

Research Article

Comparison of Transurethral Resection of the Prostate and Laser Enucleation for Benign Prostatic Hyperplasia

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Abstract

Background: Benign prostatic hyperplasia (BPH) is a common cause of lower urinary tract symptoms in older men and may require surgical intervention when symptoms are severe or refractory to medical therapy.

Objective: To compare perioperative outcomes, functional improvement, and postoperative complications between transurethral resection of the prostate (TURP) and laser enucleation in patients with BPH.

Methods: This prospective comparative study was conducted at Department of Urology, Sahiwal Teaching Hospital, Sahiwal from March 2024 to December 2024 and included 90 patients with symptomatic BPH. Patients were divided into two groups, with 45 undergoing TURP and 45 undergoing laser enucleation. Baseline characteristics, operative time, amount of tissue removed, reduction in hemoglobin level, transfusion requirement, duration of bladder irrigation, catheterization time, length of hospital stay and postoperative complications were recorded. Functional outcomes were assessed at 3 and 6 months after surgery.

Results: Baseline characteristics were comparable between the two groups. Laser enucleation was associated with a longer operative time than TURP (74.2 ± 18.4 vs. 61.5 ± 15.8 minutes; $p < 0.001$) but resulted in a greater amount of tissue removal (42.1 ± 12.4 vs. 34.6 ± 10.2 g; $p = 0.002$). The reduction in hemoglobin level was significantly lower in the laser enucleation group (0.74 ± 0.41 vs. 1.42 ± 0.66 g/dL; $p < 0.001$). The duration of bladder irrigation, catheterization time, and hospital stay were also shorter following laser enucleation. At 6 months, mean IPSS was comparable between the groups (6.3 ± 2.2 vs. 6.9 ± 2.4 ; $p = 0.219$), whereas Qmax was significantly higher following laser enucleation (24.0 ± 4.5 vs. 22.1 ± 4.2 mL/s; $p = 0.041$).

Conclusion: It is concluded that both TURP and laser enucleation provide effective symptom relief in patients with BPH. Laser enucleation was associated with lower blood loss, shorter postoperative recovery, and greater improvement in urinary flow, although it required a longer operative time.

Keywords: Benign Prostatic Hyperplasia, Transurethral Resection of the Prostate, Laser Enucleation, HoLeP.

INTRODUCTION

One of the most prevalent causes of lower urinary tract symptoms (LUTS) in elderly males is benign prostatic hyperplasia (BPH), which may cause a variety of symptoms including

urinary frequency, urgency, nocturia, weak urinary stream, incomplete emptying, urinary retention, recurrent infection, and deterioration in quality of life [1]. Medical treatment may be ineffective or unsuccessful and/or

complications may develop, including recurrent retention, bladder stones, recurrent urinary infection, hematuria, and renal impairment, which may necessitate surgical treatment [2]. The current guidelines are accepting transurethral resection of the prostate (TURP) as a conventional surgical intervention, especially in men with a prostate volume of ~30-80 mL [3]. The efficacy of TURP for relief of bladder outlet obstruction is well established with significant improvement in International Prostate Symptom Score (IPSS), maximum urinary flow rate (Qmax), post-void residual urine volume and quality of life [4]. Meta-analytic data has demonstrated significant improvement in urinary flow and symptom scores after TURP, which has established it as a standard procedure for treatment of BPH for many years [5]. But there are some complications of TURP, such as perioperative bleeding, blood transfusion, prolonged catheterization, fluid absorption, urethral stricture, bladder-neck contracture and postoperative hospitalization [6].

Laser enucleation of the prostate (LEP) has become an important alternative procedure, as the treatment of the obstructing adenoma occurs within the anatomical surgical capsule without having to resect the prostate in pieces [7]. Holmium laser enucleation of the prostate (HoLEP) is the most widely studied laser-enucleation procedure and offers comparable long-term benefits in terms of urinary symptoms, urine flow rate and residual urine as TURP [8]. According to the current European literature, HoLEP is an effective technique for prostate surgery in patients who cannot undergo TURP surgery and has a generally favorable perioperative profile in terms of blood loss, catheterization and hospital stay [9]. More recently, randomized and pooled evidence has confirmed these findings. Meta-analysis of 13 randomized trials with 1309 patients showed that HoLEP and TURP had similar functional outcomes and laser enucleation had benefits in some peri-operative parameters [10]. The long-term randomized follow-up has also demonstrated the long-term symptom relief and urinary flow improvement after both procedures, which have not shown significant differences in major functional outcomes several years after treatment [11]. The same has been observed in randomized studies of thulium laser enucleation, in which less hemoglobin reduction, shorter catheterization, and shorter hospital stay were seen when

compared to TURP, but operative time may be longer [12, 13].

Objective

To compare perioperative outcomes, functional improvement, and postoperative complications between transurethral resection of the prostate (TURP) and laser enucleation in patients with BPH.

METHODOLOGY

This prospective comparative study was conducted at Department of Urology, Sahiwal Teaching Hospital, Sahiwal from March 2024 to December 2024. A total of 90 male patients with symptomatic benign prostatic hyperplasia (BPH) requiring surgical treatment were included and divided into two equal groups. Group A consisted of 45 patients who underwent transurethral resection of the prostate (TURP), while Group B included 45 patients treated with laser enucleation of the prostate. Men aged 50–80 years with moderate-to-severe lower urinary tract symptoms, an International Prostate Symptom Score (IPSS) ≥ 8 , prostate volume between 30 and 80 mL, and an indication for surgical management were included. Patients with suspected or confirmed prostate cancer, neurogenic bladder, urethral stricture, previous prostate or urethral surgery, bladder malignancy, active urinary tract infection, or severe uncontrolled medical illness were excluded.

Data Collection

After approval from the institutional ethical review committee and written informed consent, demographic and clinical information was recorded. Preoperative assessment included age, duration of symptoms, IPSS, quality-of-life score, prostate volume measured by ultrasonography, maximum urinary flow rate (Qmax), post-void residual urine volume (PVR), serum prostate-specific antigen, hemoglobin, and serum creatinine. Patients in the TURP group underwent standard transurethral resection of obstructing prostatic tissue using a resectoscope. Patients in the laser-enucleation group underwent endoscopic anatomical enucleation of the prostatic adenoma using laser energy, followed by tissue morcellation where required. All procedures were performed under spinal or general anesthesia according to anesthetic assessment. Operative time, amount of resected or enucleated tissue, change in hemoglobin level, need for blood transfusion,

duration of postoperative bladder irrigation, catheterization time, and length of hospital stay were recorded. Postoperative complications including hematuria requiring intervention, urinary retention, urinary tract infection, urinary incontinence, urethral stricture, and bladder-neck contracture were documented. Patients were followed at 1, 3, and 6 months after surgery. At follow-up, IPSS, quality-of-life score, Qmax, and PVR were reassessed to compare functional improvement between the two procedures.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables such as age, prostate volume, operative time, hemoglobin reduction, catheterization duration, hospital stay, IPSS, Qmax, and PVR were expressed as mean±standard deviation. Categorical variables including transfusion requirement and postoperative complications were presented as frequencies and percentages. Continuous

variables between the TURP and laser-enucleation groups were compared using the independent-samples t-test or Mann–Whitney U test, as appropriate. Changes in IPSS, Qmax, and PVR from baseline to follow-up were assessed using paired statistical tests and compared between groups. Categorical variables were analyzed using the chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline characteristics were comparable between the two groups. The mean age was 67.4 ± 7.3 years in the TURP group and 66.9 ± 7.0 years in the laser enucleation group. Similarly, the mean prostate volume was 62.8 ± 12.5 mL versus 64.1 ± 13.2 mL, respectively. Baseline International Prostate Symptom Score (IPSS) was 24.6 ± 4.1 in the TURP group and 25.1 ± 4.3 in the laser enucleation group, while the maximum urinary flow rate (Qmax) was 8.4 ± 2.1 mL/s and 8.1 ± 2.0 mL/s, respectively.

Table 1. Baseline Characteristics of Patients in the Two Treatment Groups

Characteristic	TURP (n=45)	Laser Enucleation (n=45)	p-value
Age (years), mean±SD	67.4±7.3	66.9±7.0	0.741
Prostate volume (mL), mean±SD	62.8±12.5	64.1±13.2	0.633
IPSS, mean±SD	24.6±4.1	25.1±4.3	0.574
QoL score, mean±SD	4.7±0.8	4.8±0.7	0.529
Qmax (mL/s), mean±SD	8.4±2.1	8.1±2.0	0.489
PVR (mL), mean±SD	112.3±48.0	118.1±51.2	0.581
PSA (ng/mL), mean±SD	3.2±1.4	3.4±1.6	0.530
Hemoglobin (g/dL), mean±SD	13.7±1.2	13.8±1.1	0.681
Acute urinary retention at presentation	12 (26.7%)	13 (28.9%)	0.813

Laser enucleation required a longer mean operative time than TURP, 74.2 ± 18.4 versus 61.5 ± 15.8 minutes ($p < 0.001$), but removed more tissue, 42.1 ± 12.4 versus 34.6 ± 10.2 g ($p = 0.002$). Hemoglobin reduction was significantly lower with laser enucleation, 0.74 ± 0.41 versus 1.42 ± 0.66 g/dL ($p < 0.001$).

Bladder irrigation duration, catheterization time, and hospital stay were also shorter with laser enucleation at 12.4 ± 6.1 hours, 1.8 ± 0.7 days, and 2.1 ± 0.8 days compared with 22.8 ± 8.9 hours, 2.9 ± 1.0 days, and 3.3 ± 1.1 days after TUR.

Table 2. Comparison of Perioperative Outcomes between TURP and Laser Enucleation

Perioperative Variable	TURP (n=45)	Laser Enucleation (n=45)	p-value
Operative time (minutes)	61.5±15.8	74.2±18.4	<0.001
Tissue removed (g)	34.6±10.2	42.1±12.4	0.002
Hemoglobin reduction (g/dL)	1.42±0.66	0.74±0.41	<0.001
Blood transfusion	4 (8.9%)	0 (0%)	0.117
Bladder irrigation duration (hours)	22.8±8.9	12.4±6.1	<0.001
Catheterization duration (days)	2.9±1.0	1.8±0.7	<0.001
Hospital stay (days)	3.3±1.1	2.1±0.8	<0.001

At 3 months, both procedures produced marked functional improvement, although laser

enucleation showed somewhat better urinary flow. Mean IPSS was 8.4 ± 2.8 after TURP and

7.2±2.5 after laser enucleation (p=0.035), while Qmax was 20.9±4.5 versus 23.1±4.8 mL/s (p=0.027). Mean PVR was 36.8±18.4 versus 29.7±16.5 mL, and improvement in

Qmax from baseline was significantly greater with laser enucleation, 15.0±4.6 versus 12.5±4.2 mL/s (p=0.008).

Table 3. Functional Outcomes at 3 Months after Surgery

Outcome	TURP (n=45)	Laser Enucleation (n=45)	p-value
IPSS	8.4±2.8	7.2±2.5	0.035
QoL score	2.0±0.7	1.8±0.6	0.151
Qmax (mL/s)	20.9±4.5	23.1±4.8	0.027
PVR (mL)	36.8±18.4	29.7±16.5	0.058
Reduction in IPSS from baseline	16.2±4.3	17.9±4.5	0.071
Increase in Qmax from baseline (mL/s)	12.5±4.2	15.0±4.6	0.008

At 6 months, symptom control remained similar between groups, with mean IPSS of 6.9±2.4 after TURP and 6.3±2.2 after laser enucleation (p=0.219). Mean Qmax remained significantly higher with laser enucleation, 24.0±4.5 versus

22.1±4.2 mL/s (p=0.041), while PVR was 22.1±13.7 versus 27.5±15.2 mL. Improvement in Qmax from baseline was also greater with laser enucleation, 15.9±4.4 versus 13.7±4.1 mL/s (p=0.016).

Table 4. Functional Outcomes at 6 Months after Surgery

Outcome	TURP (n=45)	Laser Enucleation (n=45)	p-value
IPSS	6.9±2.4	6.3±2.2	0.219
QoL score	1.6±0.6	1.5±0.5	0.392
Qmax (mL/s)	22.1±4.2	24.0±4.5	0.041
PVR (mL)	27.5±15.2	22.1±13.7	0.080
Reduction in IPSS from baseline	17.7±4.2	18.8±4.4	0.228
Increase in Qmax from baseline (mL/s)	13.7±4.1	15.9±4.4	0.016

Postoperative complications were generally infrequent in both groups. Significant hematuria occurred in 5 (11.1%) TURP patients compared with 1 (2.2%) laser-enucleation patient, while urinary tract infection occurred in 4 (8.9%) versus 3 (6.7%). Transient urinary incontinence was more frequent after laser

enucleation, 5 (11.1%) versus 2 (4.4%), whereas urethral stricture occurred in 3 (6.7%) versus 1 (2.2%), bladder-neck contracture in 2 (4.4%) versus 0, and reoperation within 6 months in 2 (4.4%) versus 0. None of these complication differences reached statistical significance.

Table 5. Postoperative Complications According To Surgical Procedure

Complication	TURP (n=45)	Laser Enucleation (n=45)	p-value
Significant postoperative hematuria	5 (11.1%)	1 (2.2%)	0.203
Urinary tract infection	4 (8.9%)	3 (6.7%)	1.000
Urinary retention after catheter removal	3 (6.7%)	2 (4.4%)	1.000
Transient urinary incontinence	2 (4.4%)	5 (11.1%)	0.434
Urethral stricture	3 (6.7%)	1 (2.2%)	0.616
Bladder-neck contracture	2 (4.4%)	0 (0%)	0.494
Reoperation within 6 months	2 (4.4%)	0 (0%)	0.494

DISCUSSION

For the 90 patients in the present study with BPH, both TURP and laser enucleation led to significant improvement in urinary symptoms

and flow parameters. Baseline parameters were found to be quite comparable, with ages of 67.4±7.3 versus 66.9±7.0 years in the TURP and laser-enucleation groups, respectively.

Other factors were also similar including mean prostate volume, baseline IPSS, Qmax, PVR, PSA, and hemoglobin, indicating that differences post-operatively were unlikely to be attributable to significant baseline imbalance. Laser enucleation required a significantly longer operative time than TURP, 74.2 ± 18.4 versus 61.5 ± 15.8 minutes ($p < 0.001$), but removed a greater amount of tissue, 42.1 ± 12.4 versus 34.6 ± 10.2 g ($p = 0.002$). This is consistent with previous studies, which demonstrated that laser enucleation was more time consuming than resection, but was effective in eliminating obstructing adenomatous tissue. One of the randomized studies reported operative time of 65.4 minutes with laser enucleation versus 47.4 minutes with bipolar resection ($p = 0.022$) [14]. One of the largest peri-operative benefits of laser enucleation in the present study was that of limited blood loss. The mean hemoglobin drop was 0.74 ± 0.41 g/dL versus 1.42 ± 0.66 g/dL after TURP ($p < 0.001$), and no patient had a transfusion requirement in the laser group versus 4 (8.9%) in the TURP group. Past studies have also shown a significantly lower reduction in hemoglobin in patients undergoing thulium laser enucleation versus TURP, such as 0.45 versus 2.83 g/dL in a randomized study [15]. In a previous study [16], the decrease in hemoglobin was reported to be 0.92 ± 0.82 g/dL for laser treatment compared to 1.46 ± 0.65 g/dL. Laser enucleation also resulted in a more rapid recovery from surgery. Laser enucleation had significant advantages in the duration of bladder irrigation (12.4 ± 6.1 versus 22.8 ± 8.9 hours, $p < 0.001$), catheterization time (1.8 ± 0.7 versus 2.9 ± 1.0 days, $p < 0.001$), and hospital stay (2.1 ± 0.8 versus 3.3 ± 1.1 days, $p < 0.001$). Similar results have been published before, with catheterization duration 2.1 days versus 3.5 days for the laser enucleation and bipolar resection, respectively, and hospital stay 2.5 days versus 4.6 days, respectively [16]. The same can be said about the laser enucleation, which has been supported by meta-analytic evidence of reduced catheterization and hospital stays compared to TURP [17].

Both procedures significantly improved symptoms at three months and laser enucleation was slightly superior in terms of function. Mean IPSS was 7.2 ± 2.5 after laser enucleation compared with 8.4 ± 2.8 after TURP ($p = 0.035$), while Qmax was 23.1 ± 4.8 versus 20.9 ± 4.5 mL/s ($p = 0.027$). The difference in Qmax between baseline and the end of the study was also significantly higher with laser enucleation (15.0 ± 4.6 mL/s, versus 12.5 ± 4.2

mL/s ($p = 0.008$)). Similar results have been reported in the literature for improvements in IPSS, Qmax and PVR after both procedures, with some reporting more Qmax improvement with laser enucleation [18]. Both treatments continued to give good symptom relief at 6 months. There were no significant differences between mean IPSS after laser enucleation (6.3 ± 2.2) and after TURP (6.9 ± 2.4 , $p = 0.219$), while mean Qmax was still significantly higher after laser enucleation (24.0 ± 4.5) than after TURP (22.1 ± 4.2 , $p = 0.041$). There was a tendency to a lower PVR after laser enucleation (22.1 ± 13.7 mL vs 27.5 ± 15.2 mL, but not significant). Earlier studies comparing the two procedures with long-term follow-up demonstrated long-term improvement in IPSS, Qmax, PVR, and quality of life, and there was no significant difference between the long-term functional efficacy of the two procedures [19]. There was a good overall complication risk in both groups. Hematuria, which was significant after TURP (11.1%), was more frequent than after laser enucleation (2.2%) and transient urinary incontinence was more frequent after laser enucleation (11.1%) than after TURP (4.4%). Although none of these differences were significant, urethral stricture occurred in 6.7% vs. 2.2% and bladder-neck contracture occurred in 4.4% vs. 0%, respectively. Earlier studies have also failed to demonstrate a significant difference between laser and TURP regarding urinary retention, transient incontinence, bladder-neck contracture, or urethral stricture, or transfusion, but demonstrated that laser surgery was better in the hemostasis aspect [20]. There were a number of limitations in this study. The generalizability of the results could be restricted due to the relatively small number of patients (90) and the single-center study design. Follow-up was limited to 6 months for a period to see if there had been an increase in late urethral strictures, bladder-neck contracture, recurrent obstruction or reoperation. Surgeon experience could have also played a role in the surgical outcomes, as there is a known learning curve for laser enucleation. Furthermore, the size of the prostates were limited to the range of prostates included in the study, which may not be applicable to very large prostates. The sexual outcomes such as retrograde ejaculation and erectile function were not assessed.

CONCLUSION

It is concluded that both transurethral resection of the prostate and laser enucleation are eff

ective surgical options for benign prostatic hyperplasia. Laser enucleation was associated with less hemoglobin reduction, shorter bladder irrigation, catheterization, and hospital stay, and slightly greater improvement in urinary flow, although it required a longer operative time. Symptom improvement at six months was comparable between the two procedures, and postoperative complication rates were generally low. These findings suggest that laser enucleation may provide perioperative advantages while maintaining functional outcomes comparable to TURP.

REFERENCES

1. Lin D, Luo C, Cui K, Xu H, Yuan H, Luan Y, et al. 1470 nm diode laser enucleation versus bipolar transurethral resection of the prostate for the surgical management of benign prostatic hyperplasia: a randomized comparison. *Lasers Med Sci.* 2025;40(1):226. doi:10.1007/s10103-025-04478-9.
2. Morsy S, Elfeky M, Abdel-Rahman S, Torad H, Rammah A, Safwat M. Comparing surgical techniques: ThuLEP and transurethral BPEP for prostate over 80 grams. Intraoperative and postoperative results: a prospective randomized trial. *Arab J Urol.* 2025;23(1):1-7. doi:10.1080/20905998.2024.2395594.
3. Jiang B, Liang P, Wu Y, Wang W, Shen L. Safety and efficacy of transurethral holmium laser enucleation of the prostate versus bipolar transurethral resection of the prostate in the treatment of benign prostatic hyperplasia: a prospective randomized controlled trial. *Langenbecks Arch Surg.* 2024;409(1):313. doi:10.1007/s00423-024-03499-2.
4. Tadha AD, Sarkar D, Pal DK. A prospective, randomized study comparing the outcome after thulium laser enucleation of the prostate with conventional monopolar TURP for the treatment of symptomatic benign prostatic hyperplasia. *Urol Res Pract.* 2024;50(1):42-46. doi:10.5152/tud.2024.23128.
5. Bulut EC, Elmas B, Koparal MY, Coşkun Ç, Aydın U, Erten KŞ, et al. A comparison of the first 60 enucleation cases using a thulium fiber laser without a mentor to transurethral resection of the prostate and open prostatectomy, and the learning curve. *Medicina (Kaunas).* 2024;60(8):1356. doi:10.3390/medicina60081356.
6. Romero Otero J, Justo Quintas J, García Gómez B, Manfredi C, Sopena Sutil R, Peña Vallejo E, et al. Prospective randomized multicenter study to evaluate holmium versus new thulium fiber laser for prostate enucleation. *Minerva Urol Nephrol.* 2024;76(4):491-498. doi:10.23736/S2724-6051.24.05706-9.
7. Kosiba M, Filzmayer M, Welte MN, Hügenell L, Keller AC, Traumann MI, et al. Thulium fiber laser versus holmium laser enucleation of the prostate: results of a prospective randomized non-inferiority trial. *World J Urol.* 2024;42(1):49. doi:10.1007/s00345-023-04748-7.
8. Di Maida F, Grosso AA, Cadenar A, Mari A, Oriti R, Di Dio M, et al. Thulium fiber laser versus holmium laser enucleation of the prostate: results of a prospective randomized non-inferiority trial. *World J Urol.* 2024;42(1):223. doi:10.1007/s00345-024-04951-0.
9. Gauhar V, Nedbal C, Castellani D, Fong KY, Sofer M, Rodríguez Socarrás M, et al. Comparison between thulium fiber laser and high-power holmium laser for anatomic endoscopic enucleation of the prostate: a propensity score-matched analysis from the REAP Registry. *Eur Urol Focus.* 2024;10(1):182-188. doi:10.1016/j.euf.2023.06.009.
10. Abdelaziz AY, Kamal I, Abdelhakim MA, Abdelmohsen M, Meshref A, Naser I, et al. A prospective analysis of thulium laser enucleation in benign prostatic hyperplasia comparing low- and high-power approaches for prostates exceeding 80 g. *World J Urol.* 2024;42(1):265. doi:10.1007/s00345-024-04901-w.
11. Lee H, So S, Cho MC, Cho SY, Paick JS, Oh SJ. Clinical outcomes of holmium laser enucleation of the prostate: a large prospective registry-based patient cohort study under regular follow-up protocol. *Investig Clin Urol.* 2024;65(4):361-367. doi:10.4111/icu.20240080.
12. Spirito L, Capra M, Sciorio C, Romano L, Morelli M, Valtorta A, et al. Long-

- term functional outcomes and predictors of efficacy in thulium laser enucleation of the prostate for benign prostatic hyperplasia: a retrospective observational study. *J Basic Clin Physiol Pharmacol.* 2024;35(3):169-174. doi:10.1515/jbcpp-2024-0036.
13. Cantiello F, Crocerossa F, Alba S, Carbonara U, Pandolfo SD, Falagario U, et al. Refining surgical strategies in ThuLEP for BPH: a propensity score matched comparison of en-bloc, three-lobes, and two-lobes techniques. *World J Urol.* 2024;42(1):431. doi:10.1007/s00345-024-05136-5.
14. Suh J, Choo MS, Oh SJ. Efficacy and safety of low-power holmium laser enucleation of the prostate: a prospective short- and medium-term single-blind randomized trial. *Investig Clin Urol.* 2023;64(5):480-488. doi:10.4111/icu.20230017.
15. Bozzini G, Berti L, Maltagliati M, Besana U, Micali S, Roche JB, et al. Thulium:YAG versus continuous-wave thulium fiber laser enucleation of the prostate: do potential advantages of thulium fiber lasers translate into relevant clinical differences? *World J Urol.* 2023;41(1):143-150. doi:10.1007/s00345-022-04201-1.
16. Weinstein IC, Wu X, Arenas-Gallo C, Zhu A, Brant A, Al Hussein Al Awamlh B, et al. Adoption and outcomes of holmium laser enucleation of the prostate in the United States. *Urology.* 2023;179:106-111. doi:10.1016/j.urology.2023.05.028.
17. Petov V, Babaevskaya D, Taratkin M, Chuvalov L, Lusuardi L, Misrai V, et al. Thulium fiber laser enucleation of the prostate: prospective study of mid- and long-term outcomes in 1328 patients. *J Endourol.* 2022;36(9):1231-1236. doi:10.1089/end.2022.0029.
18. Kaya E, Yılmaz S, Açıkgöz O, Aybal HC, Yılmaz M, Gazel E, et al. Laser enucleation for prostates larger than 100 mL: comparison of HoLEP and ThuLEP. *Andrologia.* 2021;53(8):e14125. doi:10.1111/and.14125.
19. Kavoussi NL, Nimmagadda N, Robles J, Forbes C, Wang A, Stone B, et al. MOSES technology for holmium laser enucleation of the prostate: a prospective double-blind randomized controlled trial. *J Urol.* 2021;206(1):104-108. doi:10.1097/JU.0000000000001693.
20. Shoji S, Hanada I, Otaki T, Ogawa T, Yamada K, Uchida T, et al. Functional outcomes of transurethral thulium laser enucleation versus bipolar transurethral resection for benign prostatic hyperplasia over a period of 12 months: a prospective randomized study. *Int J Urol.* 2020;27(11):974-980. doi:10.1111/iju.14341.