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The Stone Kidney Size (SKS) Score Breakthrough: A Simple Yet Powerful Tool to Predict Success and Safety Outcomes in Pediatric Mini Percutaneous Nephrolithotomy (PCNL)

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ABSTRACT

Mini percutaneous nephrolithotomy (PCNL) is now considered one of the important treatment modalities for large renal stones or stones that are refractory to other treatments. **Objective:** To evaluate the predictive accuracy of the Stone Kidney Size (SKS) score for the prediction of the success rate of mini PCNL in the pediatric population. **Methods:** A prospective cross-sectional validation study was conducted at Tabba Kidney Hospital for a period of 7 months (from June 2025 to December 2025). A total of 124 children aged 1–14 years with unilateral renal stones were included. SKS score was calculated preoperatively using Ultrasound KUB based on the number of stones and Stone Kidney Index (SKI). Statistical analysis included chi-square test, logistic regression, and ROC curve analysis. **Results:** The mean age of the participants was 6.05 ± 3.32 years, and 67.7% male predominance was observed. Overall, the stone clearance rate was 81.4%. A total of 19% patients experienced postoperative complications, with a higher proportion in patients with a SKS score of ≥ 6 (P=0.034). The SKS score was found to be an independent predictor of incomplete stone clearance (p<0.001) with good predictive accuracy on ROC analysis. **Conclusions:** The SKS score is a simple, non-invasive, and reproducible tool that could be evaluated preoperatively with the use of Ultrasound KUB. It has good predictive ability for stone clearance and postoperative complications.

INTRODUCTION

Urolithiasis is one of the important clinical pathologies in the pediatric population, and the incidence of renal stones in the pediatric population has been rising with an estimated annual increase of 4–16% [1, 2]. Pakistan reports one of the highest pediatric urolithiasis prevalence rates, reaching 11.7% [3]. Mini percutaneous nephrolithotomy (mini PCNL) is an established treatment for renal stones that are larger than 2 cm or smaller stones that are resistant to extracorporeal shock wave lithotripsy (ESWL) or ureteroscopic treatment [4]. In children, mini PCNL has a high stone clearance rate and acceptable complication rates, with studies showing an overall stone-free rate of 97%, ranging 91% to 100%, and a complication rate of 19% [5, 6]. In the era of minimally invasive surgery, to reduce complication rates in patients, instruments of smaller size have now been introduced [7, 8]. Studies show that mini PCNL reduces hospital stay, operative time, and postoperative complications [9]. Different scores like

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Guy's, Seoul National University Renal Stone Complexity (S-ReSC), and S.T.O.N.E nephrolithometry score are there for preoperative prediction of complete stone clearance and post-operative complications rates [10, 11]. These scores are difficult to apply in children undergoing PCNL, as they require multiple preoperative and postoperative parameters. The Stone Kidney Size (SKS) score was found to be the simplest score that was developed for preoperative prediction of stone clearance rate for mini PCNL in the pediatric population, along with the prediction of perioperative complication rates using less invasive investigation [12]. So, a preoperatively calculated SKS score will be helpful for surgeons for counselling of parents/ guardians regarding the chances of complete stone clearance and perioperative complications [13].

However, its predictive accuracy has not been validated for the Pakistani pediatric population. This study was conducted to evaluate the predictive accuracy of the SKS score for success and complication rates in pediatric PCNL by using preoperative and postoperative ultrasound, KUB, and lab parameters. By using this scoring system, we sought to assess whether or not the SKS score can reliably predict postoperative stone clearance and complications in our pediatric population, so that it can be used as a counselling tool. The objective of this study was to evaluate the predictive accuracy of the SKS score for determining stone clearance and postoperative complications in pediatric patients undergoing mini PCNL. Additionally, this study aimed to assess the utility of the SKS score as a simple preoperative counselling tool in the local pediatric population.

METHODS

This prospective cross-sectional validation study was conducted in the Urology Department of Tabba Kidney Institute (TKI) for a period of 7 months from 1st June 2025 to 31st December 2025. The ethical approval was obtained from Tabba Kidney Institute, Hospital Ethical Committee (TKI-HEC) with ERC NO. TKI- HEC042 approved on 25th May 2025. Sample size was calculated by OpenEpi software, taking the prevalence of stone-free rate 80.6%, sensitivity 62.1%, specificity 78%, precision of 10%, and a confidence interval of 95%. The calculated sample size was 113 [14]. A total of 124 patients were assessed for the outcomes, including both male and female children from ages 1 to 14 years. Children with unilateral single, multiple, or staghorn stones were included in the study, and those with chronic kidney disease, previous same-site open surgical intervention history, or anatomical anomalies were excluded. After approval of the study by the hospital ethical committee, data were collected by using the hospital medical record number. Informed consent in the language of understanding was presented to parents/guardians before enrollment. Patients meeting the inclusion criteria underwent mini PCNL following EAU guidelines. After consent and enrollment, patients were assessed with Ultrasound KUB and baseline laboratory parameters (CBC, UCE, urine analysis, urine culture, and coagulation profile). Preoperative Ultrasound KUB was used to observe the number of stones and to calculate SKI, which is a ratio of the length of the stone in the longest diameter and the length of the kidney along its longest diameter. In case of multiple stones, the sum of the length of each stone was taken as the longest diameter. These measurements were taken from formal radiologist reports. The SKS score and SKI were calculated using simple formulas based on preoperative ultrasound measurements. The SKI was determined by dividing the length of the stone along its longest axis by the length of the kidney along its longest axis, as measured on Ultrasound KUB. The SKS score was then calculated by adding points assigned for the number of stones and the SKI: a single stone was given 1 point, while more than one stone was given 2 points; similarly, an SKI of less than 0.3 was assigned 1 point, and an SKI greater than 0.3 was assigned 2 points. The sum of these points yielded the SKS score, which could range from 2 to 4 in this study. The SKS score was calculated as the sum of points for the number of stones. 1 point was given for a single renal stone, and 2 points were given for more than one stone. Similarly, 1 point was given to SKI < 0.3, and 2 points were given to SKI > 0.3. By the sum of these points, we obtained three possible SKS scores (2, 3, 4). According to these SKS scores, three groups were made, which were labelled as Group A, B, and C. Group A patients had SKS scores of 2, Group B patients had SKS scores of 3, and Group C patients had SKS scores of 4. Patients of the above-mentioned groups were then compared for perioperative complications and for stone clearance. All PCNLs were performed as mini PCNL technique under GA in the prone position with fluoroscopic guidance. The Amplatz sheath size and nephroscope were selected as per patient age, body habitus, and stone burden. During PCNL, operative time, on-table blood loss, need for intraoperative transfusion, and need for antegrade double J stent (DJS) were documented and compared between the three groups. After mini PCNL, labs were repeated on the 1st postoperative day to document postoperative hemoglobin drop, any increase in total leukocyte count (TLC) to rule out sepsis, and any derangement of renal function tests. Grades of postoperative hematuria, non-hemorrhagic complications (fever, vomiting, and pain), and duration of hospital stay were also compared. 1st Follow-up Ultrasound KUB was done in the 4th postoperative week, and complete stone clearance was documented as no residual stone fragments. After documentation of all preoperative, perioperative, and postoperative data, the three groups (A,

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B, C) were compared for stone clearance, either partial or complete, and complications like hemoglobin drop, hematuria, and need for blood transfusion, fever, sepsis, and postoperative pain. Other parameters, like need for DJS and inpatient hospital stay, were also assessed. For data analysis, Statistical Package for the Social Sciences (SPSS) version 23.0 was used to enter, sort, and analyze the data. Continuous variables were analyzed as mean and standard deviation, while categorical variables were analyzed as frequencies and percentages. Continuous variables were age, operative time, and stone site, and stone size, number of stones, postoperative pain, in-hospital stay, and hemoglobin drop. Categorical variables were fever, hematuria, flank pain, vomiting, sepsis, need for transfusion, and DJ placement. The primary outcome variable was stone clearance (categorized as complete or partial clearance) at the 4th postoperative week follow-up Ultrasound KUB, and it was compared with the prediction based on the preoperatively calculated SKS score. Secondary outcomes were represented as residual stones, hemoglobin drop, need for postoperative transfusion, and DJ stent placement. The chi-square test and Fisher's exact test were used to see associations between categorical variables, and a p-value of <0.05 was considered significant. To identify independent predictors for stone clearance and postoperative outcomes, the predictive accuracy of the SKS score was evaluated via the receiver operating characteristic (ROC) curve analysis. The predictive validity of the SKS score was determined by taking into consideration various statistical methods. Receiver operating characteristic (ROC) curve analysis was used to assess discriminatory ability, and the area under the curve (AUC) was computed to evaluate the sensitivity of SKS score in predicting stone clearance, residual stones, and postoperative complications. The model was calibrated using the comparison of the predicted results with the observed results between SKS categories. Further, binary logistic regression analysis was conducted to assess the independent predictive value of SKS score, which was presented as odds ratios (OR) with 95% confidence intervals. Comparison of continuous variables between SKS groups was done through one-way analysis of variance (ANOVA). A p-value less than 0.05 was taken to be statistically significant.

RESULTS

There were 124 pediatric patients undergoing mini PCNL. Mean age was 6.05 ± 3.32 years. The majority were males (67.7%). Patients had a mean stone size of 2.14 ± 0.88 cm, and 64.5% were found to have many stones. The renal pelvis was the site that had the majority of the stones (64.5%) (Table 1).

Table 1: Baseline and Perioperative Characteristics of Study Population (n = 124)

Variables	Values
Age (years)	6.05 ± 3.32
Age range (years)	1.3 – 14
Male	84 (67.7%)
Female	40 (32.3%)
Kidney length (cm)	7.64 ± 1.32
Stone size (cm)	2.14 ± 0.88
Number of stones (mean)	1.92 ± 0.83
Single stone	44 (35.5%)
Multiple stones	80 (64.5%)
Stone location (Renal pelvis)	80 (64.5%)
Renal pelvis + calyces	38 (30.6%)
Other locations	6 (4.9%)
Surgical approach (Subcostal)	124 (100%)
Amplatz sheath (12 Fr)	102 (82.3%)
Nephroscope (8 Fr)	104 (83.9%)
Lithotripsy (Pneumatic)	112 (90.3%)
Operative time (minutes)	121.3 ± 29.3

The overall stone clearance rate was 81.4%. A significant inverse relationship was observed between SKS score and stone clearance, with higher scores associated with lower clearance rates (Table 2).

Table 2: Postoperative Stone Clearance Rate According to Stone Kidney Size (SKS) Score

SKS Score	Groups	Total Patients (n)	Complete Stone Clearance, n (%)	Residual Stones, n (%)	p-value
2	A	42	42 (100%)	0 (0%)	0.002
3	B	48	37 (77.1%)	11 (22.9%)	
4	C	34	22 (64.7%)	12(35.3%)	
Total		124	101 (81.4%)	23(18.6%)	

Statistical test: Chi-square test
Interpretation: Stone clearance rate decreased significantly with increasing SKS score ($p \leq 0.05$)

Postoperative complications occurred in 21% of patients, most commonly fever (11.3%). Hematuria requiring transfusion was observed in 16% of patients. Complications increased significantly with higher SKS scores (Table 3).

Table 3: Postoperative Complications According to Stone Kidney Size (SKS) Score

Complications	Group A (SKS 2), n(%)	Group B (SKS 3), n(%)	Group C (SKS 4), n(%)	p-value
Hematuria requiring blood transfusion	2/42 (4.76%)	4/48 (8.33%)	10/34 (29.41%)	0.030
Postoperative fever	1/42 (2.38%)	7/48 (14.58%)	6/34 (17.65%)	0.021
Vomiting	0/42 (0%)	4/48 (8.33%)	1/34 (2.94%)	0.114
Flank pain	0/42 (0%)	3/48 (6.25%)	0/34 (0%)	0.152
Mild postoperative pain	1/42 (2.38%)	2/48 (4.17%)	1/34 (2.94%)	0.780

Statistical test: Fisher's Exact test
Interpretation: Postoperative complications increased

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significantly with a higher SKS score

On logistic regression, SKS score was an independent predictor of incomplete stone clearance (OR = 9.16, p < 0.001). ROC curve illustrating the predictive validity of the SKS score for postoperative stone clearance, which indicates good discriminative ability (Figure 1).

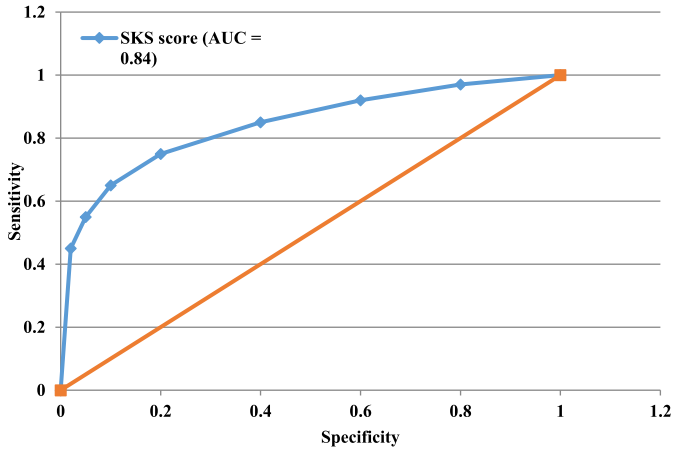

Figure 1: ROC Curve, SKS Predicting Postoperative Stone Clearance

ROC curve that demonstrates the predictive validity of SKS score in the prediction of postoperative complications, which is acceptable to good (Figure 2).

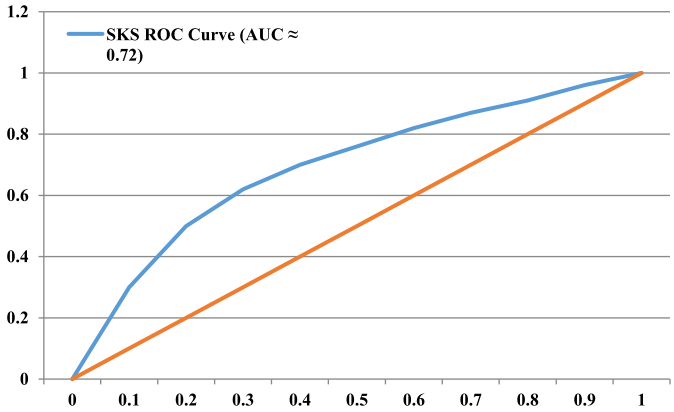

Figure 2: ROC Curve, SKS Predicting Postoperative Complications

In the multivariate logistic regression analysis, SKS score was a significant independent predictor of failed stone clearance, following age, stone size, and count of stones, and the duration of operation. One unit change (SKS) in the correct clearance score had an odds ratio of about nine (p=0.001). The other factors that were found to be significantly associated with incomplete clearance were the size of the stones and the number of stones, whereas age and operative time were found to have no statistically significant relationship. The positive correlation with SKS score showed a considerable increase in the operating time, hemoglobin decrease, and length of stay in the hospital, demonstrating that the SKS score of the patients in the higher groups had more complex procedures and morbidity (Table 4).

Table 4: Multivariable Logistic Regression Analysis and SKS-Based Perioperative Outcomes

Variables	Categories	Group A / Effect	Group B / Effect	Group C / Effect	AOR / Mean ± SD	95% CI	p-value
Logistic Regression (Predictors of Incomplete Stone Clearance)	SKS score	–	–	–	9.16	3.92 – 21.45	<0.001
	Stone size (cm)	–	–	–	1.78	1.08 – 2.94	0.024
	Number of stones	–	–	–	1.69	1.02 – 2.81	0.041
	Operative time (min)	–	–	–	1.01	0.99 – 1.02	0.176
	Age (years)	–	–	–	0.96	0.87 – 1.06	0.392
	Stone location (pelvis vs calyces)	–	–	–	1.34	0.65 – 2.78	0.423
Perioperative Outcomes across SKS Groups	Operative time (min)	105.2 ± 18.4	122.6 ± 25.3	139.8 ± 30.1	–	–	0.001
	Hemoglobin drop (g/dL)	0.9 ± 0.4	1.3 ± 0.6	1.9 ± 0.8	–	–	<0.001
	Hospital Stay (days)	2.8 ± 0.9	3.6 ± 1.2	4.5 ± 1.5	–	–	–

DISCUSSION

Renal stones in children have become a major problem in the world in the past two decades, with the transformations in eating habits, water consumption, and genetic factors being the reasons behind the rise in their prevalence in children [15]. Although CT KUB is still the most sensitive and specific imaging modality in the diagnosis of renal stones, it is not utilized much in children because of the radiation exposure. Ultrasound KUB is thus a first-line diagnostic modality of choice in the pediatric population because it is non-invasive, safe, and able to identify most clinically important stones without exposing children to unnecessary radiation [15]. Early and prompt diagnosis is essential in the prevention of complications that could involve obstruction, frequent infections, and renal impairment. Pediatric stone management is based on the size, location, and composition of the kidney stone and patient-specific factors (age and renal structure) [16]. Mini PCNL has proved to be safe and effective in the treatment of large and complex stones with high stone clearance and low complication rates [14, 17]. Mini PCNL in pediatrics should be performed carefully with a lot of planning and consideration to anatomical differences. Reduced calyceal

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size, inconsistent renal sizes, and fragile renal parenchyma make them more technically demanding and require a judicious choice of sheath size, nephroscope, and surgery methodology [18]. Surgeons should also be able to predict possible problems during surgery, such as bleeding, inaccessibility of stones, or the necessity of auxiliary procedures. Several variables, such as stone burden, count of stones, position of stones, and anatomy of the patients, have been found to influence stone clearance and postoperative safety outcomes in children undergoing mini PCNL [19]. Nevertheless, they tend to be complicated systems that need several imaging and intraoperative parameters, which restrict their practical implementation in the pediatric population [12]. The SKS score was formed as a simplified assessment tool designed to be used with children and is based on the preoperative measurements of Ultrasound KUB. The purpose of our research was to confirm the SKS score among Pakistani pediatric patients and determine its predictive capability regarding the stone clearance and post-operative complications. Multiple scoring systems have been created to help adults preoperatively predict stone clearance and perioperative complications to guide surgical planning and counseling purposes [19, 20]. The present study showed that patients with a higher SKS score will have more chances of residual stone, need for DJS, secondary procedure, and need for transfusion, similar to the results of the parent article [21]. Specifically, we have shown that the lower the SKS score, the lower the chance of clearance, and the more stone burden affected the surgical outcome, i.e., all patients with a SKS score of 2 showed complete clearance, while those with scores of 3 and 4 showed decreased chances of clearance, and more stone burden was observed in patients with 3 and 4 [22, 23]. These results can be compared to those of other researchers who find that the preoperative stone features observed have a significant impact on the success of the procedure. The SKS score has a number of advantages in practice. It can be easily calculated during the preoperative period, and only a non-invasive ultrasound assessment is needed to give valuable prognostic data to both the surgeon and family. The presence of higher SKS scores can warn the surgeon about possible complications, and he or she may take precautionary actions, including preparing blood products, negative or treated urine cultures, optimizing perioperative care, and intensive postoperative monitoring. The score can also be used as a counseling instrument among parents or guardians, and it offers realistic expectations towards stone clearance, possible complications, and the possibility of secondary interventions. Finally, the SKS score is one of the simplest, most reliable, and non-invasive instruments to predict stone clearance rates and perioperative complications of mini PCNL in children. Integrating it into standard preoperative evaluation, surgeons can enhance surgical preparation, patient safety, and counseling. Research in the future should focus on determining the validity of the SKS score in larger multicenter cohorts, determining the usability of the SKS score with newer imaging methods, and determining long-term outcomes such as stone recurrence and renal functioning.

Although this study has shown the predictive power of the SKS score in pediatric mini PCNL, it is associated with several limitations. This was carried out in one tertiary care center with a rather small sample size, which can make the application of the results to other populations questionable. The researchers used Ultrasound KUB as the only measurement technique during preoperative examination, which is not invasive but might not be as accurate as CT-based examinations. Moreover, no long-term follow-up was conducted after the fourth week after the operation was conducted; thus, no postoperative complications in the late period or stone recurrence could be evaluated. Future studies must be based on multicenter studies involving larger, more diverse pediatric cohorts, use more sophisticated imaging techniques to calculate the SKS score, and determine long-term outcomes in order to further confirm the usefulness of the SKS score in predicting both stone clearance and perioperative complications. While SKS offers practical prognostic value, it should be used alongside a comprehensive clinical assessment. Further studies in larger, multicenter settings are warranted to validate and refine its predictive accuracy in diverse pediatric populations.

CONCLUSIONS

The Stone Kidney Size (SKS) score is a simple, noninvasive, and reliable preoperative tool for predicting stone clearance and perioperative complications in children undergoing mini PCNL. It allows surgeons to provide clear, individualized counseling to parents and guardians regarding the likelihood of complete stone removal and potential risks.

Authors' Contribution

Conceptualization: YF
Methodology: YF, AM
Formal analysis: SSQ, AM, SAS, HAK
Writing and Drafting: JS, UR
Review and Editing: YF, SSQ, JS, UR, AM, SAS, HAK

All authors approved the final manuscript and take responsibility for the integrity of the work

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Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Zeng G, Zhu W, Somani B, Choong S, Straub M, Maroccolo MV *et al.* International Alliance of Urolithiasis (IAU) Guidelines on the Management of Pediatric Urolithiasis. Urolithiasis. 2024 Sep; 52(1): 124. doi: 10.1007/s00240-024-01621-z.

[2] Kovacevic L. Diagnosis and Management of Nephrolithiasis in Children. Pediatric Clinics. 2022 Dec; 69(6): 1149-1164. doi: 10.1016/j.pcl.2022.07.008.

[3] Al-Naggar K, Aljuma'ai N, Ahmed F, Alnadhari I, Al-Hagri A, Alhakamy M *et al.* Prevalence of Urolithiasis in Children from the EMRO Region: A Systematic Review and Meta-Analysis. Journal of Emergency Medicine, Trauma and Acute Care. 2025 Sep; 2025(3): 40. doi: 10.5339/jemtac.2025.40.

[4] Mahmood SN, Falah B, Ahmed C, Fakhralddin S, Tawfeeq H. Is Mini Percutaneous Nephrolithotomy a Game Changer for the Treatment of Renal Stones in Children? European Urology Open Science. 2022 Mar; 37: 45-9. doi: 10.1016/j.euros.2021.12.014.

[5] Gnech M, Van Uitert A, Kennedy U, Skott M, Zachou A, Burgu B *et al.* European Association of Urology/European Society for Paediatric Urology Guidelines on Paediatric Urology: Summary of the 2024 Updates. European Urology. 2024 Nov; 86(5): 447-456. doi: 10.1016/j.euros.2021.12.014.

[6] Jones P, Hawary A, Beck R, Somani BK. Role of Mini-Percutaneous Nephrolithotomy in the Management of Pediatric Stone Disease: A Systematic Review of Literature. Journal of Endourology. 2021 May; 35(5): 728-735. doi: 10.1089/end.2020.0743.

[7] Dede O, Sancaktutar AA, Dağguli M, Utangaç M, Baş O, Penbegul N. Ultra-Mini-Percutaneous Nephrolithotomy in Pediatric Nephrolithiasis: Both Low Pressure and High Efficiency. Journal of Pediatric Urology. 2015 Oct; 11(5): 253. doi: 10.1016/j.jpurol.2015.03.012.

[8] Jackman SV, Docimo SG, Cadeddu JA, Bishoff JT, Kavoussi LR, Jarrett TW. The "Mini-Perc" Technique: A Less Invasive Alternative to Percutaneous Nephrolithotomy. World Journal of Urology. 1998 Dec; 16(6): 371-374. doi: 10.1007/s003450050083.

[9] Fang H, Wang Z, Wei K, Liu X, Wu S, Hua Y, Lin T, He D, Wei G, Zhang D. Safety and Efficacy of Standard Vs. Tubeless Percutaneous Nephrolithotomy in Pediatric Populations: An Updated Systematic Review and Meta-Analysis. BioMed Central Urology. 2025 May; 25(1): 110. doi: 10.1186/s12894-025-01798-4.

[10] Chen YH, Li WM, Juan YS, Huang TY, Wang YC, Lee HY. A Comparison of STONE Nephrolithometry Scoring System, Guy's Stone Score, and Seoul National University Renal Stone Complexity (S-Resc) in Predicting Mini-PCNL Stone-Free Rate. Urolithiasis. 2024 Jan; 52(1): 19. doi: 10.1007/s00240-023-01499-3.

[11] He Q, Huang Q, Hou B, Hao Z. Prediction of Percutaneous Nephrolithotomy Outcomes and Flexible Ureteroscopy Outcomes Using Nephrolithometry Scoring Systems. International Urology and Nephrology. 2024 May; 56(5): 1585-1593. doi: 10.1007/s11255-023-03847-z.

[12] Aslan H, Senocak C, Haberal HB, Guvenir FG, Ibis MA, Sadioglu FE *et al.* Validation of Stone-Kidney Size Score to Predict Outcome and Complications of Pediatric Percutaneous Nephrolithotomy. Journal of Pediatric Urology. 2024 Dec; 20(6): 1026-1033. doi: 10.1016/j.jpurol.2024.07.030.

[13] Hughes SF, Moyes AJ, Jones K, Bell C, Duckett A, Moussa A, Shergill I. Pre-and Peri-Operative Clinical Information, Physiological Observations and Outcome Measures Following Flexible Ureterorenoscopy (FURS), for the Treatment of Kidney Stones. A Single-Centre Observational Clinical Pilot Study In 51 Patients. BioMed Central Urology. 2022 Jul; 22(1): 104. doi: 10.1186/s12894-022-01053-0.

[14] Altunkol A, Alma E, Anıl H, Özbilen MH, Aksay B, Deniz ME. Assessing the Predictive Value of Scoring Systems for Stone-Free Success Outcomes in Pediatric Mini Percutaneous Nephrolithotomy: A Comprehensive Retrospective Analysis. Urolithiasis. 2025 May; 53(1): 90. doi: 10.1007/s00240-025-01762-9.

[15] Raghavan VR, Porter JJ, Monuteaux MC, Neuman MI, Nelson KA. Imaging trends and surgical outcomes for nephrolithiasis in the pediatric emergency department. The American Journal of Emergency Medicine. 2025 Jun; 92: 104-108. doi: 10.1016/j.ajem.2025.03.014.

[16] Ost MC. Treatment of Pediatric Stone Disease Driven by Age and Stone Size. JAMA Network Open. 2025 Jun; 8(6): 2516759. doi: 10.1001/jamanetworkopen.2025.16759.

[17] Khan W, Khan TS, Khan RA, Khalid M, Ahmad A, Khan AI. Efficacy of Percutaneous Nephrolithotomy in Pediatric Renal Stone Clearance in Khyber Pakhtunkhwa: A Cross-Sectional Analytical Study: Percutaneous Nephrolithotomy in Pediatric Renal

DOI: https://doi.org/10.54393/pjhs.v7i7.4017

Stone Clearance. Pakistan Journal of Health Sciences. 2025 Jul: 209-214. doi: 10.54393/pjhs.v6i7.3344.

[18] Baltaci KE, Hazir B, Altan M, Bozaci AC, Gasimov K, Tekgul S *et al.* Assesment of Factors Affecting Outcome of Mini-PCNL by Single-Shot Dilatation in Pediatric Patients. Pediatric Surgery International. 2025 Sep; 41(1): 299. doi: 10.1007/s00383-025-06198-1.

[19] Mazzon G, Claps F, Pavan N, Choong S, Zeng G, Wu W *et al.* Reliability of Nephrolithometric Nomograms in Patients Treated with Minimally Invasive Percutaneous Nephrolithotomy: A Precision Study. Asian Journal of Urology. 2023 Jan; 10(1): 70-80. doi: 10.1016/j.ajur.2022.02.010.

[20] Tahir R, Bakar A, Khan UU, Imran M, Ullah H. Safety and Efficacy of Mini-Percutaneous Nephrolithotomy (mini PCNL) in Pediatric Patients with Staghorn Stone: A Single Center Study in Pakistan. 2024 May: 1-12. doi: 10.21203/rs.3.rs-4414321/v1.

[21] Çitamak B, Dogan HS, Ceylan T, Hazir B, Bilen CY, Sahin A, Tekgül S. A New Simple Scoring System for Prediction of Success and Complication Rates in Pediatric Percutaneous Nephrolithotomy: Stone-Kidney Size Score. Journal of Pediatric Urology. 2019 Feb; 15(1): 67. doi: 10.1016/j.jpurol.2018.09.019.

[22] Mushtaq A, Wani S, Shaheen FA, Hamid A, Khawaja AR, Malik SA, Para SA, Mehdi S, Shaheen F, Khawaja A, Para SA. Evaluation of the GUYS, STONE, and S-ReSC Scores in Predicting the Outcomes of Mini-Percutaneous Nephrolithotomy: A Prospective Study. Cureus. 2025 Apr; 17(4): 1-11. doi: 10.7759/cureus.82723.

[23] Polat S, Yarimoglu S, Koras O, Sahan M, Sefik E, Bozkurt IH, Degirmenci T. Comparison of Guy's, STONE, and CROES Scoring Systems for Predicting Percutaneous Nephrolithotomy Outcomes in Elderly Patients. Journal of the College of Physicians and Surgeons Pakistan. 2021 Mar; 31(3): 307-313. doi: 10.29271/jcpsp.2021.03.307.