in rural settings, safety concerns emerge during or after multi-tract PNL due to the increased risk of post-PNL bleeding, which could require a life-saving nephrectomy, especially since a selective angioembolisation (AE) facility is unavailable. Therefore, our hospital protocol prohibits PNL in CSB cases that are likely to require multiple tracts for stone clearance, including those with upper or mid-pole entry, and instead refers these cases to an advanced urology centre. Patients with CSB who refuse or cannot access distant urban centres are offered OSS after proper counselling. In resource-limited rural settings, the benefits of OSS in CSB include a higher single-stage SFR rate (about 85%),[15] a lower overall intervention rate, and better cost-effectiveness.[16] Additionally, multiple endourologic procedures are more expensive than OSS, and this matters to a low-income patient; furthermore, the cost savings are proportional to the duration of surgery.[17] Thus, despite the existence of high-quality, evidence-based international

 https://doi.org/10.2147/RRU.S564070

guidelines, choosing OSS is often appropriate based on the complexity of the pelvicalyceal system, stone burden, distribution, and safety considerations in a resource-limited rural environment.[4]

There is evidence that CSB often requires multi-tract PNL or multiple stages to achieve a satisfactory SFR. This frequently results in a higher transfusion rate or postoperative haemorrhagic complications, leading to a haemoglobin drop of 1.8 to 8.3 g/dL that may necessitate transfusion with a concomitant increase in renal scar tissue volume.[18] Vascular lesions can also cause late bleeding complications, arising from pseudoaneurysms or arteriovenous fistulas, which usually require therapeutic angioembolization (TAE) in 1–1.5% of cases.[19] Stone size, multiple tracts, and prior ipsilateral surgery are directly related to these risks.[20] Multiple interventions also involve repeated anaesthesia and extended hospital stays (more than 10 days), even in many specialised urology centres. Despite this, overall, combining PCNL, RIRS, and ESWL results in a variable SFR of 78% to 83.2%.[15] Our postoperative single-session SFR of 95.92% at discharge was arguably low, which, we believe, is due to the mandatory use of IONL. The average hospital stay and costs were within acceptable limits. Our complication rate (14.28%) was satisfactory, and only two patients required RIRS to clear residual fragments.

Having justified the role of OSS in a rural, resource-limited setting, we aimed to reduce morbidity and improve the SFR of conventional OSS in our study. To achieve this, we introduced four different modifications: the anterior extraperitoneal subcostal approach for renal exposure, the anterior hilar approach to access the renal pelvis, lower calycotomy in select cases, and the mandatory use of IONL. Compared to the conventional transcostal approach with 12th rib resection, an anterior subcostal incision offers optimal kidney exposure. It is quick, safe, and less painful.[21] Besides providing satisfactory control of anaesthesia and direct cardiac access, it has a lower incidence of paralytic ileus or respiratory complications. Additionally, the kidney becomes more superficial and easier to mobilise.[22] In our series, the mean incision length was 12.02 cm, which is relatively smaller than the conventional approach; the mean operative time was 88.67 minutes.

As traditionally believed, issues with the anterior hilar approach include increased technical difficulty due to the complex and variable arrangement of the renal vessels, with the risk of accidental injury preventing proper dissection to create a safe space during pyelotomy.[23] However, in practice, it is easier than the traditional flank approach. The anterior extraperitoneal approach offers several benefits: it provides the most direct access to the renal hilum and pelvis without mobilising the kidney, and offers good exposure of the kidney. It also provides better visualisation of blood vessels than the classic flank incision, allowing for careful dissection of the pelvis, avoiding unexpected bleeding and enabling better control if necessary. Additionally, it facilitates easier removal of stones from the renal pelvis or calyces, resulting in less postoperative discomfort.[24] In our cases, we performed careful dissection and sometimes used sling retraction of any adjoining prominent vessels, which helps create enough space for a safe pyelotomy and stone removal. In our series, we did not have to resort to hilar clamping or anatrophic nephrolithotomy, in any case.

The lower pole calycotomy is a safe technique for enhancing internal renal access during stone removal, regardless of the size of the renal sinus. This technique is especially useful for a small renal sinus that can limit exposure of the intrarenal pelvis and make it difficult to approach the sinus for stone removal. It works by following the avascular plane, which is the boundary between the lower segmental artery and the posterior segmental artery zones. Incising the renal parenchyma along the intersegmental avascular plane significantly improved exposure of the intrarenal collecting system, allowing for the extraction of a significant part of the stone.[25] We had to perform, in 12 such cases, a lower pole calycotomy combined with an extended pyelolithotomy.

IONL is an excellent tool for achieving a satisfactory single-stage SFR. Rigid nephroscopy through a wide pyelotomy incision provides better visualisation of all the calyces and improves the egress of irrigation fluid, keeping it unobstructed. This technique facilitates the easier detection of residual stones and simplifies the removal of small caliceal stones, eliminating the need for blind probing and forceps manipulation, thereby reducing the risk of kidney trauma.[26] We have used IONL in all our cases with intraoperative fluoroscopy as an adjunct to maximise residual stone clearance.

The combination and multi-stage therapy impose a significant financial burden on the healthcare budget due to increased morbidity, especially when the total number of procedures exceeds what is considered “reasonable”. Additionally, the economic impact of unplanned readmissions and retreatments for complications has been relatively overlooked.[27] The operative trend is often influenced by provider preference and reimbursement rather than by resource availability. Considering the multiple interventions, costs, and overall morbidity associated with combination therapy, OSS is a viable option, particularly in developing countries, because it is a one-time, efficient, and cost-effective solution.[28] Furthermore, providing this information is part of the patient's right and can help well-informed, competent patients select an appropriate treatment modality. In our series, OSS accounts for 2.18% of the total stone surgeries performed.

In our case series, we observed a high stone clearance rate, which would be unlikely to occur with just a single endourologic session. Our complication rates were acceptable, and only two patients needed an auxiliary RIRS to clear residual fragments. IONL greatly helped us achieve this low SFR by removing small stone fragments that were entrapped in deep calyces and were not palpable during surgery. Furthermore, viewing OSS as indicating or implying failure may lead to a strong bias against it, resulting in the OSS option being overlooked, withheld, or delayed, which could harm these rural patients without access to advanced urology facilities.

Therefore, although the role of OSS is very limited in today's context, even for complex stones, some specific situations still require an OSS based on patient preference or complexity. Our technique has the potential to reduce the morbidity associated with OSS significantly and, at the same time, improve the SFR in a single session.

The main shortcomings of our study are its retrospective nature, small sample size, and the selection of patients based solely on clinical decisions. As a non-randomised retrospective study, there may be over- or underestimation of the observed associations (confounding bias) as well as selection bias. Secondly, as the samples are taken from an extended period, they may not accurately reflect current medical practice (Temporal bias). Additionally, we did not perform any pre- or postoperative radionuclide scans to assess renal function; consequently, we missed information regarding the potential impact of OSS on renal function, especially in lower calycotomy cases. In addition, beyond the third month, follow-up primarily relied on renal ultrasound, which is less sensitive than CT; thus, several recurrences may have been missed.

Conclusion

Endourologic approaches are regarded as superior to OSS based on current evidence and guidelines in all aspects, including CSB. However, OSS remains an important option, especially in rural, resource-limited settings, for a carefully selected group of patients. It is also a patient's right to be informed that OSS still remains a valid option for CSB. Although more invasive, OSS offers a high single-stage stone clearance rate and shorter operating times. Our technique improves exposure, reduces operating duration, increases the likelihood of single-session SFR, and decreases the risk of renal parenchymal damage compared to the standard flak approach.

Artificial Intelligence (AI)

AI was not used in the research and manuscript development.

Institutional Review Board Approval

Although this is a retrospective study of human subjects who have already undergone surgical treatment and followed standard national and international guidelines, an institutional review board (IRB) approval was obtained from the Ethics Committee at Zion Hospital, Nagaland, India, before data collection. We strictly adhered to the principles outlined in the Declaration of Helsinki for studies involving human subjects.

Disclosure

The authors declare no conflicts of interest in this work.

References

1. Heers H, Turney BW. Trends in urological stone disease: a 5-year update of hospital episode statistics. *BJU Int*. 2016;118(5):785–789. doi:10.1111/bju.13520
2. Alatab S, Pourmand G. National profiles of urinary calculi. *Iranian J Kidney Dis*. 2016;10(2):51–61.

3. Abdulrasheed HA, George AO, Ayobami-Ojo PS, et al. Current practices and challenges in the management of complex renal stones in Africa: a scoping review. *Cureus*. 2024. doi:10.7759/cureus.61134
4. Honeck P, Wendt-Nordahl G, Krombach P, et al. Does open stone surgery still play a role in the treatment of urolithiasis? Data of a primary urolithiasis center. *J Endourol*. 2009;23(7):1209–1212. doi:10.1089/end.2009.0027
5. Mathew G, Sohrabi C, Franchi T, et al. Preferred Reporting Of Case Series in Surgery (PROCESS) 2023 guidelines. *Int J Surg*. 2023;109 (12):3760–3769. doi:10.1097/JS9.0000000000000940
6. Science P, London UK, Agha R, et al. Revised Strengthening the reporting of cohort, cross-sectional and case-control studies in surgery (STROCSS) guideline: an update for the age of artificial intelligence. *Prem J Sci*. 2025.
7. Al-Kohlany KM, Shokeir AA, Mosbah A, et al. Treatment of complete staghorn stones: a prospective randomized comparison of open surgery versus percutaneous nephrolithotomy. *J Urol*. 2005;173(2):469–473. doi:10.1097/01.ju.0000150519.49495.88
8. Silverio FD, Gallucci M, Alpi G. Staghorn Calculi of the Kidney: classification and Therapy. *Br J Urol*. 1990;65(5):449–452. doi:10.1111/j.1464-410X.1990.tb14784.x
9. Lang J, Narendrula A, El-Zawahry A, Sindhwani P, Ekwenna O. Global trends in incidence and burden of urolithiasis from 1990 to 2019: an analysis of global burden of disease study data. *Eur Urol Open Sci*. 2022;35:37–46. doi:10.1016/j.euros.2021.10.008
10. Skolarikos A, Geraghty R, Somani B, et al. European Association of Urology guidelines on the diagnosis and treatment of urolithiasis. *Eur Urol*. 2025;88(1):64–75. doi:10.1016/j.eururo.2025.03.011
11. Alivizatos G, Skolarikos A. Is there still a role for open surgery in the management of renal stones? *Curr Opinion Urol*. 2006;16(2):106–111. doi:10.1097/01.mou.0000193379.08857.e7
12. Akram M, Jahrreiss V, Skolarikos A, et al. Urological guidelines for kidney stones: overview and comprehensive update. *J Clin Med*. 2024;13 (4):1114. doi:10.3390/jcm13041114
13. Juliebø-Jones P, Emiliani E, Sierra A, et al. Patient perspectives on kidney stone surgery: a content analysis of Instagram posts by patients versus surgeons. *Eur Urol Open Sci*. 2023;58:82–86. doi:10.1016/j.euros.2023.10.009
14. Aron M, Yadav R, Goel R, et al. Multi-tract percutaneous nephrolithotomy for large complete staghorn calculi. *Urol Int*. 2005;75(4):327–332. doi:10.1159/000089168
15. Rizvi SAH, Hussain M, Askari SH, Hashmi A, Lal M, Zafar MN. Surgical outcomes of percutaneous nephrolithotomy in 3402 patients and results of stone analysis in 1559 patients. *BJU Int*. 2017;120(5):702–709. doi:10.1111/bju.13848
16. Özer Ural Çakici. Open stone surgery: still-in-use approach for complex stone burden. *Central Eur J Urol*. 2017;70(2).
17. Watson G, Payne SR, Kunitsky K, Natchagande G, Mabedi C, Scotland KB. Stone disease in low- and middle-income countries: could augmented reality have a role in its management? *BJU Int*. 2022;130(4):400–407. doi:10.1111/bju.15877
18. Balaji S, Ganpule A, Herrmann T, Sabnis R, Desai M. Contemporary role of multi-tract percutaneous nephrolithotomy in the treatment of complex renal calculi. *Asian J Urol*. 2020;7(2):102–109. doi:10.1016/j.ajur.2019.12.012
19. Poudyal S. Current insights on haemorrhagic complications in percutaneous nephrolithotomy. *Asian J Urol*. 2022;9(1):81–93. doi:10.1016/j.ajur.2021.05.007
20. Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. *Eur Urol*. 2007;51(4):899–906. doi:10.1016/j.eururo.2006.10.020
21. Shamim M. Open renal approach: comparative analysis of sub-costal incision versus trans-costal incision with excision of 12th rib. *Pak J Med Sci*. 2009;25(04):557–562.
22. Srivastava A, Tripathi DM, Zaman W, Kumar A. Subcostal versus transcostal mini donor nephrectomy: is rib resection responsible for pain related donor morbidity. *J Urol*. 2003;170(3):738–740. doi:10.1097/01.ju.0000081649.53247.2d
23. Trivedi S, Sharma U, Rathore M, John MR. Comprehensive study of arrangement of renal hilar structures and branching pattern of segmental renal arteries: an anatomical study. *Cureus*. 2023. doi:10.7759/cureus.42165
24. Poutasse EF. Anterior approach to upper urinary tract surgery. *J Urol*. 1961;85(3):199–205. doi:10.1016/S0022-5347(17)65307-2
25. Masaki Z, Iguchi A, Kinoshita N, Kumazawa J, Yamaguchi A, Fujisawa Y. Intrasinusal pyelocalicotomy with lower pole nephrotomy for removal of renal stones. *Urology*. 1985;26(5):461–465. doi:10.1016/0090-4295(85)90154-2
26. Zingg EJ, Futterlieb A. Nephroscopy in stone surgery. *Br J Urol*. 1980;52(5):333–337. doi:10.1111/j.1464-410X.1980.tb03054.x
27. Scales CD, Saigal CS, Hanley JM, Dick AW, Setodji CM, Litwin MS. The impact of unplanned postprocedure visits in the management of patients with urinary stones. *Surgery*. 2014;155(5):769–775. doi:10.1016/j.surg.2013.12.013
28. Raheem OA, Khandwala YS, Sur RL, Ghani KR, Denstedt JD. Burden of urolithiasis: trends in prevalence, treatments, and costs. *Eur Urol Focus*. 2017;3(1):18–26. doi:10.1016/j.euf.2017.04.001

Research and Reports in Urology

Dovepress
Taylor & Francis Group

Publish your work in this journal

Research and Reports in Urology is an international, peer-reviewed, open access journal publishing original research, reports, editorials, reviews and commentaries on all aspects of adult and pediatric urology in the clinic and laboratory including the following topics: Pathology, pathophysiology of urological disease; Investigation and treatment of urological disease; Pharmacology of drugs used for the treatment of urological disease. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit http://www.dovepress.com/testimonials.php to read real quotes from published authors.

Submit your manuscript here: https://www.dovepress.com/research-and-reports-in-urology-journal