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Comparison of Work Productivity Loss Following Retrograde Intrarenal Surgery and Mini-Percutaneous Nephrolithotomy Using the WPAI Questionnaire

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ABSTRACT

Objective: This study aimed to compare the effects of retrograde intrarenal surgery (RIRS) and mini percutaneous nephrolithotomy (mPCNL) on work productivity in patients with 1–2 cm kidney stones, using the Turkish-validated Work Productivity and Activity Impairment (WPAI) questionnaire. A secondary aim was to evaluate, through subgroup analysis, how the presence of a perioperative DJ stent modifies this effect.

Materials and Methods: A total of 70 patients undergoing RIRS (n=35) or mPCNL (n=35) were prospectively included. The WPAI questionnaire was administered preoperatively, at discharge, and at postoperative weeks 1 and 2. The mPCNL group was further stratified by perioperative DJ stent status into stented (mPCNL-S, n=13) and non-stented (mPCNL-NS, n=22) subgroups, allowing a three-way comparison with RIRS. Between-group comparisons were performed using the Mann-Whitney U and Kruskal-Wallis tests.

Results: Compared with RIRS, mPCNL was associated with significantly longer operative time (110 vs 60 min), longer hospital stay (2 vs 1 day), and greater hemoglobin loss (−1.00 vs 0.00 g/dL) (all $p<0.001$). At discharge and postoperative week 1, WPAI Overall Loss scores were significantly higher in the mPCNL group than in the RIRS group ($p<0.001$). On DJ stent stratification, no difference was observed between stented and non-stented mPCNL subgroups at postoperative week 1 ($p=1.000$); however, at postoperative week 2, the stented mPCNL subgroup showed significantly higher Overall Loss (47.87) than both RIRS (32.00; $p=0.011$) and the non-stented mPCNL subgroup (28.00; $p<0.001$), while the non-stented mPCNL subgroup, although still significantly different from RIRS ($p=0.027$), showed a markedly smaller effect size. Stone-free status was achieved in all patients with both techniques, and no Clavien-Dindo grade ≥III complications occurred.

Conclusion: mPCNL results in more pronounced early postoperative work productivity loss compared with RIRS, and the persistence of this difference into the later postoperative period is largely attributable to DJ stent presence rather than the surgical technique itself. In appropriately selected patients, a stent-free mPCNL approach may represent a practical strategy for shortening return-to-work time.

Keywords: Kidney stone, Mini percutaneous nephrolithotomy, Retrograde intrarenal surgery, Work productivity loss, DJ stent, WPAI

INTRODUCTION

Urinary stone disease represents a substantial clinical and economic burden for both patients and healthcare systems, with its prevalence increasing worldwide (1,2). Beyond the direct costs of treatment, this burden also includes indirect consequences related to impaired work productivity and daily activities (3).

The European Association of Urology (EAU) and American Urological Association (AUA) guidelines recommend both retrograde intrarenal surgery (RIRS) and mini-percutaneous nephrolithotomy (mPCNL) as treatment options for renal stones measuring 10–20 mm (4,5). Previous studies have primarily compared these procedures in terms of stone-free rates, complication profiles, operative time, and length of hospital stay. mPCNL has generally been associated with higher single-session stone-free rates, although its more invasive nature may result in greater hemoglobin loss and longer hospitalization (6–8).

However, beyond conventional clinical outcomes, the impact of surgical modality on patients' working life remains largely underexplored in the stone surgery literature. The Work Productivity and Activity Impairment (WPAI) questionnaire is a validated instrument for assessing productivity loss across several medical fields, including orthopedics, dermatology, and gastroenterology (9–11); however, it has not yet been applied to urolithiasis surgery.

The primary aim of this study was to prospectively compare work productivity loss after RIRS and mPCNL for 1–2 cm renal stones using the Turkish-validated WPAI questionnaire. Secondary aims were to assess the effects of DJ stent placement and surgical position through subgroup analyses and to compare stone-free rates, complications, and hematological and biochemical parameters between the two procedures.

METHODS

Study Design and Ethical Approval

This prospective, cross-sectional study was approved by the Ethics Committee of Basaksehir Cam and Sakura City Hospital, Ministry of Health, Republic of Türkiye (Decision No. 111, August 28, 2024), and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants. The study was conducted at the Department of Urology, Basaksehir Cam and Sakura City Hospital, between September 2024 and March 2025. This article presents a thesis study by Dr. Cemal Topal. The thesis adviser was Prof. Dr. Halil Lutfi Canat from the urology department.

Patient Population

Patients aged >18 years who were actively employed, had one or more renal stones measuring 1–2 cm, and underwent RIRS or mPCNL were included. Exclusion criteria were age <18 years, unemployment, pregnancy, active urinary tract infection, history of urinary diversion or previous stone surgery, urinary tract malignancy, and bleeding diathesis. A total of 70 patients were included and categorized according to surgical modality as RIRS (n=35) or mPCNL (n=35). The mPCNL group was further stratified according to intraoperative DJ stent placement into stented (mPCNL-S) and non-stented (mPCNL-NS) subgroups.

Surgical Techniques

Sterile preoperative urine culture was confirmed in all patients, and a single intravenous dose of a third-generation cephalosporin was administered for antibiotic prophylaxis.

For RIRS, renal stones were acessed using a flexible ureteroscope through a 12–14 Fr ureteral access sheath. Lithotripsy was performed with either a holmium or thulium fiber laser, according to surgeon preference, typically using settings of 1 J and 10 Hz. Intrarenal operative time did not exceed 90 minutes.

For mPCNL, percutaneous access was established under ultrasound and/or fluoroscopic guidance with the patient in either the supine position using the modified Valdivia-Galdakao technique or the prone position, according to surgeon preferance. A12 Fr nephroscope was used, and stones were fragmented using holmium laser, thulium fiber laser, pneumatic lithotripsy, or ultrasonic lithotripsy. DJ stent placement was left to the discretion of the operating surgeon.

Outcome Measures

Demographic characteristics, including age, sex, and body mass index (BMI), were recorded. Stone-related variables included stone size, Hounsfield unit (HU), and location (ureteropelvic junction, renal pelvis, or upper, middle, or lower calyx). Operative parameters included operative time, surgical position, and DJ stent placement. Length of hospital stay, perioperative changes in hemoglobin and serum creatinine (Δ), and postoperative visual analog scale (VAS) pain scores were also recorded. Complications were classified according to the Clavien-Dindo system.

Work productivity loss was assessed using the validated Turkish version of the Work Productivity and Activity Impairment (WPAI) questionnaire preoperatively, on the day of discharge, and at postoperative weeks 1 and 2. Four domains were calculated: absenteeism [S2/(S2+S4)], presenteeism [S5/10], overall work impairment [S2/(S2+S4) + (1−S2/(S2+S4)) × (S5/10)], and activity impairment [S6/10]. The sum of overall work impairment values across the four assessment time points was additionally defined as Total Overall Loss. In patients with DJ stents, the stent was removed in the outpatient setting at the end of postoperative week 2.

Statistical Analysis

Statistical analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Normality of continuous variables was assessed using the Shapiro-Wilk test. Normally distributed variables are presented as mean ± standard deviation, whereas non-normally distributed variables are presented as median [interquartile range]. Between-group comparisons were performed using Student’s t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables.

For comparisons among the three groups (RIRS, mPCNL-S, and mPCNL-NS), the Kruskal-Wallis test or analysis of variance, as appropriate, was used, followed by pairwise post-hoc comparisons when a significant overall difference was detected. Categorical

variables were compared using the chi-square test or Fisher's exact test, as appropriate. A two-sided p value <0.05 was considered statistically significant.

RESULTS

Demographic and Operative Characteristics

A total of 70 patients were included, with 35 patients each in the RIRS and mPCNL groups. Sex distribution was similar between the groups (RIRS: 22 men [62.9%] and 13 women [37.1%]; mPCNL: 21 men [60.0%] and 14 women [40.0%]; p=1.000). No significant differences were observed in age (46.00±10.75 vs 44.66±9.31 years; p=0.578) or BMI (median 27.00 [IQR 26.00–28.00] in both groups; p=0.778).

As expected, stones in the mPCNL group were significantly larger (20.00 [18.50–20.00] vs 12.00 [11.00–16.00] mm; p<0.001) and had higher density (1200 [1000–1300] vs 1000 [900–1100] HU; p=0.024) than those in the RIRS group. Stone location did not differ significantly between groups (p=0.163), although renal pelvic stones were more frequent in the mPCNL group (60.0% vs 37.1%).

Compared with RIRS, mPCNL was associated with longer operative time (110.00 [100.00–120.00] vs 60.00 [47.50–75.00] min; p<0.001), longer hospital stay (median 2 vs 1 day; p<0.001), greater hemoglobin decline (ΔHb: −1.00 [−2.00 to −1.00] vs 0.00 [−1.00 to 0.00] g/dL; p<0.001), and higher postoperative VAS pain scores (5.00 [4.00–6.00] vs 3.00 [3.00–4.00]; p<0.001). No significant differences were observed in serum creatinine change (p=0.135) or QoL score (p=0.109). Intraoperative DJ stent placement was significantly more frequent in the RIRS group (97.1% vs 37.1%; p<0.001). In the mPCNL group, 51.4% of procedures were performed in the supine position and 48.6% in the prone position (Table 1).

Table 1. Demographic and Operative Characteristics

Variables	RIRS (n=35)	mPCNL (n=35)	p
Gender, n (%) — Male/Female	22 (%62,9) / 13 (%37,1)	21 (%60,0) / 14 (%40,0)	1,000
Age (year), mean ± SD	46,00 ± 10,75	44,66 ± 9,31	0,578
BMI (kg/m²), median [IQR]	27,00 [26,00–28,00]	27,00 [26,00–28,00]	0,778
Stone size (mm), median [IQR]	12,00 [11,00–16,00]	20,00 [18,50–20,00]	<0,001
Stone density (HU), median [IQR]	1000 [900–1100]	1200 [1000–1300]	0,024
Localization, n (%)			0,163
Ureteropelvic junction	6 (%17,1)	3 (%8,6)	
Renal pelvis	13 (%37,1)	21 (%60,0)	
Upper calyx	3 (%8,6)	0 (%0,0)	
Middle calyx	9 (%25,7)	7 (%20,0)	
Lower calyx	4 (%11,4)	4 (%11,4)	
Operation time (min), median [IQR]	60,00 [47,50–75,00]	110,00 [100,00–120,00]	<0,001
Length of hospital stay (day), median [IQR]	1,00 [1,00–1,00]	2,00 [2,00–2,00]	<0,001
Δ Hemoglobin (g/dL), median [IQR]	0,00 [−1,00–0,00]	−1,00 [−2,00–−1,00]	<0,001

Variables	RIRS (n=35)	mPCNL (n=35)	p
Δ Creatinin (mg/dL), median [IQR]	0,00 [0,00–0,10]	0,00 [−0,20–0,10]	0,135
VAS score, median [IQR]	3,00 [3,00–4,00]	5,00 [4,00–6,00]	<0,001
QoL score, median [IQR]	3,00 [3,00–3,00]	3,00 [2,00–3,00]	0,109
Peroperative DJ stent, n (%)	34 (%97,1)	13 (%37,1)	<0,001
Surgical position, n (%) — Supine/Prone	N/A	18 (%51,4) / 17 (%48,6)	—

BMI: body mass index; HU: Hounsfield unit; VAS: visual analog scale; QoL: quality of life.

WPAI Outcomes: Comparison of RIRS and mPCNL

At baseline, no significant between-group differences were observed in absenteeism (p=0.290) or activity impairment (p=0.083). However, presenteeism was higher in the mPCNL group (40.00 [30.00–50.00] vs 30.00 [30.00–40.00]; p=0.026), as was overall work impairment (54.03±18.09 vs 45.61±16.07; p=0.043).

At discharge, all WPAI domains except absenteeism (p=0.303) were significantly higher in the mPCNL group, including presenteeism (50.00 vs 40.00; p<0.001), activity impairment (50.00 vs 40.00; p<0.001), and overall work impairment (70.00 [64.95–80.48] vs 58.00 [53.33–65.00]; p<0.001).

The greatest differences were observed at postoperative week 1, when all four WPAI domains were significantly higher after mPCNL (all p<0.001). Overall work impairment was 80.00 [75.00–84.12] in the mPCNL group compared with 36.00 [32.00–38.48] in the RIRS group.

By postoperative week 2, the pattern had partially changed. Activity impairment remained significantly higher after mPCNL (50.00 vs 20.00; p<0.001), whereas presenteeism was significantly higher in the RIRS group (p=0.039). No significant differences were observed in absenteeism (p=0.060) or overall work impairment (32.00 vs 28.21; p=0.689). Total Overall Loss across all four assessment time points was significantly higher in the mPCNL group than in the RIRS group (233.79 [218.38–258.12] vs 169.17 [154.72–186.25]; p<0.001) (Table 2).

Table 2. Perioperative Comparison of WPAI Parameters Between the RIRS and mPCNL Groups

Point in time	Parameter	RIRS	mPCNL	p
Preoperative	Absenteeism	16,67 [10,88–20,82]	17,50 [14,95–26,32]	0,290
	Presenteeism	30,00 [30,00–40,00]	40,00 [30,00–50,00]	0,026
	Activity Impairment	30,00 [30,00–40,00]	40,00 [30,00–50,00]	0,083
	Overall Loss, mean ± SD	45,61 ± 16,07	54,03 ± 18,09	0,043
Discharge	Absenteeism	33,33 [28,99–42,86]	37,50 [29,89–45,51]	0,303
	Presenteeism	40,00 [30,00–40,00]	50,00 [50,00–60,00]	<0,001

Point in time	Parameter	RIRS	mPCNL	p
	Activity Impairment	40,00 [30,00–40,00]	50,00 [50,00–60,00]	<0,001
	Overall Loss	58,00 [53,33–65,00]	70,00 [64,95–80,48]	<0,001
Postoperative week 1	Absenteeism	20,00 [15,00–22,68]	51,28 [46,25–60,00]	<0,001
	Presenteeism	20,00 [20,00–20,00]	60,00 [50,00–60,00]	<0,001
	Activity Impairment	20,00 [20,00–20,00]	50,00 [50,00–60,00]	<0,001
	Overall Loss	36,00 [32,00–38,48]	80,00 [75,00–84,12]	<0,001
Postoperative week 2	Absenteeism	17,14 [15,00–20,00]	10,71 [7,60–25,00]	0,060
	Presenteeism	20,00 [10,00–20,00]	20,00 [15,00–25,00]	0,039
	Activity Impairment	20,00 [20,00–20,00]	50,00 [50,00–60,00]	<0,001
	Overall Loss	32,00 [26,88–34,00]	28,21 [26,00–44,42]	0,689
Total Overall Loss		169,17 [154,72–186,25]	233,79 [218,38–258,12]	<0,001

WPAI Outcomes According to DJ Stent Status: RIRS vs mPCNL-S vs mPCNL-NS

The mPCNL group was further stratified according to intraoperative DJ stent placement into stented (mPCNL-S, n=13) and non-stented (mPCNL-NS, n=22) subgroups. At postoperative week 1, both mPCNL subgroups demonstrated significantly greater work productivity impairment than the RIRS group, whereas no significant difference was observed between mPCNL-S and mPCNL-NS (overall work impairment: 76.67 [75.00–83.64] vs 81.26 [75.00–84.19]; p=1.000), suggesting no additional early impact of DJ stenting.

In contrast, a clear separation emerged at postoperative week 2. Overall work impairment was significantly higher in the mPCNL-S group (47.87 [41.33–51.00]) than in both the RIRS group (32.00 [26.88–34.00]; p=0.011) and the mPCNL-NS group (28.00 [20.75–28.48]; p<0.001). Although the difference between mPCNL-NS and RIRS also remained statistically significant (p=0.027), its magnitude was smaller than that observed in comparisons involving mPCNL-S. A similar pattern was observed for absenteeism; although mPCNL-NS differed significantly from RIRS (p<0.001), its median absenteeism was lower (10.00 [7.50–11.50] vs 17.14 [15.00–20.00]), favoring the non-stented mPCNL group.

Total Overall Loss remained significantly higher in both mPCNL subgroups than in the RIRS group (mPCNL-S: 225.50 [213.84–256.24]; mPCNL-NS: 237.89 [219.48–258.75]; both p<0.001 vs RIRS), whereas no significant difference was observed between the stented and non-stented mPCNL subgroups (p=1.000) (Table 3).

Table 3. Comparison of WPAI Parameters Among the RIRS, Stented mPCNL (mPCNL-S), and Non-Stented mPCNL (mPCNL-NS) Groups

Time / Parameter	RIRS	mPCNL-S	mPCNL-NS	p (genel)	p RIRS-NS	p RIRS-S	p NS-S
Preop. Absenteeism	16,67 [10,88–20,82]	15,00 [10,00–20,00]	19,20 [15,10–30,00]	0,112	0,218	1,000	0,215
Preop. Presenteeism	30,00 [30,00–40,00]	30,00 [30,00–40,00]	45,00 [32,50–57,50]	0,025	0,021	1,000	0,370
Preop. Act. Impairment	30,00 [30,00–40,00]	30,00 [30,00–40,00]	40,00 [32,50–50,00]	0,036	0,044	1,000	0,171
Preop. Overall Loss*	45,61 ± 16,07	47,55 ± 17,93	57,86 ± 17,46	0,030	0,025	0,933	0,195
Dis. Absenteeism	33,33 [28,99–42,86]	30,00 [25,00–36,36]	38,74 [34,79–50,00]	0,022	0,098	0,985	0,031
Dis. Presenteeism	40,00 [30,00–40,00]	50,00 [50,00–50,00]	60,00 [50,00–60,00]	<0,001	<0,001	0,001	0,874
Dis. Act. Impairment	40,00 [30,00–40,00]	50,00 [50,00–60,00]	55,00 [50,00–60,00]	<0,001	<0,001	<0,001	1,000
Dis. Overall Loss	58,00 [53,33–65,00]	65,00 [62,50–69,05]	75,90 [69,42–81,18]	<0,001	<0,001	0,052	0,217
Po1 Absenteeism	20,00 [15,00–22,68]	53,33 [45,00–56,67]	50,64 [47,50–60,00]	<0,001	<0,001	<0,001	1,000
Po1 Presenteeism	20,00 [20,00–20,00]	50,00 [50,00–60,00]	60,00 [50,00–60,00]	<0,001	<0,001	<0,001	1,000
Po1 Act. Impairment	20,00 [20,00–20,00]	50,00 [50,00–60,00]	60,00 [50,00–60,00]	<0,001	<0,001	<0,001	1,000
Po1 Overall Loss	36,00 [32,00–38,48]	76,67 [75,00–83,64]	81,26 [75,00–84,19]	<0,001	<0,001	<0,001	1,000
Po2 Absenteeism	17,14 [15,00–20,00]	26,67 [25,00–30,00]	10,00 [7,50–11,50]	<0,001	<0,001	0,051	<0,001
Po2 Presenteeism	20,00 [10,00–20,00]	30,00 [20,00–30,00]	20,00 [10,00–20,00]	<0,001	1,000	<0,001	0,001
Po2 Act. Impairment	20,00 [20,00–20,00]	50,00 [50,00–60,00]	60,00 [50,00–60,00]	<0,001	<0,001	<0,001	1,000
Po2 Overall Loss	32,00 [26,88–34,00]	47,87 [41,33–51,00]	28,00 [20,75–28,48]	<0,001	0,027	0,011	<0,001
Total Overall Loss	169,17 [154,72–186,25]	225,50 [213,84–256,24]	237,89 [219,48–258,75]	<0,001	<0,001	<0,001	1,000

Dis:Discharge; Preop: Preoperative, Po1/Po2: Postoperative 1./2 week. Act: Activity
**Presented as mean ± SD; all other values are median [IQR]. p<0.05 was considered statistically significant. The overall p-value refers to the Kruskal-Wallis test (or ANOVA, where appropriate), while pairwise p-values refer to post-hoc comparisons.*

DISCUSSION

This prospective study compared the effects of RIRS and mPCNL on postoperative work productivity loss in patients treated for 1–2 cm renal stones using the WPAI questionnaire and yielded two main findings. First, mPCNL was associated with substantially greater work productivity impairment than RIRS, particularly at discharge and during the first postoperative week. Second, persistence of this difference into the second postoperative week appeared to be largely related to the presence of a DJ stent, as patients undergoing non-stented mPCNL demonstrated a recovery pattern closer to that observed after RIRS. To our knowledge, no previous study has compared these two procedures using WPAI in the context of urinary stone surgery, highlighting the potential originality of the present findings.

Our overall comparisons between RIRS and mPCNL were consistent with previous literature. mPCNL was associated with longer operative time and hospitalization, greater hemoglobin decline, and higher postoperative VAS scores, findings that may reflect its relatively more invasive nature (6–8). Importantly, these perioperative differences were also reflected in WPAI-derived work productivity outcomes. This observation extends the comparison beyond conventional clinical endpoints and emphasizes the socioeconomic implications of surgical treatment selection. Previous studies evaluating the economic burden of stone disease have similarly suggested that treatment outcomes should be considered not only in terms of stone clearance but also in terms of time required to return to normal occupational activity (3).

One of the most notable findings emerged after stratification according to DJ stent status. The absence of a significant difference between stented and non-stented mPCNL patients during the first postoperative week suggests that early work productivity impairment may primarily reflect the effects of the procedure itself, including surgical trauma, renal parenchymal manipulation, and hospitalization. By the second postoperative week, however, a clear divergence was observed. Work impairment remained substantially higher in patients with DJ stents, whereas patients without stents demonstrated recovery approaching that of the RIRS group. This finding suggests that DJ stent-related morbidity may contribute importantly to prolonged postoperative productivity loss. Previous studies have shown that DJ stents may adversely affect irritative urinary symptoms, pain, and overall quality of life (12). To our knowledge, however, the present study is among the first to quantify this potential impact specifically in terms of work productivity. Clinically, these findings suggest that omission of DJ stenting after mPCNL in appropriately selected patients, provided that safety and stone-related outcomes are not compromised, may facilitate earlier recovery of occupational function.

The significantly higher presenteeism observed in the RIRS group at postoperative week 2 may initially appear unexpected. However, this finding may be explained by the markedly higher rate of perioperative DJ stent placement in the RIRS group compared with the mPCNL group (97.1% vs 37.1%). This observation indirectly supports the hypothesis that late postoperative work impairment may be influenced more strongly by stent-related symptoms than by the surgical modality itself.

The significant differences in stone size and HU values between groups represent an important limitation of the study. Median stone size was 12 mm in the RIRS group and 20 mm in the mPCNL group, while median stone density was 1000 and 1200 HU, respectively. These imbalances likely reflect treatment selection in routine clinical practice rather than random allocation, with larger and denser stones more frequently treated using mPCNL in

accordance with contemporary guideline-based decision-making (4,5). Similarly, DJ stent placement was determined according to surgeon preference. Therefore, comparisons between the mPCNL-S and mPCNL-NS subgroups should be interpreted as observational and associative rather than causal.

Additional limitations include the single-center design, lack of randomization, and relatively small sample size, particularly in the mPCNL-S subgroup (n=13), all of which may limit generalizability. Nevertheless, the prospective design, standardized WPAI assessments at four predefined time points, and detailed subgroup analyses according to DJ stent status and surgical position represent important strengths.

Future multicenter studies with larger cohorts and randomized stent allocation are warranted to validate these findings. The effect of shorter stent duration on work productivity should also be investigated. In addition, studies using matched cohorts with comparable stone size and density may help clarify the independent effect of surgical modality on postoperative occupational recovery.

CONCLUSION

RIRS was associated with less work productivity impairment than mPCNL during the early postoperative period in patients treated for 1–2 cm renal stones. Although both procedures represent effective treatment options, persistence of work impairment after mPCNL into the second postoperative week appeared to be associated, at least in part, with DJ stent placement. The recovery pattern observed in patients undergoing non-stented mPCNL was closer to that of the RIRS group, suggesting that omission of stenting in appropriately selected patients may offer both clinical and socioeconomic advantages.

These findings support considering return to work alongside conventional outcomes such as stone-free and complication rates when selecting surgical modality and deciding on postoperative stent placement. Larger multicenter studies with randomized DJ stent allocation are needed to confirm these observations.

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