

TABLE 2

Validation Studies for Current Nephrolithometric Scoring Systems

Study	Country	N	Preoperative Imaging	Postoperative Imaging	Definition of Stone Free	Clearance by Stone Complexity	Complications by Stone Complexity	Statistical Method
Guy's Stone Score								
Thomas K et al ⁷	United Kingdom	100	CT, radiograph, IVU	KUB radiograph	< 4-mm fragments	Overall, 62% Grade 1, 81% Grade 2, 72.4% Grade 3, 35% Grade 4, 29%	Not reported; no significant correlation only	Multivariate linear regression analysis
Mandal S et al ¹¹	India	278	Radiograph, IVU, USS, noncontrast CT	KUB radiograph	Complete absence of stones	Overall, 76.1% Grade 1, 100% Grade 2, 74% Grade 3, 56% Grade 4, 0%	Overall, 41.7% Grade 1, 4.8% Grade 2, 9.1% Grade 3, 26.2% Grade 4, 44.4%	Univariate analysis
Vicentini FC et al ¹³	Brazil	147	Noncontrast CT		Asymptomatic fragments < 4 mm	Overall, 71.6% Grade 1, 95.2% Grade 2, 79.5% Grade 3, 59.5% Grade 4, 40.7%	Overall, 18.7% Grade 1, 4.8% Grade 2, 9.1% Grade 3, 26.2% Grade 4, 44.4%	Univariate analysis
Ingimarsson JP et al ¹⁴	Lebanon	66	Noncontrast CT		No fragments/no fragments > 2 mm/ no fragments > 4 mm	Overall, 90% Grade 1, 95% Grade 2, 97% Grade 3, 95% Grade 4, 75%	Not reported; no significant correlation only	Univariate analysis
Labadie K et al ¹²	United States	246	CT scan	Unclear	Not defined	Overall, 56% Grade 1, 70.2% Grade 2, 65.4% Grade 3, 48.1% Grade 4, 35.9%	Overall, 17%	Logistic regression
Noureldin YA et al ²⁷	Canada	185	Unclear	Plain radio-graphs or non-contrast CT	Asymptomatic residual fragments < 4 mm	Overall, 71.9% Grade 1, 91.5% Grade 2, 80% Grade 3, 47.6% Grade 4, 43.2%	Overall, 16.2% Grade 1, 17% Grade 2, 15% Grade 3, 9.5% Grade 4, 21.6%	Logistic regression analysis

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Validation Studies for Current Nephrolithometric Scoring Systems (continued)									
Study	Country	N	Preoperative Imaging	Postoperative Imaging	Definition of Stone Free	Clearance by Stone Complexity	Complications by Stone Complexity	Statistical Method	
Bozkurt IH et al ²⁰	Turkey	437	CT scan	KUB radiograph (unless CT; which is reserved for only symptomatic patients)	Asymptomatic residual fragments < 4 mm	Overall, 75% Grade 1, 92.8% Grade 2, 72.4% Grade 3, 68.5% Grade 4, 47.4%	Overall, 35% Grade 1, 13.0% Grade 2, 2.5% Grade 3, 8.7% Grade 4, 10.3%	Linear and logistic regression analyses	
Nephrolithometric Nomogram (CROES)									
Smith A et al ⁸	International (CROES PCNL Group)	2806	Unclear	KUB radiograph	No fragments > 4 mm	Overall, 82% Odds ratios and nomogram reported ROCAUC = 0.76	Not reported	Multivariate logistic regression	
Labadie K et al ¹²	United States	246	CT scan	Unclear	Not defined	Overall, 56% 80-129 = 22.7% 130-169 = 46.4% 170-219 = 45.5% ≥ 220 = 72.7%	Overall, 17%	Logistic regression	
Bozkurt IH et al ²⁰	Turkey	437	CT scan	KUB radiograph (unless CT; which is reserved for only symptomatic patients)	Asymptomatic residual fragments < 4 mm	Overall, 75% Grade 1, 48.5% Grade 2, 51.4% Grade 3, 69.1% Grade 4, 92.8%	Overall, 35% Grade 1, 4.8% Grade 2, 8.0% Grade 3, 7.5% Grade 4, 14.2%	Linear and logistic regression analyses	
S.T.O.N.E. Nephrolithometry									
Okhunov Z et al ⁹	United States	117	Noncontrast CT	Fluoroscopy ± CT	Complete absence of stones on CT	Overall, 80% Low (4-5), 94%-100%; medium (6-8), 83%-92%; high (9-11), 27%-64%; ROCAUC = 0.83	Not reported	Multivariate logistic regression	

Author	Country	n	Imaging	Fluoroscopy ± CT	N/A ^a	N/A ^a	N/A ^a	Cohen's kappa coefficient ^b
Okhunov Z et al ²⁴	United States	58	Noncontrast CT	Fluoroscopy ± CT	N/A ^a	N/A ^a	N/A ^a	N/A ^a
Okhunov Z et al ²⁶	United States	706	CT scan	Unclear	Not defined	Overall 67% S.T.O.N.E. score significantly associated with postoperative SFS	S.T.O.N.E. score significantly associated with overall complication rate	Univariate analysis
Labadie K et al ¹²	United States	246	CT scan	Unclear	Not defined	Overall, 56% 5-6 = 70.6% 7-8 = 66.3% 9-13 = 46.2% ROC AUC = 0.67	Overall, 17%	Logistic regression
Akhavain A et al ²⁵	United States	122	CT scan	Residual fragments < 4 mm	Residual fragments < 4 mm	Score vs clearance %: 5-7 = 100% 8 = 80% 9 = 94.1% 10 = 79.2% 11 = 66.7% 12 = 45%	Score vs complication %: 5 = 0% 6 = 1.6% 7-8 = 0% 9 = 0.8% 10 = 6.6% 11-12 = 0%	Univariate analysis and logistic regression
Noureidin YA et al ²⁷	Canada	185	Unclear	Plain radiographs or noncontrast CT	Asymptomatic residual fragments < 4 mm	Overall, 71.9% 5 = 100% 6 = 75% 7 = 77.3% 8 = 67.6% 9 = 79.3% 10 = 58.3% 11 = 42.9% 12-13 = 0%	Overall, 16.2% 5 = 20% 6 = 18.2% 7 = 11.4% 8 = 20.6% 9 = 20.7% 10 = 8.3% 11 = 0% 12 = 25% 13 = 0%	Logistic regression analysis

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Validation Studies for Current Nephrolithometric Scoring Systems (<i>continued</i>)							
Study	Country	N	Preoperative Imaging	Postoperative Imaging	Definition of Stone Free	Clearance by Stone Complexity	Statistical Method
Noureldin YA et al ²⁸	Canada	155	Noncontrast CT	KUB and/or non-contrast CT	Residual stones \geq 4 mm considered as non-stone-free	Overall, 71.6% Significant inverse association between S.T.O.N.E. score and clearance AUC = 0.63	Multivariate logistic regression
Seoul Renal Stone Complexity Score							
Jeong CW et al ¹⁰	South Korea	155	Noncontrast CT		No evidence of residual stones on postop images after 1 mo	Overall, 72.3% Low (1-2), 96%; medium (3-4), 69%; high (5-9), 28%	Univariate analysis; ROCs
Choo MS et al ³¹	South Korea	327	Noncontrast CT		Complete clearance/clearance with clinically insignificant residual fragments (4 mm) at 1 mo follow-up imaging	Overall, 65.4% Low (1-2), 83.9%; medium (3-4), 47.6%; high (5-9), 21.4%	Univariate and multivariate regression analyses; ROCs
Park J et al ³²	South Korea	159	Unclear		No evidence of a stone or with clinically insignificant residual fragment stones < 2 mm	Overall, 73.0% Low (1-2), 86.7%; medium (3-4), 70.2%; high (5-12), 48.6%	Uni- and multivariate linear regression

²⁸Study focuses on interobserver reliability. AUC, area under the curve; CT, computed tomography; IVU, intravenous urogram; KUB, kidneys, ureters, and bladder; ROC, receiver operating characteristic; SF5, stone-free status; S.T.O.N.E., stone size, tract length, obstruction, number of involved calices, and essence/stone density; USS, abdominal and pelvic ultrasound.