

# Heavy as a rock or light as dust: a comparison between the perceived workload for extracorporeal shockwave lithotripsy, ureterorenoscopy and percutaneous nephrolithotomy

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**Introduction** There are three common treatment options for kidney stones: extracorporeal shockwave lithotripsy (ESWL), ureterorenoscopy (URS) and percutaneous nephrolithotomy (PNL). The choice of treatment is based on stone- and patient-related characteristics. However, some stones are eligible for several approaches and the decision is made based on patient and urologist's preferences. This study evaluates which approach has the highest workload.

**Material and methods** Between March and August 2022, five members of the Amsterdam Endourology Research Group collected data from 22 ESWL, 31 URS and 22 PNL procedures. After each procedure, the SURG-TLX questionnaire was completed by the surgeon to evaluate workload. Six dimensions were scored for each procedure, including: mental demands, physical demands, temporal demands, task complexity, situational stress, and distractions. The total workload, and the median for each dimension, was calculated and compared for the three treatments.

**Results** ESWL scored significantly lower than URS for mental demands, physical demands, temporal demands, situational stress, distraction and total workload. However, task complexity did not differ significantly between the two techniques. Compared with PNL, ESWL scored significantly lower for all dimensions. Finally, PNL received significantly higher scores for mental demands, physical demands, temporal demands, situational stress, distractions and total workload than URS. Only task complexity showed no significant difference between both groups.

**Conclusions** Urologists perceive the highest workload during PNL, followed by URS and finally ESWL. A follow-up study is needed to identify stressors that increase perceived workload with the purpose to address these variables and as final objective to improve urologists' workload, patient safety and treatment outcomes.

**Key Words:** endourology ↔ extracorporeal shockwave lithotripsy ↔ percutaneous nephrolithotomy ↔ SURG-TLX ↔ ureterorenoscopy ↔ workload

## INTRODUCTION

Kidney stone disease is one of the most common urological disorders worldwide. The reported estimated

overall prevalence of urolithiasis is currently 5–14% in Europe, 7–13% in the United States, and 1–5% in Asia and the incidence is still increasing [1, 2, 3]. The European Association of Urology (EAU) recom-

mends three different approaches for the treatment of kidney stones: extracorporeal shockwave lithotripsy (ESWL), ureterorenoscopy (URS), and percutaneous nephrolithotomy (PNL). The choice of treatment is made based on various patient- and stone-related characteristics. However, some stones are eligible for several, even all, therapeutic approaches and the choice of treatment could then be made based on patient and urologist's preferences [4].

Additionally, there has been an increasing interest in surgeon's wellbeing more recently [5–8]. Several papers have investigated the role of ergonomics during stone-treatment [9, 10, 11]. A recent survey on practice patterns and rates of musculoskeletal pain among urologists treating kidney stones found that there is a broad variance in the adherence to ergonomic best practice. Furthermore, the study discovered high rates of musculoskeletal pain among urologists [11]. However, the perceived workload of a procedure depends on more than ergonomics alone. The Surgery Task Load Index (SURG-TLX) questionnaire, which assesses six dimensions (*mental demands, physical demands, temporal demands, task complexity, situational stress and distractions*) has been developed and validated to evaluate the impact of several stressors on the perceived workload of surgeons during surgery [12]. This questionnaire was based on the widely used National Aeronautics and Space Administration Task Load Index (NASA-TLX) [13]. Previous studies in the field of endourology have used or recommended the SURG-TLX questionnaire, but none have compared the perceived workload between ESWL, URS and PNL [14, 15, 16]. Identifying the procedures and stressors causing the highest workload may enable the implementation of simple interventions to reduce the perceived workload for urologists in the future and consequently improve patient safety and treatment outcomes. As a first step, this study aims to evaluate the perceived workload of the three most common stone-treatment approaches. Furthermore, it aims to compare these three approaches to determine which of these options received the highest scores on the six dimensions of the SURG-TLX questionnaire.

## MATERIAL AND METHODS

### Study design

This is a prospective, dual-centre study conducted between March and August 2022. Data was collected from consecutive ESWL, URS and PNL procedures for the treatment of kidney stones performed at the Amsterdam UMC (Amsterdam, the Netherlands) and the Alrijne hospital (Leiderdorp, the Netherlands)

by members of the Amsterdam Endourology Research Group (AERG). Twenty-two ESWL procedures were performed at the Alrijne hospital, while 31 URS and 22 PNL procedures were performed at the Amsterdam UMC. The exact process of evaluation was previously described in detail by our research group [15]. The primary surgeon assessed workload using a 20-point visual scale, as illustrated in Figure 1, after each procedure, scoring six dimensions. The second part of the SURG-TLX was omitted for this study, as research has shown that there is little to no additional value to the attribution of weight to the different dimensions, especially in the field of endourology [15, 17, 18]. However, the participants completed the second part of the SURG-TLX questionnaire during data collection and this data is available upon request. The total workload was determined as the aggregate of the scores from the six dimensions [12].

### Ethics

This study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments, as well as with the ethical standards of the institutional and/or national research committee (complying with the Dutch law

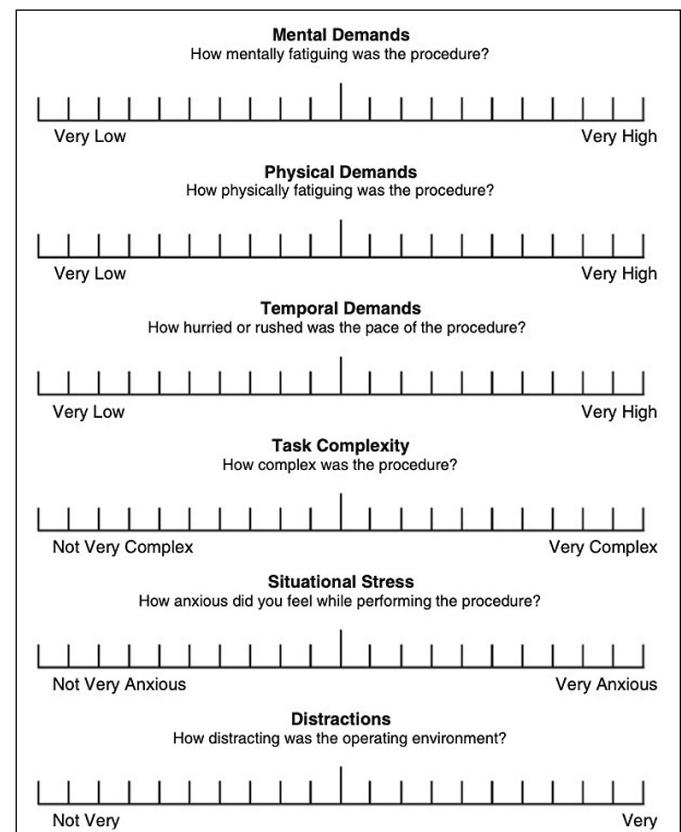


Figure 1. Six dimensions, 20-point visual scale.

on Medical Research in Humans: non-WMO-obligated due to the nature of the study).

### Statistical analysis

Due to the lack of publications on this topic, a power-analysis to determine the sample size was not possible. Based on practical grounds, we decided to include procedures during a six month period, which resulted in 75 procedures.

Descriptive analysis was performed to determine workload per dimension for each stone-treatment approach. To provide a graphic representation of the data and to compare the distribution of our data, simple boxplots were used. Within the boxplots, outliers (1.5 x IQR) are displayed as circles and extreme values are displayed as asterisks (3 x IQR).

As all variables were continuous, outcomes were reported as medians and interquartile ranges (IQR). Normality of these continuous variables was checked with the Shapiro-Wilk test. Not all variables were normally distributed (Table 1). As non-parametric tests are valid for both non-normally distributed data and normally distributed data, we opted to use non-parametric tests to compare the results. Thus, the Kruskal Wallis-test and Mann-Whitney

test were used to compare the results of the three stone-treatment approaches and determine statistical significance between the various dimensions. A two-sided p-value of  $\leq 0.05$  was considered statistically significant.

Statistical analysis was performed and boxplots were created using SPSS V28 (IBM Corp., Armonk, NY, USA) and tables were created using Microsoft® Excel for Mac V.2016 (Microsoft Corp., Redmond, WA, USA).

## RESULTS

Five members of the AERG (ACB-H, JB, MMELH, NH and GMK), associated with the departments of Urology of the Amsterdam UMC (Amsterdam, the Netherlands) and the Alrijne hospital (Leiderdorp, the Netherlands), collected data for this study. A total of 75 procedures, of which 22 ESWL, 31 URS and 22 PNL, were included between March and August 2022.

### Workload of the different treatment modalities

Figure 2 stone-treatment approach as simple boxplots. Compared to URS and PNL, ESWL had the lowest median mental demands (3.0/20 (IQR 2.0–4.3)), physical demands (2.5/20 (IQR 1.0–3.3)), temporal demands (1.5/20 (IQR 1.0–4.0)), task complexity (4.0/20 (IQR 3.0–5.3)), situation stress (1.0/20 (IQR 1.0–1.0)), distraction (1.0/20 (IQR 1.0–3.3)) and total workload (2.6/20 (IQR 1.9–3.4)).

URS received intermediate scores compared to ESWL and PNL for all dimensions. Median mental demands were 5.0/20 (IQR 3.0–8.0), median physical demands were 5.0/20 (IQR 3.0–7.0), median temporal demands were 4.0/20 (IQR 3.0–6.0), median task complexity was 6.0/20 (IQR 4.0–9.0), median situation stress was 4.0/20 (IQR 2.0–7.0), median distraction was 4.0/20 (IQR 3.0–6.0) and median total workload was 4.8/20 (IQR 3.3–7.7).

Finally, PNL had the highest median mental demands (7.5/20 (IQR 5.8–12.5)), physical demands (8.5/20 (IQR 6.0–12.0)), temporal demands (6.5/20 (IQR 5.0–9.5)), task complexity (7.0/20 (IQR 4.8–14.0)), situation stress (8.5/20 (IQR 5.8–13.3)), distraction (9.5/20 (IQR 6.0–14.0)) and total workload (8.2/20 (IQR 6.0–10.4)) compared to ESWL and URS.

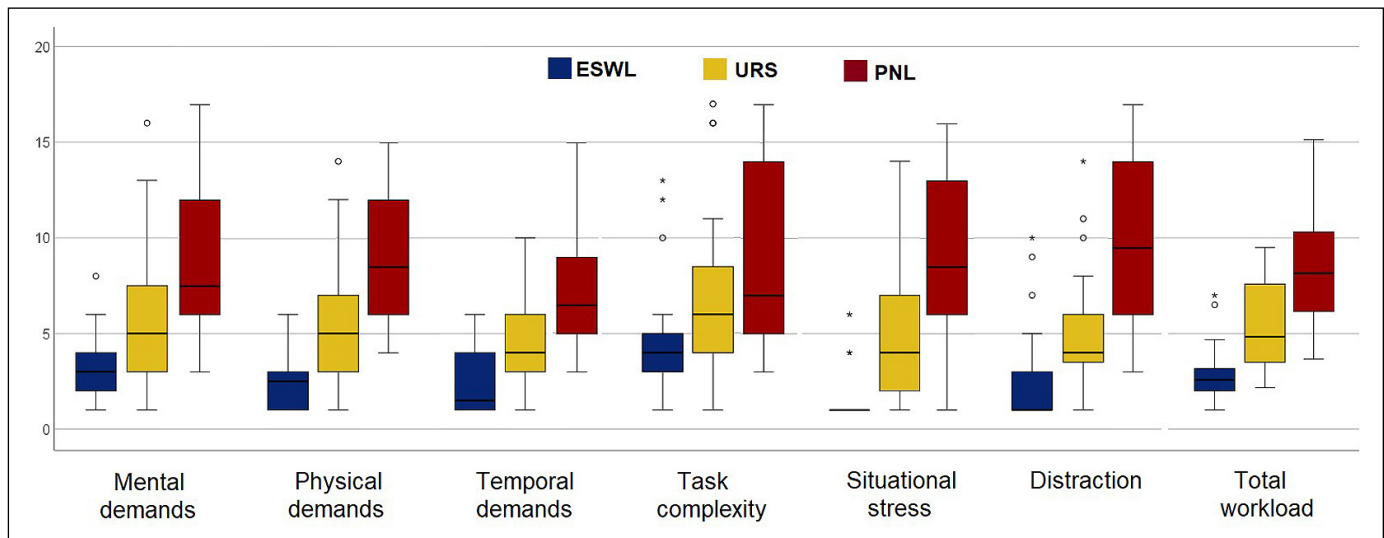
### Comparison between the different treatment modalities

A Mann-Whitney test showed a statistically significant difference between ESWL and URS concerning mental demands, physical demands, temporal demands, situational stress, distraction and total

**Table 1.** A Shapiro-Wilk test of normality

Dimension	Treatment approach	p-value
Mental demands	ESWL	<0.05
	URS	<0.05
	PNL	0.093
Physical demands	ESWL	<0.05
	URS	<0.05
	PNL	0.195
Temporal demands	ESWL	<0.05
	URS	<0.05
	PNL	<0.05
Task complexity	ESWL	<0.05
	URS	<0.05
	PNL	<0.05
Situational stress	ESWL	<0.05
	URS	<0.05
	PNL	0.252
Distraction	ESWL	<0.05
	URS	<0.05
	PNL	0.172
Total workload	ESWL	<0.05
	URS	<0.05
	PNL	0.293

ESWL – extracorporeal shockwave lithotripsy; PNL – percutaneous nephrolithotomy; URS – Ureterorenoscopy



**Figure 2.** The workload per dimension for each stone-treatment approach – boxplots.

ESWL – extracorporeal shockwave lithotripsy; PNL – percutaneous nephrolithotomy; URS– Ureterorenoscopy

workload, as shown in Table 2. Yet, the task complexity was not different between both techniques ( $p = 0.07$ ). Compared with PNL, ESWL scored significantly lower for all dimensions ( $p < 0.05$ ). PNL received significantly higher scores for mental demands, physical demands, temporal demands, situational stress, distractions and total workload than URS. Only task complexity showed no difference between both groups ( $p = 0.32$ ).

## DISCUSSION

This study shows that there is a clear difference in perceived workload when comparing the three treatment options for kidney stones that are recommended by the EAU: ESWL, URS, and PNL (Figure 3) [4]. Furthermore, this study compared these three approaches and found that PNL received the highest scores for all six dimensions of the SURG-TLX questionnaire.

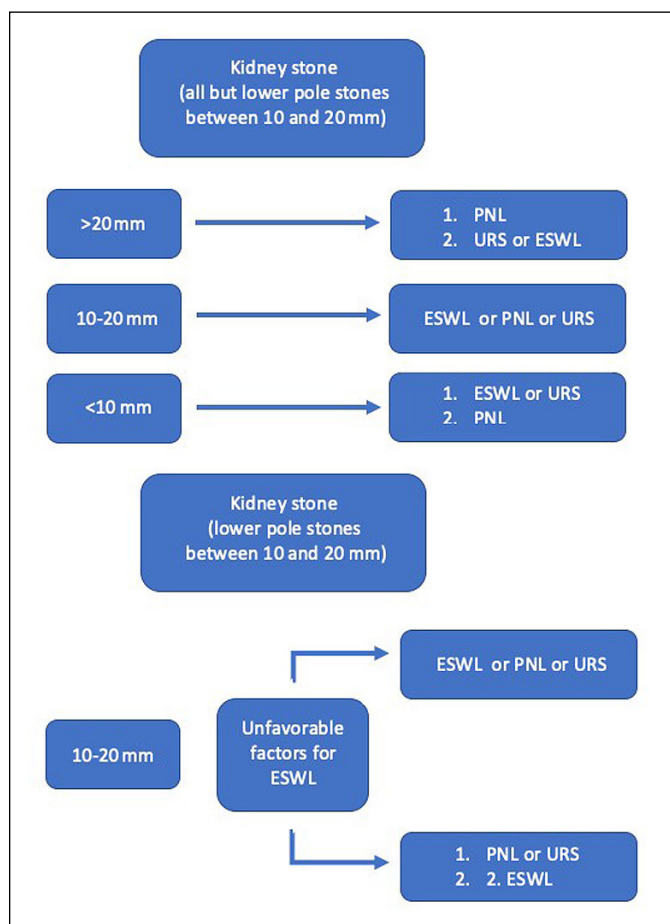
Several factors can influence stone-free rates after stone-treatment. Not only stone and patient characteristics, but also surgeon experience and the chosen treatment modality can have an effect. According to the EAU guidelines, ESWL realises good stone-free rates for interpolar and upper pole stones up to two centimetres. And even though the stone-free rate is negatively affected by larger stone size and lower pole localisation, ESWL is not contra-indicated in these situations [4, 19–21]. Although stone-free rates are somewhat higher for URS when compared to ESWL for stones smaller than two centimetres, similar to ESWL, the stone-free rate of URS is negatively affected by increasing stone size and auxiliary

**Table 2.** Comparison between the different treatment modalities

Dimension	ESWL - URS	ESWL - PNL	URS - PNL
Mental demands	<0.05	<0.05	<0.05
Physical demands	<0.05	<0.05	<0.05
Temporal demands	<0.05	<0.05	<0.05
Task complexity	0.07	<0.05	0.32
Situational stress	<0.05	<0.05	<0.05
Distraction	<0.05	<0.05	<0.05
Total workload	<0.05	<0.05	<0.05

ESWL – extracorporeal shockwave lithotripsy; PNL – percutaneous nephrolithotomy; URS– Ureterorenoscopy

treatments may be necessary to reach a stone-free status. Furthermore, URS is considered more invasive than ESWL and therefore shared decision making might lead to ESWL as the preferred choice of treatment [22]. Nonetheless, URS, and to a lesser extent ESWL, remain valid treatment options in stones larger than two centimetres, especially in patients who are not fit to undergo PNL [4, 22, 23, 24]. Even though, PNL remains the first choice for stones larger than two centimetres, as its stone-free rate is hardly affected by stone size [4]. Additionally to stone and patient characteristics, factors related to the surgeon, such as their experience and preference, influences the choice of treatment for kidney stones [25]. Until now, there is limited knowledge about the impact of surgeon preference on treatment selection, and the current focus is on patient-centred care, including shared decision making with extensive consideration for patient



**Figure 3.** The treatment options for kidney stones.

ESWL – extracorporeal shockwave lithotripsy; PNL – percutaneous nephrolithotomy; URS– Ureterorenoscopy

preferences [26, 27, 28]. Physician burnout, however, is an important issue, especially in urology, with a considerable impact on the field [5, 29]. A study by Bohrer et al. on the quality of life of surgeons in Germany, found that 40% deemed their quality of life to be poorer than that of the general public [6]. According to Nauheim and North, an increase in workload, among other factors, leads to an increased burnout-rate [5]. Both studies concluded that measures should be taken to increase quality of life and prevent physician burnout [5, 6]. By taking the perceived workload of procedures into account, urologists could lower their workload and subsequently possibly influence the risk of burnout. Two systematic reviews investigated the effect of surgeon's wellbeing on patient outcomes and found an association between poor wellbeing and burnout of the surgeon and worse patient safety [7, 8]. Thus, by identifying procedures with a higher workload, as well as the stressors that increase the perceived workload, we could try to improve surgeon's wellbeing by ad-

ressing these stressors and this may subsequently help to improve patient safety and outcomes.

Until now, only two studies reported on the workload of stone-treatment with the SURG-TLX questionnaire. Hussain and colleagues evaluated the impact of flow disruption on mental workload and performance of surgeons during PNL. They divided this procedure into four steps and used a standardized tool to identify disruptions. Afterwards, they used the SURG-TLX questionnaire to assess the perceived workload and to correlate these results with the intraoperative interruptions. They concluded that the intraoperative disruptions were directly correlated with the surgeon's workload and had a detrimental effect on teamwork. Furthermore, they stated that reducing unnecessary disruptions and thus perceived workload, would lead to safer surgical care [16]. Our research group recently assessed if the SURG-TLX questionnaire is applicable for endourological procedures and set a first point of reference for perceived workload for these procedures. They included data on URS and PNL, however none on ESWL [15].

The current study is the first to assess the perceived workload of ESWL and compare the three most common stone-treatment options with one another. As one might expect, ESWL received the lowest and PNL the highest workload scores.

The most striking differences were found for the dimension of situational stress, where ESWL showed an extremely low median score of 1.0/20 (IQR 1.0–1.0) and PNL received a high median score of 8.5/20 (IQR 5.8–13.3). According to a systematic review and meta-analysis by Kallidonis and colleagues, the complication rate of ESWL seemed to be lower than for PNL [30]. Hence, the differences found in our study may be the result of the possible risks that are known to be inherent to a PNL procedure and consequently increases situational stress for the urologist. Risks that are not commonly associated with an ESWL procedure, thus possibly lowering the score for situational stress for this treatment modality.

Interestingly, the perceived task complexity did not differ between ESWL and URS ( $p = 0.07$ ), nor did it differ significantly between URS and PNL ( $p = 0.32$ ). However, the perceived task complexity was significantly lower for ESWL, when compared with PNL ( $p < 0.05$ ). These results could be due to the fact that ESWL procedures were performed by participants in the beginning of their endourology career and PNL-procedures were performed by the more experienced members of the AERG. As the less experienced members are still in a learning curve, they might attribute more weight to task complexity, whereas the

contrary could be said about the more experienced members, who have already seen and lived it all. To the best of our knowledge, this is the first study to evaluate the perceived workload for ESWL, URS and PNL and compare the results of these three stone treatment-options. Although this is a dual-centre, prospective study that gives an insight in the workload of the three main stone-treatment approaches, a future prospective multicentre study, including more participants and procedures, is needed to assess the true workload of these procedures. This study has some limitations, including the fact that it focused solely on the urologist's experience and did not include surgical outcomes in the equation. Additionally, it did not assess which variables influence the perceived workload, as the main goal was to identify which treatment modality had the highest workload. Therefore, a more in-depth evaluation of these three stone-treatment approaches, including the possible effect of external variables, is necessary to understand the perceived workload better. By identifying high workload procedures and stressors during these procedures that influence perceived workload, measure could be taken to lower workload for urologists. As described

before, this could lead to less burnout and increased wellbeing for the urologist and consequently to improved patient safety and treatment outcomes. These findings then would require further interventional studies that address these stressors with a final objective to not only improve urologist's quality of life but also improve patient safety and treatment outcomes.

## CONCLUSIONS

Each stone treatment modality has a different perceived workload. Urologists perceive the highest workload during PNL, followed by URS and ESWL when treating kidney stones. However, bigger cohorts are needed to balance out environmental and surgeon-specific variables. Furthermore, a better understanding of the perceived workload and the stressors influencing said workload may lead to interventions to enhance surgeons' working conditions and to subsequently improve patient safety and treatment outcomes.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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