

Mini vs Standard: The Cost of Percutaneous Nephrolithotomy



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Percutaneous nephrolithotomy (PCNL) has traditionally been the standard of care for staghorn calculi and larger kidney stones greater than 20 mm. The standard PCNL (sPCNL) procedure typically involves a 30Fr dilation through a patient's flank into the renal collecting system. However, improvements in technology have produced smaller and more powerful instruments that have effectively allowed for smaller PCNL dilation tracts while achieving similar stone removal rates.

The sPCNL dilation for stone removal while effective presented issues with prolong hospitalizations, a small but not insignificant need for blood transfusion and protracted pain particularly when nephrostomy tubes remained. Minipercutaneous nephrolithotomy (mPCNL) is now a consideration for smaller lower pole stones due to its high stone clearance rates compared to retrograde intrarenal surgery or extracorporeal shock-wave lithotripsy,¹ but the capability of this procedure for larger stone sizes and types is now being widened and tested.

With the development of smaller lithotripters and advancements in long pulsed and stabilization modes for holmium laser lithotripsy, our team has used mPCNL for a range of kidney stones where a standard dilation may be

increasingly traumatic including lower pole renal stones between 10 and 20 mm, diverticular stones and patients whose postoperative pain may present an issue. The modern mPCNL system uses a single step metal dilator and sheath and was designed for the removal of lower pole stones 0.8 to 1.5 cm.² Although different sizes exist for mPCNL dilations, the most popular within the United States is the 16.5/17.5Fr inner/outer diameter reusable single metal dilator and sheath. While a smaller dilation tract has advantages in reducing blood loss, reducing renal trauma and potentially improving post-operative pain, a seldom examined aspect is the financial cost. Additionally, mPCNL may be the first step for urologists who wish to transition from a placement of a postoperative nephrostomy tube to a tubeless procedure with just an indwelling ureteral stent.

Although procedures should be chosen based on best modality to clear stones, it is inevitable that cost may play a role into the type of procedure chosen. Single step balloon dilators and serial dilation with Amplatz renal dilators have been shown to increase cost when compared to reusable metal dilators.^{3,4} In our study we examined all PCNL procedures performed at our standalone ambulatory surgery center (ASC) in a 6-month period from April to September 2019. All procedures regardless of dilation size were performed in a tubeless fashion with urinary drainage via a single indwelling ureteral stent. Our mPCNL dilation size was 16.5/17.5Fr while our sPCNL dilation size ranged from 24/28 to 30/34Fr. All dual tract procedures and patients needing transfer to hospital were excluded. Patient and

stone characteristics such as age, sex, body mass index (BMI), skin-to-stone distance, Hounsfield Units (HU) and operative characteristics such as operating room (OR) time, fluoroscopy time, intracorporeal time, and total treatment time were compared between groups. Cost in U.S. dollars was assessed and compared between the mini and standard tract groups.

Overall, 33 patients with a mPCNL procedure and 61 patients with a sPCNL procedure qualified for analysis. There were no differences in sex, BMI, skin-to-stone distance or stone HU between groups. Patients having mPCNL tended to be younger (50.4 vs. 59.1, $p=0.0045$) and as expected have lower overall stone burden (17.73 mm vs. 33.38 mm) compared to sPCNL procedures. Despite the stone size difference between groups there were no significant differences in any of the operative room characteristics between groups (see table).

When direct disposables cost was compared between groups we noted a statistically and clinically significant savings in patients receiving a mPCNL procedure. This analysis was subdivided into 2 groups, stones less than 20 mm and stones greater than 20 mm (CPT codes 50080 and 50081) and compared between mPCNL and sPCNL procedures. Our analysis shows that there is a substantial decrease in disposable costs in patients receiving mPCNL compared to sPCNL whether the stones treated were less than 20 mm (\$1382 vs \$1805, $p=0.0087$) or greater than 20 mm (\$1293 vs \$1774, $p<0.0001$, see figure). The average savings in disposable costs amounts to about \$400 to \$450 per case.

Although a holmium laser fiber is used for our patients receiving

mPCNL and an ultrasonic lithotripter in sPCNLs, these costs are surprisingly similar and balance the disposable cost difference between these modalities. The main difference between disposable costs between mPCNL and sPCNL comes down to the balloon dilator used in sPCNL, which averages between \$400 and \$500 per case. Surprisingly, there was no difference when comparing disposable costs within a single modality amongst stone size. Namely, a mPCNL for a 40 mm partial stag-horn is likely to cost as much as a mPCNL for a 10 mm lower pole stone. Our findings suggest that in economic models such as within a surgery center where disposable costs are tallied and subtracted from a prenegotiated surgery facility cost, mPCNL is a viable and effective procedure for stones between 10 and 40 mm while having the advantage of lowering disposable costs.

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1. Assimos D, Krambeck A, Miller NL et al: Surgical Management of Stones: American Urological Association/Endourological Society Guideline, PART I. J Urol 2016; **196**: 1153.
2. Nagele O, Schilling D, Sievert KD et al: Management of lower-pole stones of 0.8 to 1.5 cm maximal diameter by the minimally invasive percutaneous approach. J Endourol 2008; **22**: 1851.
3. Li Y, Yang L, Xu P et al: One-shot versus gradual dilation technique for tract creation in percutaneous nephrolithotomy: a systematic review and meta-analysis. Urolithiasis 2013; **41**: 443.
4. Arslan B, Akbulat M, Onuk O et al: A comparison of Amplatz dilators and metal dilators for tract dilatation in mini-percutaneous nephrolithotomy. Int Urol Nephrol 2017; **49**: 581.

[runninghead]Percutaneous Nephrolithotomy Cost

Table. Demographics, stone characteristics and OR times between mPCNL and sPCNL.

	mPCNL n=33	sPCNL	p Value
Total No.	33	61	
Age±SD (IQR)	50.42±14.88 (23–71)	59.1±12.72 (27–81)	0.0045
Sex (M:F)	13:20	25:34	0.0780
BMI±SD	28.27±5.17 (17–36)	29.81±6.98 (20–48)	0.2750
cm Skin-to-stone±SD (IQR)	10.23±2.76 (4–16)	10.53±2.64 (5.5–19)	0.9166
mm Stone burden±SD (IQR)	17.73±7.52 (8–40)	33.38±22.22 (8–130)	0.0002
Hounsfield Units±SD (IQR)	959±312 (450–1,500)	878±327 (300–1,500)	0.2511
OR time in mins (IQR)	85.36±15.71 (55–126)	90.38±20.52 (53–134)	0.2290
Fluoroscopy time in secs (IQR)	86.18±30.09 (50–166)	83.80±39.28 (36–209)	0.7650
Intracorporeal time in mins (IQR)	37±9.57 (12–60)	41.22±18.96 (12–103)	0.2390
Treatment time in mins (IQR)	12.22±9.20 (3–68)	14.86±15.90 (1–68)	0.3918

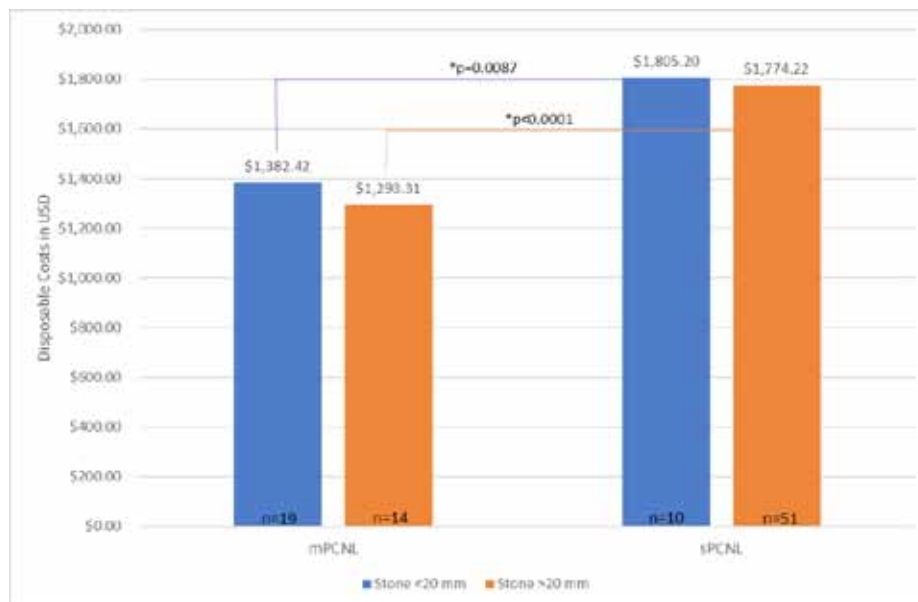


Figure. Disposable cost difference between mPCNL and sPCNL.