



Longitudinal Assessment of Clinical and Functional Outcomes Following Thulium Laser Enucleation of the Prostate in Jordan

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Received: January 17, 2025

Accepted: April 15, 2025

ePublished: May 4, 2025

Abstract

Introduction: Significantly impairs the quality of life through lower urinary tract symptoms. Ejaculation-sparing Thulium laser enucleation, a minimally invasive technique, offers symptom relief while aiming to preserve sexual function. This study aimed to assess the clinical outcomes, safety, and efficacy of thulium laser enucleation of the prostate in Jordan

Methods: A longitudinal, quantitative study was conducted in three private clinics and three private hospitals in Amman, Jordan. This study included 29 male patients suffering from moderate to severe benign prostatic hyperplasia (BPH). Postoperatively, at intervals of 2, 4, 6, and 8 months following ejaculation-sparing thulium laser enucleation, several instruments were utilized to measure the maximum urinary flow rate, post-void residual (PVR) volume, average flow rate, prostate-specific antigen (PSA), International Prostate Symptom Score (IPSS), and International Index of Erectile Function (IIEF-5).

Results: After undergoing ejaculation-sparing thulium laser enucleation, the mean maximum urinary flow rate saw a significant increase from 6.3 ± 2.8 mL/s at baseline to 19.8 ± 3.2 mL/s at 2 months. It then increased to 20.6 ± 3.0 mL/s at 4 months and to 19.0 ± 1.7 mL/s at 8 months ($P < 0.001$). Furthermore, the average urinary flow rate improved, rising from 4.31 ± 1.8 mL/s to 9.5 ± 4.1 mL/s, then to 16.2 ± 2.8 mL/s, and finally to 12.7 ± 2.9 mL/s at the same intervals ($P < 0.001$). Symptom severity, as indicated by the IPSS, underwent a significant improvement from 21.33 ± 3.1 to 5.1 ± 3.4 ($P < 0.001$).

Conclusion: Ejaculation-sparing thulium laser enucleation is an effective and safe treatment for BPH. It offers notable improvements in urinary function and symptom relief, and it also helps to preserve sexual function.

Keywords: Ejaculation; Jordan; Lasers; Prostatic hyperplasia; Sexual health.



Introduction

Benign prostatic hyperplasia (BPH) is a prevalent condition affecting the aging male population worldwide. It has significant implications for the quality of life. The disease is characterized by various lower urinary tract symptoms, such as urinary retention, reduced urinary flow, frequent voiding, and nocturia.^{1,2} If left untreated, BPH can lead to serious complications such as acute urinary retention, bladder stones, recurrent urinary tract infections, and in severe cases, kidney damage.^{3,4}

The evolution of BPH treatments has introduced a spectrum of surgical and pharmacological interventions.⁵⁻⁷ Many factors influence the choice of surgical intervention. These factors include the severity of symptoms, prostate size, patient age, comorbidities, and the availability

of healthcare resources.^{8,9} This minimally invasive technique combines effective removal of prostatic tissue with reduced post-operative risks.^{10,11} One of the most notable advancements in BPH management is the introduction of ejaculation-sparing surgical techniques, representing a significant shift in preserving sexual health postoperatively.^{11,12} Conventional methods often compromise sexual function. These side effects can have profound psychosocial implications, particularly in regions like Jordan where cultural and familial values place significant emphasis on sexual health as a key component of well-being.^{12,13} Ejaculation-sparing techniques, such as the thulium laser enucleation approach, address these concerns by preserving sexual function and providing effective symptom relief.^{14,15}

Ejaculation-sparing thulium laser enucleation of the prostate has emerged as a promising solution for managing BPH.^{16,17} It results in quicker recovery times, shorter hospital stays, and fewer post-operative complications.¹⁸⁻²⁰

In the Jordanian context, this is significant as healthcare providers strive to balance traditional values with modern medical advancements.^{21,22} By addressing the physical symptoms and psychosocial well-being, this technique offers a holistic solution to the challenges posed by BPH, paving the way for its broader adoption in clinical practice.²³⁻²⁵ Accordingly, this study aimed to evaluate the clinical outcomes, safety, and efficacy of thulium laser enucleation of the prostate in Jordan, focusing on urinary function, symptom relief, and overall post-operative recovery.

Methods

Study Design

This study utilized a longitudinal design to assess the outcomes of ejaculation-sparing thulium laser enucleation of the prostate. The research was conducted across three private clinics and three private hospitals in Amman, Jordan.

Sample

The study includes 29 male patients diagnosed with BPH. Participants were chosen based on predefined inclusion and exclusion criteria consistent with clinical guidelines for surgical intervention. The inclusion criteria required patients to possess moderate to severe lower urinary tract symptoms due to BPH, as assessed by the International Prostate Symptom Score (IPSS), together with eligibility for ejaculation-sparing thulium laser enucleation based on prostate size and functional status. A purposeful sampling technique was utilized.

The sample size for this study was determined based on prior literature, statistical power analysis, and clinical feasibility. Previous studies on ejaculation-sparing thulium laser enucleation reported similar cohort sizes, with studies of 20–50 patients providing sufficient data to evaluate changes in urinary function, symptom relief, and sexual function outcomes.^{15,20,24} A power analysis was carried out to estimate the minimum sample size required to detect notable differences in key parameters such as maximum urinary flow rate, post-void residual (PVR) volume, and IPSS, assuming a power of 80% and an alpha level of 0.05. Based on these computations, a minimum of 25–30 participants was deemed sufficient to achieve statistical significance.

Intervention

All patients underwent ejaculation-sparing thulium laser enucleation of the prostate (ES-ThuLEP) following a standardized protocol for multi-hospital consistency. A pre-operative evaluation covered urinary function,

erectile function, urinary flow rates, PVR volume, and prostate-specific antigen (PSA) levels. Strict inclusion and exclusion criteria ensured uniform patient selection, only including those who met defined clinical standards. The procedure utilized a high-powered thulium laser (2013 nm), tailored for precise tissue cutting and coagulation with minimal thermal damage. The surgical method prioritized the preservation of key anatomical structures while effectively removing obstructive prostatic tissue. Identifying critical structures endoscopically was the initial step.¹³⁻¹⁶

The enucleation technique involved gently separating the prostatic lobes along natural surgical planes using a thulium laser. This allowed for accurate dissection with minimal collateral thermal damage. The procedure performed a controlled en bloc enucleation of the adenoma, ensuring minimal interference to the bladder neck, and ejaculatory ducts. This aimed to maximize functional preservation and reduce the risk of retrograde ejaculation.¹³⁻²⁵

A standardized post-operative care protocol was implemented across all sites to ensure consistent recovery and follow-up. Bladder irrigation was maintained for 24–48 hours, and urethral catheters were removed within 48–72 hours based on voiding trials. Patients were discharged once normal urinary function had been confirmed, with follow-up evaluations scheduled at 2, 4, 6, and 8 months. To maintain uniformity in surgical outcomes, all surgeons involved underwent pre-study training to ensure consistent application of the technique. Data collection adhered to a centralized methodology, and regular quality audits were conducted to verify adherence to surgical protocols.¹³⁻²⁵

Instruments

Validated instruments were used to collect pre-and post-operative clinical data: average urinary flow rates (Qave) and maximum and average urinary flow rates (Qmax), measured in milliliters per second; PSA levels, measured in nanograms per milliliter; PVR volume, measured in milliliters; IPSS, and International Index of Erectile Function (IIEF-5), which quantify urinary symptoms and erectile function.²

The Dindo-Clavien system is used to assess the severity of complications. The system spans from Grade I (minor complications not requiring intervention) to Grade V (fatalities due to complications). Grade I includes complications that resolve on their own and do not necessitate medical or surgical treatment. Grade II consists of complications managed with pharmaceutical interventions like antibiotics or blood transfusions. Grade III pertains to surgical, endoscopic, or radiological interventions, with Grade IIIa not necessitating general anesthesia and Grade IIIb requiring it. Grade IV is for life-threatening complications needing management in

an intensive care unit (ICU), and Grade V denotes patient death.²⁰⁻²⁵

Data Collection

Data collection was conducted at baseline (pre-operative) and at follow-up intervals of 2, 4, 6, and 8 months post-operation. Measurements were carried out by trained healthcare professionals. Clinical parameters, such as urinary flow rates, PSA levels, and PVR, were documented during patient visits to ensure consistency and accuracy.

Data Analysis

The clinical outcomes were summarized using descriptive statistics (means and standard deviations). Trends and statistically significant changes over time were assessed using ANOVA. A P value of less than 0.05 was deemed significant. IBM SPSS® version 22.0 (IBM Corp., Armonk, NY, USA, 2013) was used for all calculations.

Results

As depicted in Table 1, the study cohort comprises men with moderate to severe BPH. Their age distribution indicates an older patient population. Elevated levels of prostate volume and PSA suggest significant prostatic enlargement. Pre-operative urinary flow rates were low, signaling obstruction, whereas PVR volume was high, suggesting incomplete bladder emptying. The patients also bore a high symptom load, as shown by high IPSS scores.

As shown in Table 2, the intraoperative parameters indicate that ejaculation-sparing thulium laser enucleation of the prostate was executed with marginal blood loss, ensuring a safer surgical experience for patients. The documented drop in hemoglobin was relatively low, suggesting this technique minimizes intraoperative

bleeding, a widely recognized advantage of laser-based enucleation procedures over traditional surgical methods.

The operative time was within a reasonable range, reflecting surgical efficiency and the precision of the laser technique. The duration of laser application adhered to international standards for this procedure, indicating the effective application of the technique to achieve optimal prostatic tissue removal. Additionally, the weight of the enucleated prostate tissue was within the expected range for patients undergoing this type of intervention.

As shown in Table 3, the overall incidence of post-operative complications was relatively low. This suggests that ejaculation-sparing Thulium laser enucleation of the prostate is a safe and well-tolerated procedure. Among the reported complications, a few patients experienced acute urinary retention, suggesting that while the procedure effectively restores urinary function, some cases may require temporary catheterization or additional management.

The most frequently reported post-operative issue was haemospermia, which was experienced by numerous patients, especially in the early post-operative period. The incidence peaked 2 months postoperatively, but progressively declined over subsequent follow-up intervals, with only rare cases reported at 6 and 8 months.

Table 1. Baseline Preoperative Clinical Characteristics of Patients Undergoing Ejaculation-Sparing Thulium Laser Enucleation of the Prostate in Jordan

Characteristic	Mean ± SD
Age (y)	59.8 ± 13.2
Prostate volume (cc)	73.70 ± 27.7
PSA (ng/mL)	3.23 ± 1.9
Qave (mL/s)	4.31 ± 1.8
Qmax (mL/s)	6.3 ± 2.8
PSA (mL)	68.14 ± 28
Voided volume (mL)	244.68 ± 77
IIEF-5 score	19.67 ± 6.1
IPSS score	24.33 ± 3.1
Characteristic	Number (%)
Previous alpha-blocker therapy	15 (51.7%)
Previous alpha blocker+ 5 alpha-reductase inhibitor	6 (20.9%)
Bladder catheter	2 (6.9%)

Abbreviations: PSA, Prostate-specific antigen; IIEF-5, International Index of Erectile Function; IPSS, International Prostate Symptom Score.

Table 2. The Intra-operative and Peri-operative Parameters for Patients Who Underwent Ejaculation-Sparing Thulium Laser Enucleation of the Prostate in Jordan

	Parameter	Mean ± SD
Intra-operative parameters	Hb drop, g/dL	0.837 ± 0.651
	Operative time, min	137.361 ± 63.054
	Use of thulium laser, min	67.146 ± 10.509
	Enucleated tissue weight, g	29.016 ± 13.206
Peri-operative parameters	Hospitalization, days	2.976 ± 1.023
	Stop bladder irrigation, days	1.767 ± 0.837
	Catheter removal, days	2.604 ± 0.558

Table 3. The Post-operative Complications Among Patients Who Underwent Ejaculation-Sparing Thulium Laser Enucleation of the Prostate in Jordan

Post-Operative Complication	Number (%)
Acute urinary retention	3 (5.56%)
Prostate adenocarcinoma	2 (3.70%)
Bladder neck sclerosis	2 (3.70%)
Haemospermia at 2 months	6 (11.11%)
Haemospermia at 4 months	4 (7.41%)
Haemospermia at 6 months	1 (1.85%)
Haemospermia at 8 months	1 (1.85%)
Dindo-Clavien Grade	
Grad 1	12 (22.22%)
Grade IIIa	3 (5.56%)
Grade IIIb	2 (3.70%)
Not classified	2 (3.70%)

The majority of observed complications were mild and self-limiting, requiring no medical intervention. Haemospermia, the most frequent issue, gradually declined over time and resolved spontaneously.

As demonstrated in Table 4, significant improvements in urinary function were observed in patients following ejaculation-sparing thulium laser enucleation of the prostate. The maximum (Qmax) and average urinary flow rates (Qave) increased notably after surgery, reaching their peak at 4 months and stabilizing by 8 months. Symptom severity, measured by the IPSS, decreased significantly, indicating substantial relief from lower urinary tract symptoms such as weak stream, nocturia, urgency, and incomplete voiding. Improvements in sexual function, assessed using the IIEF-5, showed a modest yet statistically significant enhancement after the operation, suggesting that the procedure preserves erectile function while potentially benefiting overall urological health.

Discussion

The study employed a structured methodology to assess the outcomes of ejaculation-sparing thulium laser enucleation of the prostate in Jordan. Pre-operative results highlighted the severity of BPH in Jordan. Elevated prostate volume and PSA levels indicated significant prostatic enlargement and pathology. This is consistent with observations in Middle Eastern populations where delayed diagnosis is common.^{2,24,25} The low urinary flow rates and high PVR volumes demonstrated the functional impact of advanced BPH. This emphasizes the need for effective surgical interventions.^{22,23}

The intraoperative parameters ensure the safety of ejaculation-sparing thulium laser enucleation. Minimal blood loss during the procedure underscores the minimally invasive nature of this technique. This is aligned with global findings on laser-based surgeries.⁷⁻⁹ The effective use of the thulium laser, along with the amount of enucleated tissue, is critical for achieving long-term symptom relief, reflecting the efficiency of the procedure and resolution of the obstruction.^{22,25}

These findings are especially important in Jordan, where reducing hospital stays can significantly improve resource utilization and reduce costs.^{22,24}

Complication rates, such as transient haemospermia

and low incidences of acute urinary retention and bladder-neck sclerosis, underscore the safety of the procedure.^{12,19} The low complication rates highlight the potential of the procedure to become a preferred surgical option for BPH in the region.^{17,20,23}

The longitudinal improvements in urinary flow rates over follow-up intervals demonstrated the effectiveness of the procedure in restoring bladder function.^{13,16,22} These outcomes are critical in settings such as Jordan since patients often delay surgical intervention until symptoms become severe.^{22,24} The reduction in PSA levels reflects successful tissue removal and reduced inflammation. This is aligned with global standards for evaluating BPH treatment efficacy.^{8,25}

The gradual increase in voided volume over time reflects improvements in bladder efficiency and capacity, enhancing the quality of life. These improvements also reduce the risk of secondary complications, including urinary tract infections, which are common in patients with significant PVR volumes.^{21,23}

The dramatic decrease in IPSS scores signifies the significant symptomatic relief achieved through this procedure.^{11,13} This outcome is particularly relevant in Jordan, where improving the quality of life for the aging population is a key healthcare priority.^{23,25} The ability of this procedure to address both physical and psychological burdens makes it a valuable treatment option for BPH patients.²⁵

The slightly improved IIEF 5 scores echo the success of the ejaculation-sparing technique in preserving sexual function. This is a critical consideration in Jordan, where cultural values lay significant emphasis on sexual health as a component of overall well-being.^{18,19} These findings parallel international studies that advocate for surgical strategies prioritizing the quality of life while enhancing functional outcomes.^{20,21}

When comparing the current findings with prior research, ejaculation-sparing thulium laser enucleation of the prostate (ES-ThuLEP) exhibits similar, if not superior, outcomes to other laser-based prostate enucleation techniques. Several international studies have assessed holmium laser enucleation of the prostate (HoLEP) and standard thulium laser enucleation procedures, reporting similar improvements.^{14,18,19} The present study underlines

Table 4. The Longitudinal Outcomes of the Patients Undergoing Ejaculation-Sparing Thulium Laser Enucleation of the Prostate in Jordan

Parameter	Baseline	2 Months	4 Months	8 Months	P Value
Qmax, mL/s (mean±SD)	6.3±2.8	19.8±3.2	20.6±3	19±1.7	<0.001
Qave, mL/s (mean±SD)	4.31±1.8	9.5±4.1	16.2±2.8	12.7±2.9	<0.001
PSA level, ng/mL (mean±SD)	3.23±1.9	2.3±0.9	2.1±0.8	1.6±0.9	<0.001
PVR, mL (mean±SD)	68.18±18	19.9±9.9	17.5±11.3	22.3±13.8	<0.001
Voided volume, mL (mean±SD)	244.68±77	301.4±79.5	299.9±83.1	318.8±88.8	0.799
IPSS score	21.33	3.4±2	5.6±3.2	5.1±3.4	<0.001
IIEF-5 score	17.67±6.1	19.8±2.7	19.3±1.9	20.1±1.9	0.042

this benefit, as demonstrated by the stability of the IIEF-5 scores. This suggests that the procedure successfully maintained sexual function without hindering the efficiency of bladder outlet obstruction relief.

The low complication rate observed in this study aligns with findings from other research on minimally invasive laser-based prostate surgeries.^{12,19} The incidences of acute urinary retention and bladder-neck sclerosis also fell within the expected range when compared to other laser enucleation techniques, and were effectively managed without long-term consequences.^{7,20}

Limitations

Despite its strengths, this study has several limitations. The relatively small sample size of 29 patients restricts the applicability of the findings to a broader population. The study was conducted in private clinics and hospitals in Amman, which may not fully represent outcomes in public healthcare settings or rural areas.

Future Implications

The findings of this study propose numerous directions for future research and clinical practice. Larger, multicenter studies involving diverse healthcare settings across Jordan, including public hospitals and rural clinics, are needed to affirm and enlarge these results. Comparative studies that evaluate the effectiveness of ejaculation-sparing thulium laser enucleation against other surgical and non-surgical interventions would provide a comprehensive understanding of its strengths and limitations.

Conclusion

This study demonstrated that, for the management of BPH in Jordan, ejaculation-sparing thulium laser enucleation of the prostate is an effective, safe, and patient-centered surgical option. It offers significant improvements in urinary function, provides symptom relief, preserves sexual function, and reduces complication rates.

Acknowledgments

The authors express their gratitude to the medical staff and research teams at the participating private hospitals and clinics in Amman, Jordan.

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Competing Interests

The authors declare no conflicts of interest related to this study.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Approval

Ethical approval was obtained from the Institutional Review Board (IRB) of Mutah University (reference number: 21021). Data confidentiality was maintained by anonymizing patient records and securely storing data. Participants were informed of their right to withdraw from the study at any point without any impact on their clinical care. The study adhered to the ethical guidelines outlined in the Declaration of Helsinki.

Funding

This research received no specific grant from any funding agency, commercial, or not-for-profit sectors.

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