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ORIGINAL ARTICLE

'En Bloc' HoLEP with early apical release in men with benign prostatic hyperplasia

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Abstract

Purpose HoLEP represents an excellent treatment option for benign prostatic hyperplasia. Recently, 'en bloc' techniques resulting in improved visualization, shorter surgical times, and easier recognition of the dissection plane have been described. In this paper we describe the 'En bloc' HoLEP technique with early apical release.

Materials and methods Between January 2015 and March 2017, 137 consecutive patients were subjected to this technique by a single surgeon. The following parameters were measured pre- and post-procedure: International Prostate Symptom Score (IPSS), maximum flow rate (Q_{max}), post-void residual urine (PVR) and PSA. Complications were recorded.

Results Mean (SD; range) age was 66 years (8.0; 51–84), mean PSA was 4.8 ng/ml (7.0; 0.3–70), mean prostate volume was 75.63 ml (42.1; 37–253), mean volume of prostatic tissue removed was 65.9 ml (35.8; 30–217). Mean surgical duration was 47.58 min (21.3; 15–120 min): enucleation 31.5 min (14.9; 5–80 min), morcellating 6.9 min (6.6; 1–60 min). Mean hospitalization duration was 1.2 days (range 1–3), mean catheterization time was 1.2 days (range 1–5). The rate of stress urinary incontinence (SUI) was 5.8, 1.5 and 0.7% at 1, 3, and 6 months post-operation, respectively. Compared to pre-operative values, IPSS, Q_{max}, and PVR showed significant improvements at 1, 3, 6, and 12 months following the operation ($p < 0.05$).

Conclusions 'En Bloc' HoLEP with early apical release is a safe technique that allows for easier recognition of the surgical plane and preserves the external sphincter's mucosa to provide low rates of post-operative stress incontinence and significant functional results.

Keywords Benign prostatic hyperplasia · Prostate-specific antigen · IPSS · En bloc enucleation · Holmium laser

Abbreviations

5-ARI	5-Alpha reductase inhibitors
ASAP	Atypical small acinar proliferation
BPH	Benign prostatic hyperplasia
BPO	Benign prostatic obstruction
GreenLEP	Green light enucleation of prostate
HoLEP	Holmium laser enucleation of prostate
IPSS	International Prostate Symptom Score
LUTS	Lower urinary tract symptoms
PSA	Prostate-specific antigen
PVR	Post-void residual urine
Q_{max}	Maximum peak flow
QoL	Quality of life
SD	Standard deviation
SUI	Stress urinary incontinence
ThuLEP	Thulium laser enucleation of prostate
TURP	Transurethral resection of prostate
TWOC	Trial without catheter

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Introduction

Benign prostatic hyperplasia (BPH) is a common condition in aging men that is often associated with lower urinary tract symptoms (LUTS) and a decreased health-related quality of life (QoL) [1].

The introduction of lasers for the treatment of LUTS due to benign prostatic obstruction (BPO) has dramatically changed the surgical landscape of BPO. Several laser devices, with differing laser energy sources, are now available. The unique properties of the various available lasers result in a variety of possible surgical techniques, ranging from vaporization to resection and enucleation [2].

Holmium laser ablation and resection of the prostate were first introduced in the 1990s. After the introduction of the tissue morcellator, holmium laser ablation and resection has been largely superseded by holmium laser enucleation of the prostate (HoLEP) [3], which was first described in 1998 by Gilling and Fraundorfer [4]. HoLEP is an established laser treatment option for BPH that has been shown to produce better results than those achieved with transurethral resection of the prostate (TURP) [5, 6].

Many studies have reported promising results that support the excellency of HoLEP for BPH surgery. Moody and Lingeman [7] concluded that holmium laser enucleation is an effective, safe procedure for large prostatic adenomas, resulting in significantly lower morbidity, catheterization duration and length of stay compared to open prostatectomy. Montorsi et al. [8] reported the first multicentre, prospective, randomized study comparing HoLEP and TURP in which HoLEP was associated with shorter catheterization times and hospital stays. Glybochko et al. [9] concluded that HoLEP is a safe, highly efficacious, and size-independent procedure, confirming what had been reported by Hurle [10].

Several approaches to HoLEP exist and all involve the identification of the surgical capsule followed by retrograde enucleation along this plane. In the early description of the HoLEP technique, incisions of the prostate were made at the 5 o'clock and 7 o'clock positions, with enucleation of the middle lobe initially followed by enucleation of the lateral lobes [12]. Krambeck et al. [13] and Baazeem et al. [14] proposed a two-lobe technique involving a single bladder neck incision at 5 or 7 o'clock with one of the lateral lobes excised together with the middle lobe and subsequently the second lateral lobe. Three-lobe HoLEP techniques, the first of which was described by Gilling et al. [11], have been adapted by many surgeons to date.

More recently described 'en bloc' techniques could prove advantageous in terms of better visualization, faster identification of the surgical capsule and the correct plane to dissect, early release and better preservation of the sphincter, and an improved learning curve compared to the three-lobe technique.

An evolutionary step has been the description by Scoffone and Cracco [15] of an 'en bloc' technique that uses the holmium laser to perform a single incision in the adenoma, enucleating it in one piece, with a horseshoe shape due to the incision. Minagawa et al. [16] assessed the safety and effectiveness of HoLEP using a low-power 30-W holmium laser with an en bloc enucleation technique.

Hiraoka et al. [17] were the first to describe an 'en bloc' procedure of transurethral endoscopic monopolar enucleation of the prostate for complete endoscopic removal of the adenoma [18–20].

The all-in-one technique of thulium laser enucleation of the prostate (ThuLEP) for symptomatic BPH performed by Kim et al. [21] on 47 patients was demonstrated to be both effective and efficacious compared to other techniques.

In 2015, Gomez Sancha et al. [22] described a detailed stepwise progressive enucleation technique that utilizes a 532-nm lithium triborate laser (GreenLight HPS 120 W and GreenLight XPS 180 W surgical lasers, American Medical Systems, Minnetonka, US). This green light laser en bloc technique enucleates the prostatic adenoma in a single piece, also with early apical liberation.

Materials and methods

Patient selection

This study included 137 consecutive men with BPH causing lower urinary tract symptoms, who had access to a tertiary care center of men's health and underwent a dis-obstruction operation performed by the same experienced surgeon (FGS) between January 2015 and March 2017, using the same equipment and energy setting.

Inclusion criteria were: IPSS 8 or greater, Q_{max} of 15 ml/s or less, PVR of 50 ml or greater. Exclusion criteria were: prostate cancer and voiding disorders not related to BPH.

Parameters measured

The following parameters were registered pre- and post-procedure at 1, 3, 6, 12 months, to assess the efficiency of our technique: International Prostate Symptom Score (IPSS), maximum flow rate (Q_{max}), post-void residual urine (PVR), prostate-specific antigen (PSA), mean residual prostate volume. At follow-up, urinary incontinence was defined as any need to use a pad post-operatively. All complications were registered.

Equipment

Laser equipment

A 2140 nm, 100 Watt laser (Lumenis, LTD) with a 550 µm end-firing laser fiber was used. The settings were always 1.9 J and 53 Hz for enucleation and were then lowered to 1 J and 40 Hz for coagulation of the prostatic fossa following enucleation.

Endoscopy equipment

A 26-F continuous flow resectoscope (Richard Wolf, Germany) with a simple laser bridge that allows for direct manipulation of the fiber with the surgeon's hand was used. No ureteral catheter or other fixing device was used. A 30° down lens was preferred. The tip of the inner sheath has an atraumatic blunt edge that allows for mechanical enucleation at times throughout the procedure, and the telescope lens does not reach the edge of the tip, a very important detail as the distance between the tip of the external sheath and the telescope leaves a space, a "water chamber", that allows for visualization of tissue planes while mechanical enucleation is being performed. Saline solution was used for irrigation throughout the procedure, keeping the height of the bags at 60 cm, except during the morcellation phase when the bags were elevated to 80–100 cm for distention of the bladder.

Morcellator

A mechanical tissue morcellator (Piranha: Richard Wolf, Germany) was used for the intravesical morcellation of fragments. The single use V_{max} rotation blades were used in conjunction with the motor, control unit, foot pedal and suction pump. A morcelloscope was used to introduce the morcellator blade during morcellation. A single inflow of saline was used in all cases.

Surgical technique

The patient is placed in the lithotomy position. A gentle OTIS urethrotomy is performed if the introduction of the scope is restricted by a tight urethral lumen. A careful cystoscopy is performed to rule out bladder problems and to visualize the ureteral orifices.

The anatomy of the sphincter and prostatic urethra is visualized, an important step for surgical planning (Fig. 1a). The enucleation process starts at the apex of the prostate where a mucosal incision is initiated between 11 and 1 o' clock, near the proximal edge of the external sphincter, with the fiber at 6 o'clock in the resectoscope (Fig. 1b). This incision is progressively deepened upwards to establish a clear separation between the sphincter and prostatic apex.

An incision is then performed parallel to the verumontanum, down to the edge of the sphincter, and is joined to the previously made anterior incision. The same process is carried out on the contralateral side (Fig. 1c). This results in a complete demarcation of the apex from the sphincter (Fig. 1d); following this surgical step there should be a ridge between the sphincter and the apex. From this moment of the operation on, the tip of the scope will naturally fall into this ridge, which protects the sphincter from damage. The distal mucosa covering the sphincter is respected throughout the procedure.

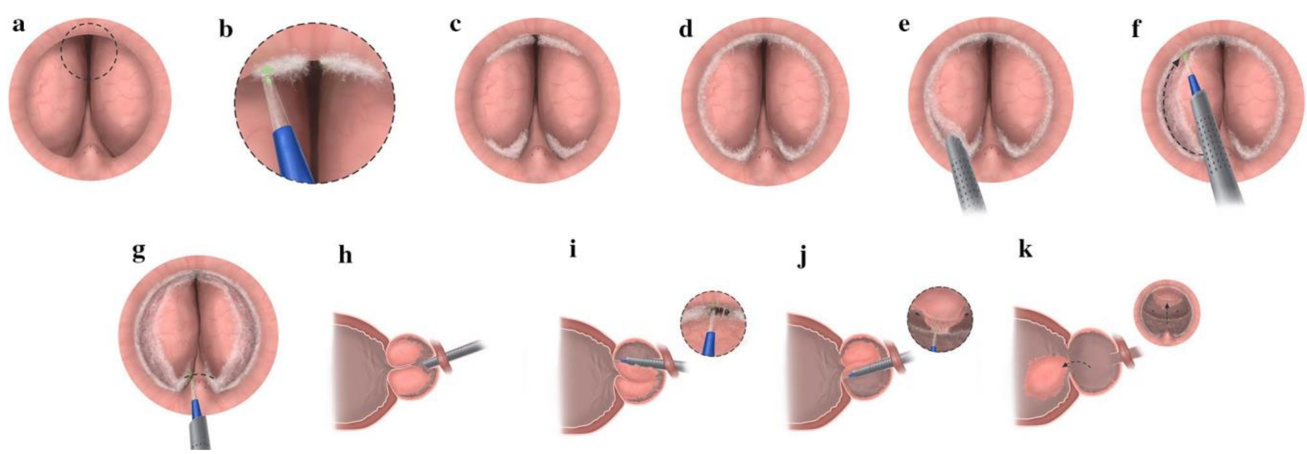


Fig. 1 **a** The anatomy of the sphincter and prostatic urethra is visualized. **b** The enucleation process is started at the apex of the prostate where an incision is initiated from 11 to 1 o'clock by the proximal edge of the external sphincter, with the fiber at 6 o'clock in the resectoscope. **c** Then an incision is carried out parallel to the verumontanum down to the edge of the sphincter; it is then joined to the previously performed anterior incision. The same process is carried out on the contralateral side. **d** This results in a complete demarcation of the apex from the sphincter. **e** The tip of the scope is positioned laterally to the right of the verumontanum and a gentle lateral tilt of the tip of the scope is performed to enter the plane between adenoma and surgical capsule under direct visualization. Alternatively, a development of the plane can be performed with energy. **f** A careful dissection of the apex is performed, alternating between laser cutting and gentle mechanical dissection, by deepening the para-sphincteric ridge from 6 to 12 o'clock until the entire right apex is released from the sphincter. The same steps are carried out in the contralateral side until the apex is completely freed from the sphincter anteriorly at 12 o'clock. **g** Then, the crista urethralis is cut over the verumontanum to allow to circumferentially liberate the apex from the sphincter. **h** The enucleation plane is followed circumferentially, progressively approaching the bladder neck. **i** Entry into the bladder is pursued anteriorly, between the adenoma and the surgical capsule. **j** The bladder neck is then cut circumferentially with care to protect the ureteral orifices. **k** At the end of the enucleation phase, the adenoma is free and can be pushed into the bladder

The tip of the scope is positioned laterally to the right of the verumontanum and a gentle lateral tilt of the tip of the scope is performed to enter the plane between adenoma and surgical capsule under direct visualization (Fig. 1e). A careful dissection of the apex, alternating between laser cutting and gentle mechanical dissection, is performed by deepening the para-sphincteric ridge from 6 to 12 o'clock until the entire right apex is released from the sphincter. The same steps are performed on the contralateral side until the apex is totally freed from the sphincter anteriorly at 12 o'clock (Fig. 1f). Then, the crista urethralis is cut over the verumontanum to allow to circumferentially liberate the apex from the sphincter (Fig. 1g). We believe this early release of the sphincter from the prostatic apex reduces the likelihood of post-operative stress urinary incontinence. Because stretching can occur more easily when the external sphincter is fixed on one side and the scope is dissecting in the opposite side, the early release technique used here is less likely to result in sphincter stretching during dissection.

Once the sphincter is released, the enucleation plane is followed circumferentially, progressively approaching the bladder neck (Fig. 1h). The circumferential nature of the dissection makes it very intuitive, simple, and fast. Entry to the bladder is pursued anteriorly, between the adenoma and the surgical capsule (Fig. 1i), and the bladder neck is then cut circumferentially with care to protect the ureteral orifices (Fig. 1j), until the adenoma is free and can be pushed into the bladder (Fig. 1k).

Haemostasis is confirmed and the prostate tissue is morcellated within the bladder with the Piranha device. The patient is catheterised overnight, the bladder irrigated if needed, and the catheter is removed the next day.

After surgery all patients were followed-up at the same Institution. At follow-up evaluations, prostate size was determined via transvesical ultrasound.

Statistical analysis

Data were collected using Microsoft Excel (version 12.2.4) and analysed with SPSS (version 22.0). Statistical differences in means were determined with *t* tests; the significance level was set at $p < 0.05$.

Results

Mean (SD; range) age was 66 years (8.0; 51–84), mean PSA was 4.8 ng/ml (7.0; 0.3–70), mean prostate volume was 75.63 ml (42.1; 37–253).

Twenty-five of the 137 patients (18.2%) had undergone previous prostate surgery, 15 (10.9%) had previously undergone TURP, 13 (9.5%) had associated bladder stone disease, 43 (34.3%) had an indwelling catheter following one or more episodes of acute urinary retention, 6 (4.4%) suffered from hydronephrosis, 107 (78.1%) were on alphalytic drugs, 14 (10.2%) were on phytotherapy and 52 (37.9%) on 5-ARI, 7 (5.1%) were taking anticholinergics for concomitant overactive bladder, 19 (13.9%) were on antiaggregant drugs with 4 of these taking double antiaggregant therapy (2.9%).

Mean (SD; range) surgical time was 47.58 min (21.3; 15–120). Mean enucleation time was 31.5 min (14.9; 5–80) and mean morcellating time was 6.9 min (6.6; 1–60).

The mean volume of prostatic tissue removed was 65.9 ml (35.8; 30–217).

Capsular perforation was never observed and conversion to TURP was not needed in any case.

Only 5 of the 137 patients (3.6%) developed post-operative gross hematuria (Clavien–Dindo II) and only one patient required immediate re-operation for persistent bleeding (0.7%): an 81-years-old man with a 191 cc prostate and an indwelling catheter, antiaggregated with aspirin.

One patient (0.7%) developed urethral stenosis and 1 (0.7%) developed pneumonia requiring intravenous antibiotics and hospitalization in the intensive care unit, with progressive restoration of respiratory and circulatory function (Clavien–Dindo IVa).

Mean hospitalization time was 1.2 days (range 1–3), mean catheterization time was 1.2 days (range 1–5), 15 (10.9%) patients developed post-operative retention and were re-catheterized for 24 additional hours with a successful trial without catheter (TWOC) afterwards. The rate of stress urinary incontinence (SUI), considered as any need to use a pad, was 5.8%, 1.5%, and 0.7% at 1, 3 and 6 months after surgery, respectively. After this period no cases of incontinence requiring use of antimuscarinic drugs or b3-agonists were observed.

Three of the 137 (2.2%) patients developed urinary tract infections 1 month after the procedure and only 1 (0.7%) presented prostatitis requiring antibiotic therapy after 3 months (Clavien–Dindo II). At subsequent follow-up no patients presented dysuria symptoms of underlying inflammatory or infectious disease.

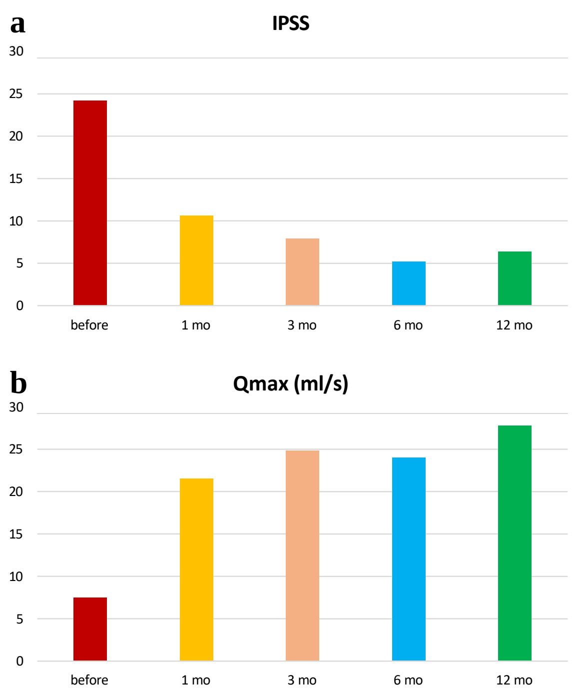
Anatomopathological results were as follows: 95.7% benign prostatic hyperplasia, 3.6% incidental prostate cancer and 0.7% ASAP.

Mean residual prostate volume (ml) was 21.66, 13.55, 10.73, and 10.68 at 1, 3, 6, and 12 months, respectively.

Mean PSA (ng/ml) was 1.34, 0.75, 1.25, and 1.06 at 1, 3, 6, and 12 months, respectively.

The mean preoperative IPSS of 24.2 (range 9–35) showed a reduction of 17.8 points to 6.4 (range 2–20) 1 year after surgery (Graph 1a).

The mean preoperative Q_{max} of 7.5 ml/s (range 2–14 ml/s) showed an increase of 20.3 ml/s, reaching 27.8 ml/s (range 11.4–44 ml/s) at the 12-month follow-up (Graph 1b).



Graph 1 Preoperative and postoperative IPSS (points) and Q_{max} (mL/s) at different time points during follow-up

The mean PVR after surgery was always negligible (0–30 ml).

IPSS, Q_{max} and PVR showed statistically significant improvements at 1, 3, 6, and 12 months post-operation (all $p < 0.05$; Table 1).

Discussion

We believe that this true 'en bloc' enucleation technique is a feasible and reproducible endoscopic technique which, through easily learned and performed steps, allows for faster procedures with the correct instruments, leading to good or even better post-operative outcomes in comparison to other prostatic adenoma enucleation techniques.

We think that this technique, involving the dissection of the prostatic adenoma as a single tissue mass, shows these advantages over the usual two- or three-lobe technique: shortened operation time, an optimal visualization of the dissection plane due to reduced bleeding and excellent irrigation, improved effectiveness and safety of the enucleation, better urinary flow, and improving general quality of life (QoL).

The demarcation of the 'white line', leading to the early release of the sphincter from the prostatic apex, could reduce the likelihood of post-operative stress urinary incontinence, as it is less likely that the sphincter will be stretched with the dissection movements as this stretching can occur more easily when the external sphincter is fixed on one side and the scope is dissecting in the opposite side.

Many papers have shown a significant initial rate of stress incontinence after anatomic enucleation procedures irrespective of the wavelength used.

But why is it that, despite the obvious anatomical preservation of the sphincter (otherwise there would be permanent incontinence), patients are incontinent for some time before recovering fully? There are several possible explanations for sphincter incompetence that is later resolved. In the classic three-lobe technique, the sphincter's mucosa is often detached by the end of the procedure, with the only part of mucosa remaining being that at 12 o'clock (the so-called mucosal flap). It is feasible that this sphincter will be incontinent until re-epithelialization ensures; the sphincter might be anatomically preserved but distended during the procedure, thus producing temporary incompetence. There could also be stress-induced bladder hyperactivity that could explain stress incontinence that gets better over time, as hyperactivity subsides. A hypoactive sphincter in patients who have large glands and thus do not use the external sphincter for continence is also a possible cause of temporary incontinence, as is a prolonged catheterisation prior to surgery in some patients. Moreover, the 12 o'clock incision in the classic HoLEP technique requires the exertion of downward force on the scope to reach the capsule, and this often results in the sphincter's mucosa being split at 12 o'clock (distension/dis-epithelization mechanisms).

Table 1 Parameters registered pre- and post-procedure

$N = 137$ patients	Before surgery	After 1 month	After 3 months	After 6 months	After 12 months	p
Mean prostate volume (ml)	75.63	21.66	13.55	10.73	10.68	NR
PSA (ng/ml)	4.8	1.34	0.75	1.25	1.06	< 0.05
IPSS score	24.2	10.6	7.88	5.22	6.4	< 0.05
Q_{max} (ml/s)	7.5	21.5	24.8	24	27.8	< 0.05
PVR (ml)	75	0–30	0–30	0–30	0–30	< 0.05

NR not recorded

Table 2 Comparative parameters with other studies evaluating HoLEP procedures

Study	Technique	No. pts	Mean (SD) prostate volume (ml)	Mean (SD) treatment duration (min)	Follow-up	Increase in mean Q_{max} (ml/s)	Reduction in mean IPSS	Reduction in mean PVR (ml)
Current study	En bloc	137	75.82 (42.1)	47.58 (21.3)	1 year	20.3	17.8	NR
Gilling et al. [4]	Three lobes	14	77.7 (32.1)	62.1 (5.9)	7 years	13.8	18.4	NR
Gong et al. [23]	Modified three lobes	189	78.1 (24.3)	54.7 (21.1)	6 months	23.4	18.1	>110
Minagawa et al. [25]	En bloc	65	72.9 (35.4)	56.4 (17.3)	3 months	14.2	18.5	> 60
Miernik and Schoeb [26]	'Three horse shoe-like incisions' en bloc	114	86.3 (46.5)	49.6	NR	NR	NR	NR
Wilson et al. [28]	Three lobes	30	77.8 (5.6)	NR	2 years	12.6	19.9	NR
Naspro et al. [29]	Three lobes	41	113.3 (35.3)	72.1 (21.2)	2 years	11.4	12.2	NR
Gupta et al. [30]	NR	50	57.9 (17.6)	75.4 (22.8)	1 year	19.9	18.2	> 110
Fayad et al. [31]	Three lobes	30	76.5 (17.2)	110.5 (28.8)	6 mo	13.2	17.1	NR

NR not recorded

The 'en bloc' technique with early apical release is designed to tackle some of these problems. First, by aiming to preserve the sphincter's mucosa with the definition of the 'white line', the first incision allows for easy identification of the landmarks. The early apical release of the sphincter frees it completely from the apex of the adenoma, so when the scope has to move around the adenoma, it is not fixed anywhere and will thus not distend the sphincter, reducing distension and tear. The progressive liberation of the anterior zone from the sides lowers the adenoma, eliminating the need to angle the scope towards 12 o'clock, and avoiding the splitting of the sphincter caused by the traditional 12 o'clock incision.

We also observe other advantages with this technique: the dissection of a single space that is not attached to the bladder allows for efficient irrigation, and visibility is maintained throughout the procedure. Typically in the three-lobe techniques it is difficult to coagulate the edges of the enucleated lobes, and the fact that the irrigating fluid enters the bladder makes for chaotic irrigation compared to the laminar irrigation of a narrow space between the adenoma and capsule. Additionally, the circumferential nature of the line of attack (dissection) makes for easy recognition of the adenoma.

Other authors have recently presented modified or updated techniques, also focusing on rates of post-operative urinary incontinence. Gong et al. [23] described a modified enucleation technique using the holmium laser, in which transient stress incontinence occurred only in 3 of 189 consecutive patients who all showed spontaneous resolution within 3 months of surgery.

Kuo et al. [24] provided detailed descriptions of the major steps of a HoLEP procedure that allows for complete removal of the intact lobes of the prostate, and resulted in immediate relief of obstruction with superior hemostasis, no risk of TUR syndrome, and minimal hospital stay. Minagawa et al. [25] simplified the anteroposterior dissection holmium laser enucleation of the prostate by combining it with a novel en bloc enucleation technique that omits median lobe enucleation and removes the adenoma en bloc; the incidence of post-operative incontinence at 3 months was 3% (65 patients treated). Miernik and Schoeb [26] demonstrated good results in their initial experience in 114 patients with a "Three horseshoe-like incision" novel en bloc technique, in which the prostatic gland is enucleated en bloc in an anatomical manner without longitudinal incisions of the urethra. The authors concluded that their approach results in a fast, safe, and easier to learn technique. Compared to other published studies on series of patients treated with HoLEP, our series shows comparable outcomes in terms of functional results at follow-up (Table 2).

Finally, regarding surgical time, we believe that the short operative time that was achieved in this series is strictly related to the technique, rather than the operating surgeon. Moreover, after the introduction of the currently used morcellator, we noted a significant reduction of the morcellating time.

The limitations of our study are that the described interventions were all performed by a single surgeon with great experience and the patients are relatively few.

There is no large series comparing patients subjected to 'classic' HoLEP to those subjected to HoLEP 'en bloc' performed by another experienced surgeon.

Rapaport et al. [27] compared the effectiveness and safety of the traditional HoLEP and HoLEP en bloc, concluding that the 'en bloc' technique results in the reduction of total operative time due to the fast identification of the surgical capsule and the correct layer.

Furthermore, a statistical comparison with other enucleation techniques is lacking.

Despite these limitations, HoLEP 'en bloc' seems to be a fast technique with good functional results (Table 2).

Conclusions

The en Bloc HoLEP technique with early apical release appears safe and allows for the preservation of the external sphincter's mucosa, thus providing low rates of post-operative stress incontinence. Further assessments of the learning curve and long-term results are required.

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Author contributions SG: protocol/project development, data collection or management, data analysis, manuscript writing/editing. JEAB: protocol/project development, manuscript writing/editing. JFA: protocol/project development. LLG: protocol/project development. JRE: protocol/project development. NS: data collection or management, data analysis, manuscript writing/editing. FG-S: protocol/project development, data collection or management, manuscript writing/editing

Compliance with ethical standards

Conflict of interest Gómez-Sancha F: Boston Scientific® (proctor, lecturer, advisory board); Lumenis® (lecturer).

Informed consent All 137 patients signed an informed consent declaring to have understood the purposes, benefits, and risks of the proposed treatment.

References

1. Calogero AE, Burgio G, Condorelli RA, Cannarella R, La Vignera S (2018) Epidemiology and risk factors of lower urinary tract symptoms/benign prostatic hyperplasia and erectile dysfunction. J Aging Male 2:1–8
2. Montorsi F, Saitta G, Suardi N (2018) Surgical treatment for LUTS/BPH: laser devices—chapter 13. In: Morgia G, Russo GI (eds) Lower urinary tract symptoms and benign prostatic hyperplasia, 1st edn. Academic Press, Cambridge. eBook ISBN: 9780128113981. Paperback ISBN: 9780128113974
3. Gravas S, Bachmann A, Reich O, Roehrborn CG, Gilling PJ, De La Rosette J (2011) Critical review of lasers in benign prostatic hyperplasia (BPH). BJU Int 107(7):1030–1043
4. Gilling PJ, Fraundorfer MR (1998) Holmium laser prostatectomy: a technique in evolution. Curr Opin Urol 8(1):11–15
5. Yin L, Teng J, Huang CJ, Zhang X, Xu D (2013) Holmium laser enucleation of the prostate versus transurethral resection of the prostate: a systematic review and meta-analysis of randomized controlled trials. J Endourol 27(5):604–611
6. Gilling PJ, Wilson LC, King CJ, Westenberg AM, Frampton CM, Fraundorfer MR (2012) 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 109(3):408–411
7. Moody JA, Lingeman JE (2001) Holmium laser enucleation for prostate adenoma greater than 100 gm.: comparison to open prostatectomy. J Urol 165(2):459–462
8. Montorsi F, Naspro R, Salonia A, Suardi N, Briganti A, Zanoni M, Valenti S, Vavassori I, Rigatti P (2004) Holmium laser enucleation versus transurethral resection of the prostate: results from a 2-center, prospective, randomized trial in patients with obstructive benign prostatic hyperplasia. J Urol 172(5 Pt 1):1926–1929
9. Glybochko PV, Rapoport LM, Enikeev ME, Enikeev DV (2017) Holmium laser enucleation of the prostate (HoLEP) for small, large and giant prostatic hyperplasia: tips and tricks. Urologia 84(3):169–173. https://doi.org/10.5301/uj.5000232 **(Epub 2017 May 10)**
10. Hurle R, Vavassori I, Piccinelli A, Manzetti A, Valenti S, Vismara A (2002) Holmium laser enucleation of the prostate combined with mechanical morcellation in 155 patients with benign prostatic hyperplasia. Urology 60(3):449–453
11. Gilling PJ, Cass CB, Malcolm AR, Fraundorfer MR (1995) Combination holmium and Nd:YAG laser ablation of the prostate: initial clinical experience. J Endourol 9(2):151–153
12. Kelly DC, Das A (2012) Holmium laser enucleation of the prostate technique for benign prostatic hyperplasia. Can J Urol. 19(1):6131–6134
13. Krambeck AE, Handa SE, Lingeman JE (2010) Experience with more than 1,000 holmium laser prostate enucleations for benign prostatic hyperplasia. J Urol 183(3):1105–1109
14. Baazeem AS, Elmansy HM, Elhilali MM (2010) Holmium laser enucleation of the prostate: modified technical aspects. BJU Int. 105(5):584–585
15. Scoffone CM, Cracco CM (2016) The en-bloc no-touch holmium laser enucleation of the prostate (HoLEP) technique. World J Urol 34(8):1175–1181
16. Minagawa S, Okada S, Morikawa H (2017) Safety and effectiveness of holmium laser enucleation of the prostate using a low-power laser. Urology. 110:51–55. https://doi.org/10.1016/j.urology.2017.08.034 **(Epub 2017 Sep 4)**
17. Hiraoka Y, Shimizu Y, Iwamoto K, Takahashi H, Abe H (2007) Trial of complete detachment of the whole prostate lobes in benign prostate hyperplasia by transurethral enucleation of the prostate. Urol Int 79(1):50–54
18. Hiraoka Y (1983) A new method of prostatectomy, transurethral detachment and resection of benign prostatic hyperplasia. J Nippon Med Sch 50:896–898
19. Hiraoka Y, Akimoto M (1989) Transurethral enucleation of benign prostatic hyperplasia. J Urol 142:1247–1250
20. Shimizu Y, Hiraoka Y, Iwamoto K, Takahashi H, Abe H (2005) Measurement of residual adenoma after transurethral resection of the prostate by transurethral enucleation technique. Urol Int 74:102–107
21. Kim YJ, Lee YH, Kwon JB, Cho SR, Kim JS (2015) A novel one lobe technique of thulium laser enucleation of the prostate: 'all-in-one' technique. Korean J Urol 56(11):769–774
22. Gomez Sancha F, Cuadros Rivera V, Georgiev G, Bocevski A, Kotsev J, Herrmann T (2015) Common trend: move to enucleation—is there a case for GreenLight enucleation? Development and description of the technique. World J Urol 33(4):539–547
23. Gong YG, He DL, Wang MZ, Li XD, Zhu GD, Zheng ZH, Du YF, Chang LS, Nan XY (2012) Holmium laser enucleation of the prostate: a modified enucleation technique and initial results. J Urol 187(4):1336–1340
24. Kuo RL, Paterson RF, Kim SC, Siqueira TM Jr, Elhilali MM, Lingeman JE (2003) Holmium laser enucleation of the prostate (HoLEP): a technical update. World J Surg Oncol 1(1):6

25. Minagawa S, Okada S, Sakamoto H, Toyofuku K, Morikawa H (2015) En-Bloc technique with anteroposterior dissection holmium laser enucleation of the prostate allows a short operative time and acceptable outcomes. Urology 86(3):628–633
26. Miernik A, Schoeb DS (2018) "Three horse shoe-like incision" holmium laser enucleation of the prostate: first experience with a novel en bloc technique for anatomic transurethral prostatectomy. World J Urol. https://doi.org/10.1007/s00345-018-2418-0
27. Rapoport LM, Sorokin NI, Sukhanov RB, Dymov AM, Enikeev DV, Davydov DS, Danilov SP (2018) En bloc holmium laser enucleation of the prostate (HOLEP EN BLOC): our experience. Urologiia 3:83–87
28. Wilson LC, Gilling PJ, Williams A, Kennett KM, Frampton CM, Westenberg AM, Fraundorfer MR (2006) A randomised trial comparing holmium laser enucleation versus transurethral resection in the treatment of prostates larger than 40 grams: results at 2 years. Eur Urol 50(3):569–573
29. Naspro R, Suardi N, Salonia A, Scattoni V, Guazzoni G, Colombo R, Cestari A, Briganti A, Mazzoccoli B, Rigatti P, Montorsi F (2006) Holmium laser enucleation of the prostate versus open prostatectomy for prostates > 70 g: 24-month follow-up. Eur Urol 50(3):563–568
30. Gupta N, Sivaramakrishna, Kumar R, Dogra PN, Seth A (2006) Comparison of standard transurethral resection, transurethral vapour resection and holmium laser enucleation of the prostate for managing benign prostatic hyperplasia of > 40 g. BJU Int 97(1):85–89
31. Fayad AS, Sheikh MG, Zakaria T, Elfottoh HA, Alsergany R (2011) Holmium laser enucleation versus bipolar resection of the prostate: a prospective randomized study. Which to choose? J Endourol 25(8):1347–1352