

Diode laser enucleation prostate for benign prostatic hyperplasia: Outcomes of the Leonardi ejaculation sparing technique

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Summary *Introduction: Benign prostatic hyperplasia (BPH) significantly impairs quality of life and may lead to complications such as urinary retention and recurrent infections. While endoscopic enucleation techniques provide effective relief, they are frequently associated with loss of antegrade ejaculation. The Leonardi ejaculation-sparing technique (LEST) was developed to preserve ejaculatory function during diode laser enucleation of the prostate (DILEP).*

Methods: We conducted an observational, retrospective analysis of 99 men undergoing DILEP with LEST between January 2018 and June 2020. Inclusion criteria were symptomatic BPH refractory to medical therapy, prostate volume ≥ 40 mL, and suitability for endoscopic surgery. Functional outcomes (IPSS, Q_{max} , PVR), erectile function (IIEF-5), and ejaculatory status (MSHQ-EjD) were assessed preoperatively and at 6 months. Patient satisfaction was evaluated with a dedicated 5-item questionnaire.

Results: Mean age was 48.1 years, and median prostate volume was 67 mL. At 6 months, IPSS decreased from 21.6 to 3.8, Q_{max} improved from 9.1 to 25.7 mL/s, and PVR decreased from 103 to 6.8 mL (all $p < 0.01$). Erectile function showed modest improvement (IIEF-5: 14.4 to 16.2; $p < 0.01$). Antegrade ejaculation was preserved in 94.1% of patients. Satisfaction was high, with $> 80\%$ willing to repeat the procedure and denying regret. No major complications occurred.

Conclusions: DILEP with LEST provides excellent functional results with high rates of ejaculatory preservation and patient satisfaction. This technique may represent a patient-centered alternative for BPH surgery, especially in younger men prioritizing sexual function.

KEY WORDS: DILEP; BPH; Ejaculation sparing surgery; Antegrade ejaculation; Prostate.

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INTRODUCTION

The management of prostatic diseases, whether malignant (1-3) or benign (4, 5), medical or surgical, is not only crucial for reduce urinary symptoms and the related complications but also has a significant impact on men's sexual health, often leading to erectile dysfunction, ejaculatory

disorders, and a consequent reduction in quality of life (6-8). Benign prostatic hyperplasia (BPH) is one of the most prevalent conditions in aging men, with a significant impact on the quality of life and often significant lower urinary tract symptoms (LUTS), impaired voiding efficiency, and associated complications such as acute or chronic urinary retention and recurrent Urinary Tract Infections (UTIs). Surgical management is recommended when conservative or pharmacological treatments fail (5). The transurethral resection of the prostate (TURP) has historically represented the gold standard. Over the last years, endoscopic enucleation techniques using different energy sources (holmium, thulium, green laser, diode lasers) are progressively replacing TURP in the management of medium and large prostates (9-13). In parallel, the last decades have also witnessed the incredibly rapid expansion of robotic surgery, progressing up to single-site platforms, which now provide additional minimally invasive options for the surgical management of BPH (14, 15). However, one of the main issues of endoscopic enucleation of the prostate is the significant risk of loss of antegrade ejaculation, reported in up to 70% of patients after some endoscopic procedures (16, 17).

The ejaculatory dysfunction has a substantial impact on patients' sexual satisfaction and quality of life. The fear of postoperative sexual side effects is one of the leading reasons why many men delay or refuse surgical intervention for BPH. In the contemporary medical practice, which is patient-centered, techniques that ensure both effective relief of obstruction and preservation of sexual function are increasingly demanded.

The Leonardi ejaculation-sparing technique (LEST), previously described in 2019 (18), was specifically developed to preserve the anatomical structures involved in the ejaculatory mechanism, including the verumontanum, genital sphincter, and selected bladder neck fibers, allowing, at the same time, complete adenoma enucleation using diode laser and a dedicated fiber (Twister).

Initial feasibility reports suggested promising results, with high rates of preservation of antegrade ejaculation without compromising voiding outcomes. However, evidence

is still limited, particularly in men with very large middle lobes and very high-volume prostates, where surgical dissection is more challenging and the risk of functional impairment is higher.

In this light, the aim of the present study is to report the outcomes of a larger size cohort of men undergoing diode laser enucleation with the LEST approach. We aimed to evaluate standard functional outcomes but also ejaculatory preservation and patient-reported satisfaction at 6 months, using a dedicated questionnaire. This represents one of the largest and most comprehensive cohorts of LEST-treated patients reported to date, providing important insights into the feasibility, safety, and patient-centered value of this novel approach.

MATERIALS AND METHODS

Study design and patients' selection

This was an observational, retrospective study based on prospectively collected data of patients undergoing diode laser enucleation of the prostate using the LEST between January 2018 and June 2020.

Inclusion criteria for LEST were: men with symptomatic BPH refractory to medical therapy, prostate volume ≥ 40 mL, and suitability for endoscopic surgical management. Exclusion criteria included: prior prostate or urethral surgery, known prostate cancer, neurogenic bladder dysfunction, or incomplete follow-up data at 6 months.

All patients included were highly motivated to undergo a procedure with the potential advantage of preserving antegrade ejaculation. They were informed, however, that the technique could not guarantee complete (100%) preservation of ejaculation (19).

Preoperatively, all patients underwent a PSA assessment. While in the past elevated PSA levels might have led to non-invasive testing such as PCA3 3 or even random biopsy, current practice involves routine multiparametric MRI. In cases where cancer was suspected, a targeted fusion biopsy was performed prior to surgery.

Surgical technique and equipment

All interventions were carried out by a single experienced surgeon (R.L.), with extensive expertise in laser prostate surgery. The procedures were performed using a high-power diode laser platform with dual wavelengths (980 and 1470 nm) in combination with dedicated "Twister" quartz contact fibers, specifically designed to allow precise tissue vaporization and enucleation while minimizing collateral damage to ejaculatory structures. The standard LEST technique has been performed (19).

Outcomes and follow-up

Preoperative assessment included general data such as age, prostate-specific antigen (PSA), prostate volume (measured by ultrasound), maximum urinary flow rate (Q_{\max}), post-void residual urine volume (PVR), International Prostate Symptom Score (IPSS), and erectile function assessed with the 5-item International Index of Erectile Function (IIEF-5). Ejaculatory function was assessed using the MSHQ-EjD short form. At 6-month follow-up, the same functional outcomes were reassessed, including

IPSS, Q_{\max} , PVR, IIEF-5, and ejaculatory status. Prostate volume reduction was also recorded (measured by ultrasound). In addition, patient-reported satisfaction was evaluated using a dedicated 5-item decisional satisfaction questionnaire (see **Supplementary File**).

Patient satisfaction questionnaire

The questionnaire explored agreement or disagreement with five key statements regarding surgical decision-making and postoperative outcomes, using a 5-point Likert scale (from "strongly agree" to "strongly disagree"). Items included willingness to repeat the procedure, absence of regret, and perceived benefits versus harms.

Statistical analysis

Continuous variables were expressed as mean \pm standard deviation or median (interquartile range) as appropriate. Comparisons between preoperative and postoperative outcomes were performed using paired t-tests or Wilcoxon signed-rank tests, depending on data distribution. Categorical variables were summarized as frequencies and percentages, and differences were assessed with the χ^2 or Fisher's exact test. A p-value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS v.25 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 99 patients were included in the study. The mean age was 48.1 ± 3.5 years, reflecting a relatively young surgical population, and therefore a group in which preservation of sexual function may be particularly relevant. The median prostate volume was 67 ml [57.5-78.5], with a mean of 68.2 ± 17.6 cc. Mean PSA was 2.2 ± 1.4 ng/mL. At baseline, patients presented with a high symptom burden, as reflected by a mean IPSS of 21.5 ± 5.1 , low Q_{\max} (9.1 ± 2.8 mL/s), and significant PVR (102.3 ± 46.1 mL). The baseline erectile function assessed with IIEF-5 averaged 14.4 ± 5.5 (Table 1).

At a median follow-up of 6 months, all functional outcomes demonstrated marked improvement. IPSS decreased from 21.6 to 3.8 ($p < 0.01$), reflecting a substantial reduction in LUTS. Q_{\max} improved almost three-fold from 9.1 to 25.7 mL/s ($p < 0.01$). PVR decreased dra-

Table 1

Descriptive characteristics of 99 patients who underwent LEST between January 2018 and June 2020.

Parameter	Cohort (n = 99)
Age at surgery (yr), mean \pm SD	48.1 \pm 3.5
BMI (kg/cm ²), median (IQR)	25.5 (24, 28)
PSA level (ng/ml), mean \pm SD	2.2 \pm 1.4
Prostate volume (ml), median (IQR)	67 (57.5-78.5)
Preoperative IPSS, mean \pm SD	21.5 \pm 5.1
Preoperative IIEF-5, mean \pm SD	14.4 \pm 5.5
Q_{\max} (mL/s), mean \pm SD	9.1 \pm 2.8
PVR (ml), mean \pm SD	102.3 \pm 46.1

Table 2. Functional results of 99 patients who underwent LEST between January 2018 and June 2020 at a median follow up of 6 months.

Parameter	Cohort (n = 99)	P value*
6 months IPSS, mean ± SD	3.8 ± 3.1	< 0.01
6 months IIEF-5, mean ± SD	16.2 ± 4.5	< 0.01
Qmax (mL/s), mean ± SD	25.7 ± 3.1	< 0.01
PVR (ml), mean ± SD	6.8 ± 10.3	< 0.01

matically from 103 to 6.8 mL ($p < 0.01$), indicating effective bladder emptying (Table 2, Figures 1-3). These improvements were not only statistically significant but also clinically meaningful, with the majority of patients reaching values within the normal or near-normal range. Regarding sexual function, the IIEF-5 scores increased modestly but significantly, from 14.4 to 16.2 ($p < 0.01$), suggesting stability or mild improvement in erectile function. Importantly, antegrade ejaculation was preserved in 94.1% of the 85 patients with available data.

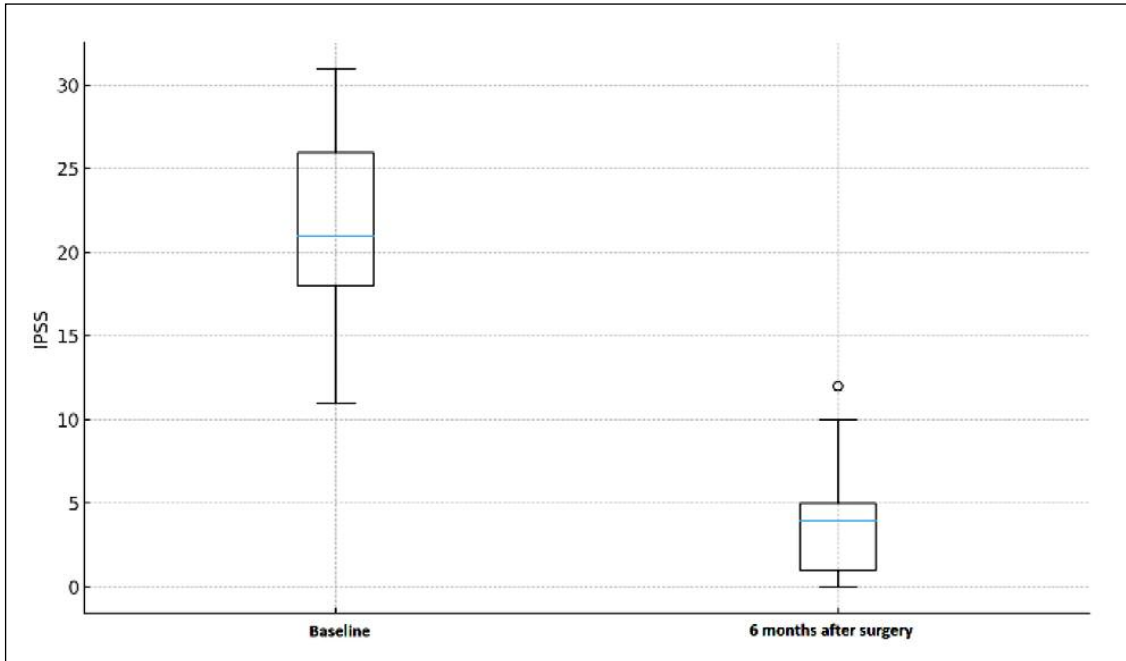


Figure 1. Box plot showing the distribution of International Prostate Symptom Score (IPSS) values before and 6 months after surgery.

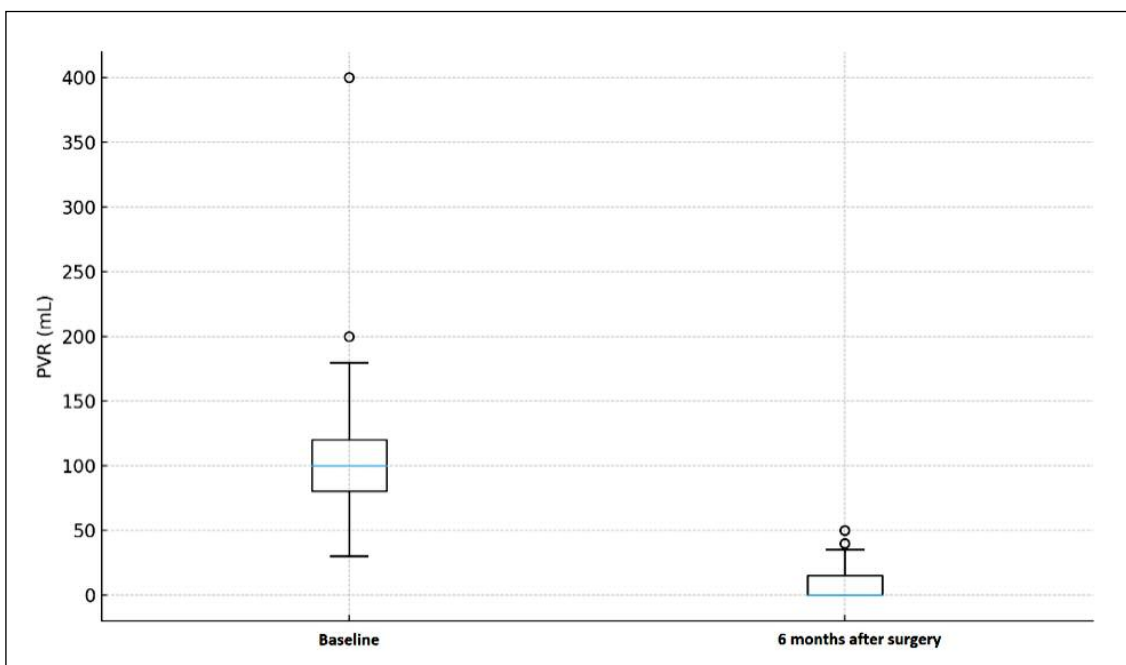


Figure 2. Box plot of post-void residual urine volume (PVR) at baseline and 6 months after surgery. PVR decreased markedly following the procedure.

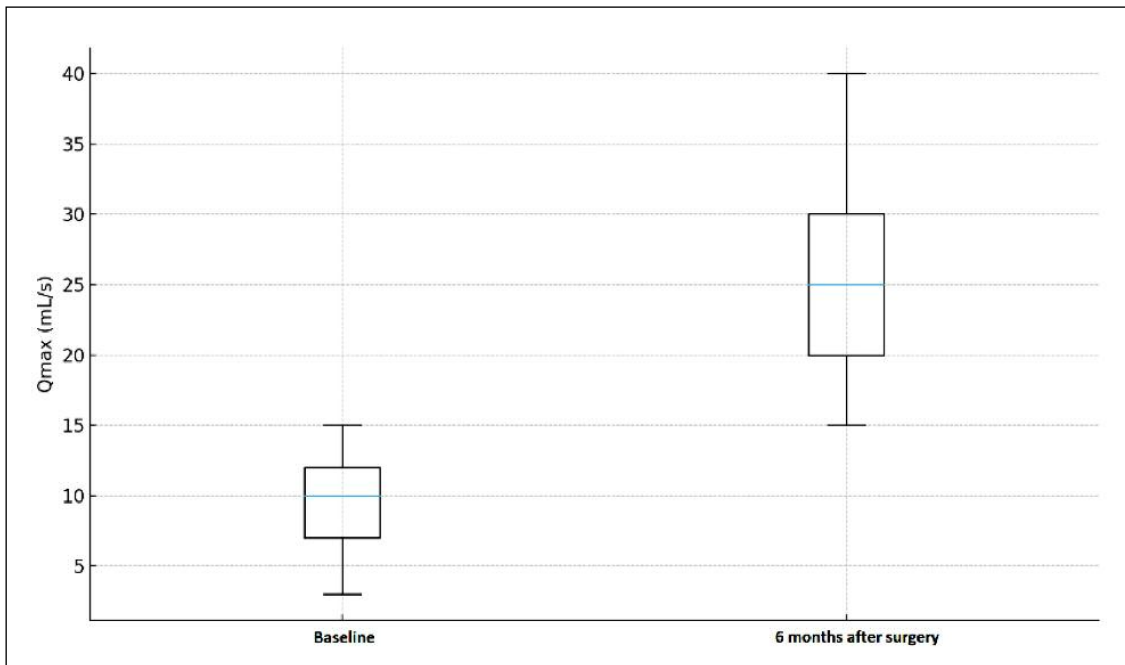


Figure 3. Box plot illustrating maximum urinary flow rate (Q_{max}) before and after surgery.

Responses to the 5-item decisional satisfaction questionnaire demonstrated consistently high satisfaction levels. Over 80% strongly agreed that they had made the right choice and would undergo the procedure again, while nearly all denied regret or harm from the decision. Specifically, for the statement “I would make the same choice”, 78.4% strongly agreed and 20.7% agreed. For negatively framed items such as “I regret my choice” and “The choice caused me damage”, approximately 80% of patients strongly disagreed. Collectively, these findings highlight that the combination of functional efficacy and ejaculatory preservation translated into exceptionally high patient-perceived value.

Although detailed perioperative morbidity data were limited, the overall safety profile was favorable. No transfusions or re-interventions were required, and minor complications were rare, consistent with the expected profile of diode laser enucleation.

DISCUSSION

The present study demonstrates that diode laser enucleation using the LEST provides excellent functional outcomes while achieving great preservation of antegrade ejaculation and very high patient satisfaction. The improvement in IPSS, Q_{max} , and PVR observed in this series is comparable to results historically reported for HoLEP, ThuLEP, GreenLEP in medium-large prostates (20-23). For example, large multicenter HoLEP series have reported IPSS reductions of about 17-20 points and Q_{max} increases of 12-16 mL/s at 6-12 months (24-25).

Our improvements (IPSS -18, Q_{max} +16.5 mL/s, PVR -95 mL) fall squarely within these ranges, supporting the efficacy of the LEST approach. Crucially, this suggests that sparing key anatomical structures does not compromise the deobstructive effect of the surgery.

Conventional endoscopic enucleation is associated with

rates of retrograde ejaculation > 70%, largely due to disruption of the ejaculatory hood, bladder neck fibers, and verumontanum. 16-18 This adverse effect, although not directly harmful, may significantly reduce patient satisfaction, particularly in young men. Many strategies to mitigate this problem have been described, including “ejaculation hood sparing” TURP and modified HoLEP techniques, with high reported ejaculatory preservation rates. Some of these approaches have consistently achieved rates > 80% (26-31). In our cohort, preservation reached 94.1% among respondents, a significant result that underscores the technical validity of LEST. This outcome is particularly relevant given the relatively young mean age of our patients, highlighting the role of LEST in a population with high expectations for preserved sexual function. The importance of patient satisfaction is of mandatory importance. Increasingly, surgical success is defined not only by objective functional metrics but also by alignment with patient priorities. In our series, decisional satisfaction was extremely high, with most patients affirming they made the right choice and would repeat the procedure. The congruence between objective functional efficacy and subjective patient satisfaction strengthens the external validity of the findings. Our results suggest that LEST maintains the favorable safety profile of diode laser enucleation, with very low perioperative morbidity and no transfusion requirement. Although complication details were limited, the absence of major adverse events further supports the feasibility of the technique.

In order to optimize surgical outcomes, particularly the preservation of antegrade ejaculation, it is essential for surgeons to gain a thorough understanding of the prostatic anatomy and the genital sphincter complex. Adequate anatomical knowledge allows precise dissection while minimizing the risk of functional compromise. To achieve this level of proficiency, structured training on synthetic models and cadaveric dissection should be undertaken

before performing such procedures independently on patients, thereby ensuring both safety and functional preservation (32-35).

This study is not without limitations. Its retrospective design, despite prospective data collection, introduces inherent biases. The absence of a control group undergoing standard procedures or other ejaculation-sparing technique precludes direct comparison of ejaculation rates and functional improvements. The follow-up period of 6 months, while adequate to assess early outcomes, is relatively short; durability of the antegrade ejaculation beyond 1-2 years remains to be demonstrated. In addition, questionnaire response rates were incomplete for some items, and the MSHQ-EjD was underutilized, limiting detailed assessment of sexual function domains. The size is based on a single surgeon, highly expert for this procedure, therefore, his results may be reproducible by every surgeon after an adequate learning curve. All advanced surgery techniques (*Robot Assisted Simple Prostatectomy, LEST, etc.*) require a learning curve to get the best out of the technique used. Furthermore, in some settings, the culture traditionally tied to values of masculinity, virility, and modesty persists. This may translate into greater difficulty in admitting sexual problems such as erectile dysfunction, reduced libido, or ejaculatory disorders, compared to more urbanized or culturally liberalized contexts. This may be one of the reasons for obtaining such high rates of ejaculatory preservation. Finally, the study was conducted in a single center with experienced surgeons, potentially limiting generalizability.

Despite these limitations, our findings have clear clinical implications. LEST represents a viable surgical option for men with symptomatic BPH, especially those with large

prostates who also prioritize sexual function preservation. Its near-complete preservation of ejaculation may reduce patient reluctance to undergo surgery, thus improving treatment uptake and quality of life. Future studies should aim to validate these findings in randomized controlled designs, with longer follow-up and broader assessment of sexual and psychosocial outcomes. Multicenter collaboration will be essential to confirm generalizability and to establish LEST as a standard technique within guidelines.

CONCLUSIONS

Diode laser enucleation with LEST combines the efficacy of complete enucleation with the advantage of consistent ejaculatory preservation. For younger men and those concerned about sexual side effects, it offers a truly patient-centered surgical solution. If validated by larger prospective trials, LEST may represent a paradigm shift in the surgical management of BPH.

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DECLARATIONS

Ethical approval and consent for participate: This study was conducted in accordance with the Declaration of Helsinki. It is a retrospective analysis involving standard clinical practices, including Diode Laser Enucleation of the Prostate (DILEP) with the Leonardi Ejaculation Sparing Technique (LEST), which are part of routine care according to current clinical guidelines for the management of benign prostatic hyperplasia (BPH). For this reason, and considering that in our institution patients routinely provide written consent for the use of their anonymized clinical data for research purposes, specific ethical committee approval was not required.

Consent for publication: All patients provided informed consent for the surgical procedure, data collection and publication.

Availability of data and material: On demand to the main author R.L.

Competing interests: The authors declare that they have no competing interests.

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