Median lobe vs. complete gland holmium laser enucleation of the prostate: A propensity score matching

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Abstract

Introduction: Benign prostatic hyperplasia (BPH) is a common condition affecting aging men. While holmium laser enucleation of the prostate (HoLEP) is one of the most effective treatments for BPH, variations of the procedure, such as median lobe HoLEP (MLHoLEP), are rarely reported. Here, we report our institution's experience with partial HoLEP.

Methods: Our institutional prospective database was queried for patients having undergone median or individual lateral lobe enucleation between 2007 and 2018. A control cohort of patients who underwent standard HoLEP (sHoLEP) was identified using 1:2 propensity score matching based on age, prostate size, maximal flow rate (Qmax), postvoid residual volume (PVR), and American Urological Association symptom score (AUAss). Three and 12-month AUAss, PVR, and Qmax were compared.

Results: Forty-seven patients were identified as having undergone MLHoLEP. At three-month followup, AUAss ($p<0.01$) and incontinence rates ($p=0.045$) were lower for MLHoLEP patients, in addition to them having shorter operative (36.5 mins vs. 64.5 mins, $p<0.01$) and enucleation (13.8 mins vs. 37 mins, $p<0.01$) times as compared to sHoLEP patients. No difference was noted between MLHoLEP and sHoLEP cohorts with respect to age, prostate volume, PVR, or Qmax. Significant improvement in AUAss, PVR, and Q max from baseline to three and 12 months was noted overall in both groups.

Conclusions: MLHoLEP could provide a surgical option with reduced operative time, quicker improvement in AUAss, and restored continence in appropriately selected patients. Ultimately, MLHoLEP represents a safe and effective treatment option to select patients who may not be eligible for or face potential morbidity concerns associated with sHoLEP.

KEY MESSAGES

- Median lobe HoLEP could be offered as an equivalent to standard HoLEP within a selected group of patients.
- In our series, median lobe HoLEP was associated with shorter operative time, faster improvement in AUA symptom score, and less early incontinence.
- Median lobe HoLEP represents a safe and effective treatment for appropriately selected patients.

Introduction

Benign prostatic hypertrophy (BPH) is one of the most common conditions of aging men, affecting approximately 50% of men over the age of 50 and 88% of men in their 80s. The disease often leads to bothersome lower urinary tract symptoms, which compromises quality of life and ultimately may require treatment.[1,2] During the past two decades, holmium laser enucleation of the prostate (HoLEP) has demonstrated superior effectiveness, durability, and versatility when compared to other transurethral interventions.[1,3]

First described in 1996, HoLEP was traditionally used for whole-gland enucleation; however, few variations of the three-lobe enucleation procedure have been studied in-depth or detailed in the literature.[4] Variations in other urological procedures, within prostate cancer especially, while anecdotal, have been shown to be successful and decrease morbidity all while providing therapeutic improvement.[5] With regards to BPH procedures, studies have illustrated that patients undergoing hemi-resection or standard transurethral resection of the prostate (TURP) had similar improvement in postvoid residual urine volume (PVR), American Urological Association symptom score (AUA ss), and maximal flow rate (Q max); however, long-term outcomes were not reported.[6]

While enucleation of the median lobe is considered the simplest portion of the procedure to learn, performing a median lobe-only HoLEP may potentially decrease the adoption and utilization barrier, facilitating another surgical modality for providers to offer patients.[1,7] To the best of our knowledge, illustrating how modifications of the standard HoLEP (sHoLEP) may influence patient outcomes has not been described. With this is mind, we wished to explore

and describe how the use of median lobe HoLEP (MLHoLEP) within our institution could potentially benefit patients.

Methods

After obtaining approval from our institutional review board committee, we queried our institution's prospectively maintained BPH database for patients who underwent HoLEP at our institution from June 2007 through December 2018. We identified patients who underwent planned MLHoLEP, including enucleation of the median lobe or of one lateral lobe only. Patients with Parkinson's disease or multiple sclerosis were found to have unique preoperative or postoperative characteristics and were excluded from matching. Additionally, we excluded patients in whom only a MLHoLEP was performed in the setting of an aborted sHoLEP.

All HoLEP procedures were performed by a single supervising surgeon (MRH) using a 100 W or 120 W holmium:yttrium-aluminum-garnet laser platform with a 550 nm end-fire laser fiber. A 26 F continuous flow resectoscope with a laser bridge and a 7 F stabilizing catheter were used to enucleate part or all of prostate, consistent with the previously described technique.[8] Partial (p)HoLEP was considered and was at the surgeon's discretion during the index procedure when one of the following conditions were encountered clinically: obstruction likely secondary to a large median lobe, patients with history of pelvic radiation for prostate cancer, or in younger patients trying to preserve antegrade ejaculation.

Preoperative demographics, comorbidities, AUAss, PVR, and Qmax on uroflowmetry, as well as the indication for MLHoLEP, were collected. Prostate volume was calculated from cross-sectional imaging or from preoperative transrectal ultrasound when available. Intraoperative data included operative, laser, and enucleation times. Postoperative data included postoperative complication rates, hospital length of stay and catheterization, functional urinary parameters, post-HoLEP secondary interventions for BPH, bladder neck contracture, or urethral strictures. Urinary incontinence was defined as any urine leakage reported by the patient at their postoperative visit.

Outcomes

The study's primary outcome was improvement in baseline functional parameters, including Qmax, PVR, and AUAss, at three and 12 months. Secondary outcomes were postoperative incontinence, the need for further interventions for persistent low urinary tract symptoms, and postoperative complications.

Statistical analysis

To control for various variables, we performed a propensity score matching with a 1:2 ratio with patients treated to sHoLEP. Continuous variables are described as median and interquartile range (IQR). Categorical variables are described as frequency and proportion. A longitudinal mixed-model was used to compare the changes in urinary parameters over time in each group and between groups. All analyses were done using IBM SPSS version 25 (SPSS). Significance was assumed at the 0.05 level.

Results

Of 1251 patients who underwent HoLEP during the study period, we identified 52 (4.2%) patients who underwent pHoLEP, of whom, five were excluded due to neuromuscular disorders. Of the remaining 47 patients, 45 underwent MLHoLEP and two underwent right lobe-only HoLEP. The indications for MLHoLEP included isolated median or lateral lobe obstruction in 27 patients, patient's wish to maintain ejaculation and/or continence in 12 patients, prior radiotherapy for prostate cancer in six patients, and severe comorbidities that would increase the risk and perioperative morbidity associated with prolonged anesthesia in two patients.

In comparison to the whole cohort, MLHoLEP patients were younger (66 vs. 70.7 years old, p=0.002), had smaller prostate volumes (36 ml vs. 78.1 ml, p=0.001), and higher PVR (212 ml vs. 160 ml, p=0.02). After propensity score matching, we identified a control group of 93 patients who underwent sHoLEP. Both groups were matched with respect to age, prostate volume, PVR, AUAss, and Qmax (Table 1).

Patients who underwent MLHoLEP had shorter operative time (36.5 minutes vs. 64.5 minutes, p<0.01) and shorter enucleation time (13.8 minutes vs. 37 minutes, p<0.01) compared to sHoLEP. Postoperative catheter duration and length of stay were similar between groups. Thirty-day complication rates were 17% and 9.7% in the MLHoLEP and sHoLEP groups, respectively (p=0.3), and included hematuria (three patients in each group), urinary tract infection (three and two patients, respectively), and urinary retention (two and four patients, respectively). Blood transfusion was not required in either group. Median followup times were 133 and 860 days in the MLHoLEP and sHoLEP groups, respectively (p<0.01).

In terms of urinary function parameters, there was a statistically significant improvement in AUAss, PVR, and Qmax, in both groups (Table 2). These results were persistent at three months and 12 months postoperatively. There was a greater improvement in AUAss in the MLHoLEP group than in the sHoLEP group after three months, but this trend was not maintained after 12 months. The improvement in PVR and Qmax was similar between the groups (Figure 1). Early stress incontinence was more frequent in the sHoLEP group after three months (29% vs. 12%, p=0.045), but was similar between the groups after 12 months.

In a subgroup analysis of the MLHoLEP group, prior radiation treatment was associated with an increased risk

Table 1. Comparison of partial vs. standard HoLEP patient characteristics

Parameter	pHoLEP (n=47)	sHoLEP (n=93)	p
Median age (IQR)	66 (60–72)	66 (63–71)	0.7
Median preoperative prostate volume (IQR)	36 (27.6–47.3)	35.5 (28.5–46.3)	0.7
Prior BPH surgery (%)	3 (6.8)	14 (15)	0.17
Prior radiation for prostate cancer (%)	6 (13)	0 (0%)	<0.01
Urinary retention (%)	11 (23.4)	16 (17.2)	0.52
Median procedure time in minutes (IQR)	36.5 (25.2–42.7)	64.5 (48–92)	<0.01
Median enucleation time in minutes (IQR)	13.8 (6.6–20.2)	37 (24.6–51)	<0.01
Mean catheterization time in days (IQR)	2 (1–3)	2 (1–3)	0.8
Median length of stay in days (IQR)	1.5 (1–3)	2 (2–3)	0.014
30-days complications (%)	8 (17)	9 (9.7)	0.3
3-month urinary leak (%)	5 (12)	26 (29)	0.045
12-month urinary leak (%)	2/15 (13.3)	9/70 (12.8)	1
Bladder neck contracture (%)	1 (2.1)	3 (3.2)	1
Urethral stricture (%)	1 (2.1)	2 (2.1)	1
Repeat BPH surgery (%)	1 (2.1)	1 (1.1)	1

BPH: benign prostatic hyperplasia; HoLEP: holmium laser enucleation of the prostate; IQR: interquartile range; p: partial; s: standard.

for incontinence after three months (50% vs. 5.5%, p=0.01) but not after 12 months (25% vs. 7%, p=0.4) in the radiation vs. no-radiation groups, respectively.

In the followup period, 16 (10.7%) patients underwent repeat intervention. One patient in each group underwent repeat BPH surgery (p=1). Urethral stricture developed in one and two patients from the MLHoLEP and sHoLEP groups, respectively (p=1), and bladder neck contracture occurred in one and three patients, respectively (p=1). Additional procedures included morcellation of retained tissue, clot evacuation, removal of prostatic calcifications, artificial urethral sphincter placement, Botox injection, and neuromodulation InterStim placement, in one patient each. The median time for treatment of bladder neck contracture was two years (range 18 months to seven years) and for urethral stricture one year (range 90 days to two years).

Discussion

HoLEP is an established treatment for men with BPH. It has been proven to be effective in patients of all ages, prostates sizes and shapes, patients taking anticoagulant medications, and patients with acute or chronic urinary retention.[1,3,9] The 2018 AUA guideline on surgical management of BPH/lower urinary tract symptoms recommends HoLEP as a prostate size-independent treatment for BPH.[10] We report our findings from the first study comparing partial with standard adenectomy using HoLEP. We found similar improvement in urinary parameters after MLHoLEP and sHoLEP, which was sustained after 12 months of followup. Additionally, the reoperation rate was similarly low (2.1% and 1.1%) between the groups. These results highlight the versatility of MLHoLEP towards select patients.

With MLHoLEP, abbreviated operative times, less tissue removal, symptom relief, and even improvement can be obtained all while preserving continence. This may be especially important for patients having previously undergone radiotherapy where external sphincter complex may be compromised and impacting quality of life.[11] In the present study, early continence rates were found to be higher in the MLHoLEP group vs. one-third of the patients who underwent sHoLEP, who had temporary stress urinary incontinence after three months. Since patients were not routinely asked to fill out a validated ejaculatory functional questionnaire, their postoperative ejaculation status could not be determined.

Voiding parameters improved following surgery and were sustained after one year. The mean change in AUAss, PVR, and Qmax from baseline to three months was -14, -188 ml, and +9.5 ml/sec, respectively, similar to earlier prospective studies.[12,13] Interestingly, greater improvement in AUAss at three months but not after 12 months was found in the

Table 2. Baseline, short- and long-term outcomes between the partial vs. complete HoLEP treatment groups

Parameter	Baseline	3 months	p	12 months	p
AUA score					
pHoLEP	20 (12–27)	4 (3–8)	<0.01	8 (1–10)	<0.01
sHoLEP	21 (17–26)	8 (5–13)	<0.01	9 (6–10)	<0.01
PVR					
pHoLEP	212 (97–432)	80 (38–142)	<0.01	83 (7–208)	<0.01
sHoLEP	149 (65–358)	25 (4–77)	<0.01	103 (47–127)	<0.01
Qmax					
pHoLEP	7 (4–10)	16 (11–26)	<0.01	17 (10–29)	<0.01
sHoLEP	8 (4–14)	18 (10–23)	<0.01	18 (13–22)	<0.01

Medians and (IQR) presented. P-values in comparison to baseline. AUA: American Urological Association; HoLEP: holmium laser enucleation of the prostate; p: partial; PVR: postvoid residual; Qmax: maximal flow rate; s: standard.

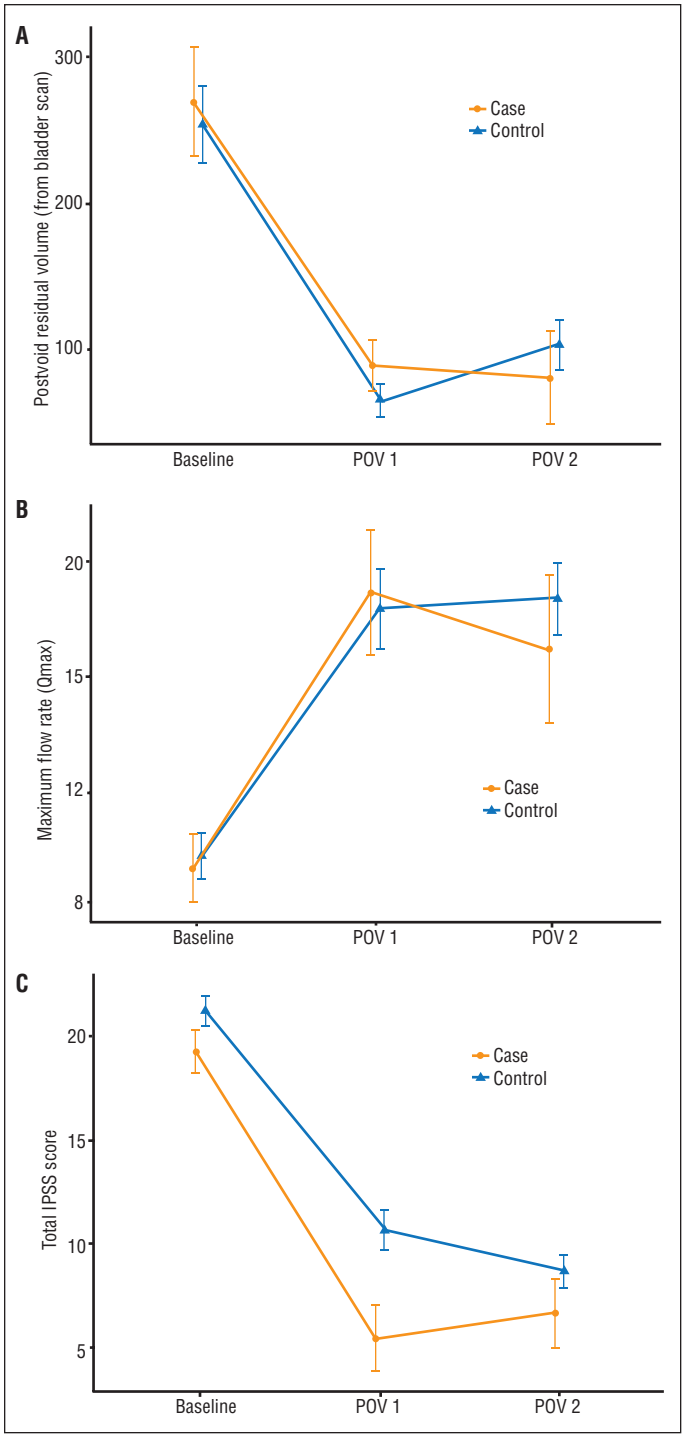

Figure 1. Changes in **(A)** postvoid residual volume; **(B)** maximal flow rate; and **(C)** International Prostate Symptom Score (IPSS) at 3 and 12 months after surgery. POV: postoperative visit.

MLHoLEP group in comparison to the sHoLEP group. It is possible that higher laser energy used during sHoLEP and a larger raw surface increased the irritation in the short-term, and that these symptoms resolved after healing of the prostatic fossa. Other studies have also shown an immediate improvement in AUAss after surgery, followed by moderate improvement at up to one year of followup.[12] Indeed, in a breakdown of the AUAss three months after surgery, the only parameter that was different between the groups was urgency (median 0 vs. 2, p=0.037).

The incontinence rate in the present study is noteworthy, since previous studies reported lower rates. Krambeck et al reported that 4.8% of the patients had stress incontinence after a followup of more than one year.[14] There are several explanations to this difference. First, we defined incontinence as any leakage reported by the patient, thus including urge incontinence, which occurs in 3–12% of patients after surgery.[11,14] Second, asymptomatic patients are less likely to return for followup, which increases the proportion of symptomatic patients engaged. Additionally, trainees were involved in the vast majority of the procedures, a factor that has been associated with increased postoperative urinary incontinence rates.[11] Lastly, six patients in the MLHoLEP group received radiation for prostate cancer, representing 60% and 50% of the incontinent patients in this group. Had they been excluded from the analysis, the incontinence rate would have been 4.8% and 7.1% after three and 12 months, respectively.

Several groups of patients are predisposed to incontinence following bladder outlet procedures. Studies have shown that some degree of permanent urinary incontinence developed in 33% and 70% of patient undergoing brachytherapy or external beam radiotherapy for prostate cancer, respectively, likely, by compromising the urinary sphincters or the urethra itself.[15,16] In the present study, half the patients undergoing MLHoLEP following radiation treatment reported some degree of incontinence. Since the control group did not contain patients with prior radiation treatment, we could not determine if the incontinence rate following sHoLEP was higher. Our results are in line with more recent studies. Only one patient who had urinary urge incontinence before the surgery continued to have incontinence postoperatively.

The durable results of the HoLEP procedure have been attributed to complete removal of the adenoma rather than its resection.[17] A concern when performing partial adenectomy is the rate of repeat surgery. Earlier studies have shown low but variable retreatment rates in sHoLEP patients. Krambeck et al reported only one patient (0.1%) who underwent repeat treatment due to bleeding nodular growth within long-term results of 1065 HoLEP procedures.[14] Elzayat et al similarly reported a low re-treatment rate of 4.2% among 118 patients, with greater than four-year followup on their initial experience with HoLEP; the re-treatment in this case was associated with the steep procedural learning curve.[18] In the present study, re-treatment for BPH was performed in one patient in each group, but the followup time was significantly shorter in the MLHoLEP group. It is possible that with longer followup, more patients may require re-treatment.

This high rate can be partially attributed to the high-volume teaching environment at our institute, but there is little doubt that leaving adenomatous tissue increases the risk for persistent or recurrent urinary symptoms. Nevertheless, this limitation of MLHoLEP should be discussed with patients prior to surgery, in which case they may choose to proceed with or pursue whole-gland enucleation.

Limitations

Our study is limited by the small sample size of patients having undergone MLHoLEP but remains the largest reported cohort within the literature to our knowledge. It also shares the same limitations traditionally associated with any retrospective analysis.

The median prostate size in our study was small, and only eight patients had prostates larger than 80 cc. As such, it is possible that the results are not generalizable to patients with larger glans. In addition, Mayo Clinic Hospital in Phoenix, Arizona, is a tertiary care center, with many patients who come for urological evaluation and treatment from more remote locations. Often, patients seek followup closer to home with community urologist, limiting the availability of longitudinal, long-term followup data.

Additional limitations stem from our criteria for MLHoLEP consideration; these considerations are limited and may not appropriately recognize all patients who could be eligible or who would benefit from partial over standard enucleation.

Lastly, while we performed matching for multiple variables, we did not control for prostate anatomy, which is an important factor when considering appropriate BPH surgical approach. We do not advise doing MLHoLEP in patients without a prominent single-lobe obstruction.

Several reports describe variations on the traditional HoLEP technique, yet MLHoLEP is not included and can be a highly useful procedure in certain circumstances. Examples of select patients for whom MLHoLEP may be indicated could include those with significant comorbidities, placing them at increased risk of perioperative morbidity and mortality during prolonged anesthesia or operative procedures. Even young, active patients might benefit from partial treatment by limiting transitory stress urinary incontinence and preserving antegrade ejaculation.

Conclusions

MLHoLEP is equivalent to sHoLEP in this selected group of patients with small prostates, and is associated with shorter operating times, faster improvement in AUAss, and less temporary stress urinary incontinence than sHoLEP. MLHoLEP represents a safe and effective treatment for patients who may not prefer or be able to tolerate any risks or outcomes associated with a sHoLEP procedure.

Competing interests: The authors do not report any competing personal or financial interests related to this work.

This paper has been peer-reviewed.

References

1. van Rij S, Gilling PJ. In 2013, holmium laser enucleation of the prostate (HoLEP) may be the new "gold standard." *Curr Urol Rep* 2012;13:427-32. https://doi.org/10.1007/s11934-012-0279-4
2. Stern K, Satyanarayan A, Funk JT. Recent advances and emerging technology in the surgical management of BPH-related voiding dysfunction. *Curr Bladder Dysfunct Rep* 2014;9:129-33. https://doi.org/10.1007/s11884-014-0228-9
3. Lee MH, Yang HJ, Kim DS, et al. Holmium laser enucleation of the prostate is effective in the treatment of symptomatic benign prostatic hyperplasia of any size including a small prostate. *Korean J Urol* 2014;55:737-41. https://doi.org/10.4111/kju.2014.55.11.737
4. Gilling PJ, Cass CB, Cresswell MD, et al. Holmium laser resection of the prostate: Preliminary results of a new method for the treatment of benign prostatic hyperplasia. *Urology* 1996;47:48-51. https://doi.org/10.1016/S0090-4295(99)80381-1
5. Short-term oncological and functional outcomes. *Eur Urol* 2017;72:333-42. https://doi.org/10.1016/j.eururo.2016.08.057
6. Agrawal MS, Aron M, Goel R. Hemi-resection of the prostate: Short-term randomized comparison with standard transurethral resection. *J Endourol* 2005;19:868-72. https://doi.org/10.1089/end.2005.19.868
7. Robert G, Cornu JN, Fourmarier M, et al. Multicenter, prospective evaluation of the learning curve of holmium laser enucleation of the prostate (HoLEP). *BJU Int* 2016;117:495-9. https://doi.org/10.1111/bju.13124
8. McAdams S, Nunez-Nateras R, Martin CJ, et al. Morcellation efficiency in holmium laser enucleation of the prostate: Oscillating morcellator outperforms reciprocating morcellator with no apparent learning curve. *Urology* 2017;106:173-7. https://doi.org/10.1016/j.urology.2017.05.018
9. Martin AD, Nunez RN, Humphreys MR. Bleeding after holmium laser enucleation of the prostate: Lessons learned the hard way. *BJU Int* 2011;107:433-7. https://doi.org/10.1111/j.1464-410X.2010.09560.x
10. American Urological Association. Benign prostatic hyperplasia (BPH) guideline. Available at: https://www.auanet.org/guidelines/benign-prostatic-hyperplasia-(bph)-guideline. Accessed October 30, 2019.
11. Lerner LB, Tyson MD, Mendoza PJ. Stress incontinence during the learning curve of holmium laser enucleation of the prostate. *J Endourol* 2010;24:1655-8. https://doi.org/10.1089/end.2010.0021
12. Elzayat EA, Elhilali MM. Holmium laser enucleation of the prostate (HoLEP): The endourological alternative to open prostatectomy. *Eur Urol* 2006;49:87-91. https://doi.org/10.1016/j.eururo.2005.08.015
13. Elmansy H, Baazeem A, Kotb A, et al. Holmium laser enucleation vs. photoselective vaporization for prostatic adenoma greater than 60 Ml: Preliminary results of a prospective, randomized clinical trial. *J Urol* 2012;188:216-21. https://doi.org/10.1016/j.juro.2012.02.2576
14. Krambeck AE, Handa SE, Lingeman JE. Experience with more than 1000 holmium laser prostate enucleations for benign prostatic hyperplasia. *J Urol* 2010;183:1105-9. https://doi.org/10.1016/j.juro.2009.11.034
15. Green N, Treible D, Wallack H. Prostate cancer: Post-irradiation incontinence. *J Urol* 1990;144:307-9. https://doi.org/10.1016/S0022-5347(17)39438-7
16. Hu K, Wallner K. Urinary incontinence in patients who have a TURP/TUIP following prostate brachytherapy. *Int J Radiat Oncol Biol Phys* 1998;40:783-6. https://doi.org/10.1016/S0360-3016(97)00928-0
17. Gilling PJ, Wilson LC, King CJ, et al. Long-term results of a randomized trial comparing holmium laser enucleation of the prostate and transurethral resection of the prostate: Results at 7 years. *BJU Int* 2012;109:408-11. https://doi.org/10.1111/j.1464-410X.2011.10359.x
18. Elzayat EA, Elhilali MM. Holmium laser enucleation of the prostate (HoLEP): Long-term results, reoperation rate, and possible impact of the learning curve. *Eur Urol* 2007;52:1465-71. https://doi.org/10.1016/j.eururo.2007.04.074

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