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T-L technique for HoLEP: perioperative outcomes of a large single-centre series

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Introduction The aim of this article was to describe, step-by-step, an original technique (T-L technique) in a single centre series of patients who underwent holmium laser enucleation of the prostate (HoLEP) for symptomatic benign prostatic hyperplasia and analyze perioperative outcomes.
Material and methods We retrospectively analyzed data of 567 patients who underwent HoLEP. The T-L technique consists of a series of incisions used as landmarks, performed at the beginning of the procedure before enucleation. Two T-shape incisions are performed at the level of bladder neck (at the 5-7 and 12 o'clock positions); two L-shape incisions are performed at the level of verumontanum, bilaterally, to mark the apex and to limit the sphincter. Another T-shape incision is performed on the bladder neck at the 12 o'clock position posterior to the level of verumontanum.
Results The median operative time (OT) was 80 minutes (IQR 64–105); 50 minutes (IQR 35–70) and 15 minutes (IQR 10–20) for enucleation and the morcellation phase, respectively. Conversion to transurethral resection of the prostate (TURP) was necessary in 3/567 (0.6%) patients. Intraoperative complications occurred in 3.4% of cases, capsule perforation occurred in 12/567 (2%) of cases, while bladder perforation during morcellation occurred in 8/567 (1.4%) of cases. Postoperative complications were observed in 20/567 (3.5%) of patients. Specifically, grade 1–2 occurred in 19/567 (3.3%) and grade 3 was recorded in 1/567 (0.2%).
Conclusions The T-L technique for HoLEP is safe and reproducible with a low rate of perioperative complications. The positioning of some landmarks before enucleation allows for the better orientation during enucleation and could be very useful in case of large prostates.

Key Words: holmium laser enucleation of the prostate ‹› benign prostatic hyperplasia ‹› laser ‹› lower urinary tract symptoms

INTRODUCTION

Bladder outlet obstruction (BOO) caused by benign prostatic hyperplasia (BPH) is the most common cause of lower urinary tract symptoms (LUTS) [1]. Monopolar and bipolar transurethral resection of the prostate (TURP) is considered to be the standard surgical procedure in small-medium glands [2].

The advent of laser energy-based technology has progressively gained acceptance into clinical practice in order to overcome TURP's perioperative outcomes. Holmium laser enucleation of the prostate (HoLEP) is a minimally invasive treatment for benign prostatic hyperplasia which has seen growing approval in the last two decades, becoming a reference point. HoLEP is recognized as a safe alternative to both

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endoscopic (TURP or laser vaporization techniques) and simple prostatectomy. It consists of the anatomical removal of the adenoma following the surgical plane between the prostatic capsule and adenoma with a subsequent morcellation of adenoma tissue. HoLEP has demonstrated an excellent safety profile in addition to better functional results compared to TURP [3–7].

The learning curve is probably the main limitation to its widespread use. HoLEP has a learning curve exceeding 20 cases [8], even in prospective training structures. Since its introduction, several enucleation techniques have been described besides the three-lobe approach originally described by Gilling [9].

This article describes a step-by-step procedure and analysis of perioperative outcomes of three-lobe enucleation with the T-L landmark technique, performed by skilled surgeons on a large contemporary series of patients.

MATERIAL AND METHODS

All cases undergoing HoLEP for BOO between February 2016 and February 2020 at Policlinico Abano Terme were retrospectively collected. Every patient was willing to participate and authorized data collection for scientific purposes.

All procedures were performed under general or spinal anesthesia by four expert surgeons who had completed at least 200 HoLEP procedures prior to the commencement of this study.

Each patient underwent a transrectal ultrasound of the prostate in order to evaluate prostatic and adenoma volume. Magnetic multiparametric resonance imaging of the (mpMRI) prostate was performed in suspected cases to exclude incidental prostate cancer [10]. Patients received antibiotic prophylaxis if their urine culture was negative or antibiotic therapy if their urine culture was positive. Postoperative complications were recorded according to the Clavien-Dindo classification [11].

Endoscopic equipment and laser settings

A two-pedal (120–60 W) Holmium: YAG Laser (VersaPulse; Lumenis Ltd., Yokneam, Israel) was used as the energy source, as well as a 550-μm end-firing laser fiber (SlimLine TM 550, Lumenis Inc.). A 26 Fr continuous flow resectoscope with a laser bridge (Karl Storz Endoscopy, CA, USA) thirty degrees camera was also used. Enucleated floating prostate tissues were removed by a morcellator (VersaCut, Lumenis, Santa Clara, CA, USA) introduced through a nephroscope (Karl Storz Endoscopy).

Surgical technique

A urethrocystoscopy was performed prior to enucleation in order to visualize the verumontanum, bladder neck, median lobe presence and ureteral orifices. These anatomical landmarks are fundamental for the commencement of the procedure and are

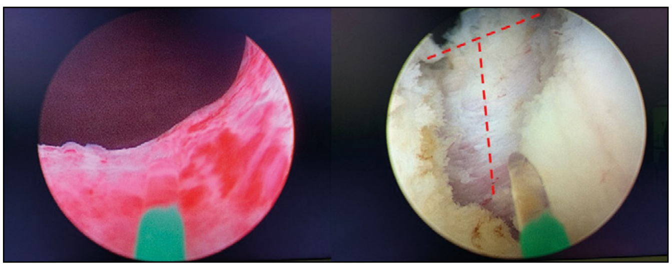

Figure 1. *T-shape incision at the 5 o'clock position between median and left lobe.*

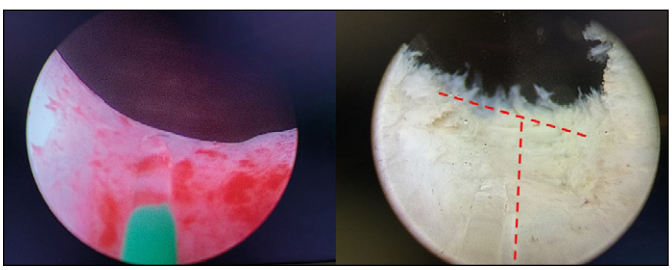

Figure 2. *T-shape incision at the 7 o'clock position between the median and right lobe.*

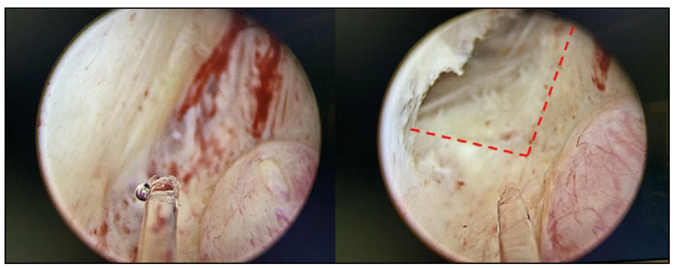

Figure 3. *L-shape incision between the verumontanum and apex of the right lobe close to the sphincter.*

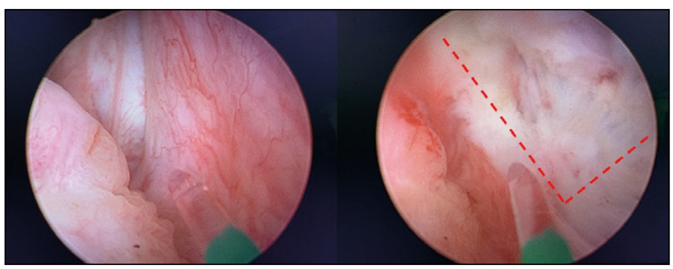

Figure 4. *L-shape incision between the verumontanum and apex of the left lobe close to the sphincter.*

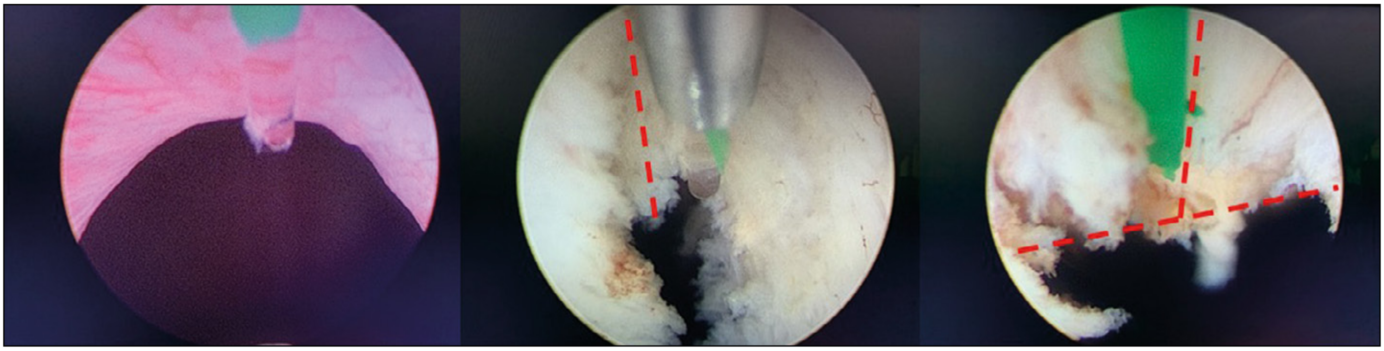

Figure 5. *T-shape retrograde incision at the 12 o'clock position from the bladder neck to the verumontanum level.*

to be kept in mind throughout the procedure in order to reduce time-consuming intraoperative repeated orienteering.

STEP 1 (bladder neck incision/median lobe definition): First, a longitudinal incision is made on both sides of the median lobe (at the 5 and 7 o'clock positions), from the bladder neck downwards to the verumon-tanum. The proximal end of these incisions must be enlarged on a horizontal plane towards the lateral lobe in a lateral direction and to the median lobe in a medial direction until the capsule is identified. At this point, incisions should take on a T-shape (Figures 1, 2).

The same incisions can be performed on patients with small prostates, or those lacking a proper median lobe: the prostatic tissue within the two T-cuts will develop a volume that can be enucleated as a median lobe. Proceeding distally with the longitudinal incision (at the 5 and 7 o'clock positions), it must be deep-ened down to the prostate capsule separating the median lobe from the lateral lobes.

STEP 2 (distal incision): Subsequently, two longitudinal incisions are made on both sides of the verumontanum, near the proximal edge of the external sphincter (Figures 3, 4). The distal end of these incisions must be enlarged laterally, towards the lobes, obtaining an L-shape. The lateral lobe is raised with a resectoscope beak leverage movement, creating a capsule plane landmark for lateral dissection. The release of the apex decreases traction to the sphincter during enucleation.

STEP 3 (median lobe enucleation): Median lobe enucleation begins by connecting the proximal and the distal longitudinal cuts, deepening the incision down until the capsule. A transverse incision is made behind the verumontanum in order to connect the previous longitudinal incisions and is then deepened down to the capsule plane. Proceeding with retrograde median lobe enucleation, a blunt dissection helps to define the plane between the adenoma and the capsule. If the T-shape incisions are performed correctly, the terminal phase of enucleation should be easier when approaching the bladder neck, with only the central portion of the median lobe still attached to the capsule. Moreover, this trick minimizes bladder neck mobilization during the latest phases of enucleation, thus reducing traction and the risk of damage to the ureteral orifices.

STEP 4 (lateral lobe enucleation): A retrograde longitudinal incision at the 12 o'clock position is made from the bladder neck proximally towards verumontanum with the resector facing up. Care should be taken not to go too deep since the anterior fibromuscular plane is rather thin (Figure 5). It is important to keep the verumontanum landmark in sight when reaching the cut's distal end in order to reduce sphincter damage. The proximal end of the longitudinal incision has to be continued, on both sides, on a horizontal plane, downward to the lateral lobes, until the operator identifies the capsule plane of the lateral lobe. This will result in a T-shape incision, like the previous ones obtained on the bladder neck. The resectoscope is now retracted back to the verumontanum in order to begin lateral lobe enucleation. There is more space to perform apical blunt dissection since the middle lobe has already been enucleated. The L-cut will now come in handy: the lateral lobe's distal portion is no longer attached to the mucosa, reducing the risk of creating mucosal crevices in bulbous urethra during blunt lifting. Once the apex has been mobilized, dissection should be aimed retrograde and upwards.

At this point, completed lateral mobilization of the lobe and the definitive detachment start at the level of ventral apex of the prostate is performed. At this level, it would be better to perform sharp cutting closer to the adenoma side rather than the capsular side (Figure 6) proximally and maintaining capsular ventral plan distally up to the bladder neck to complete lobe enucleation.

STEP 5 (hemostasis and morcellation): Once enucleation is completed and all the lobes located in the

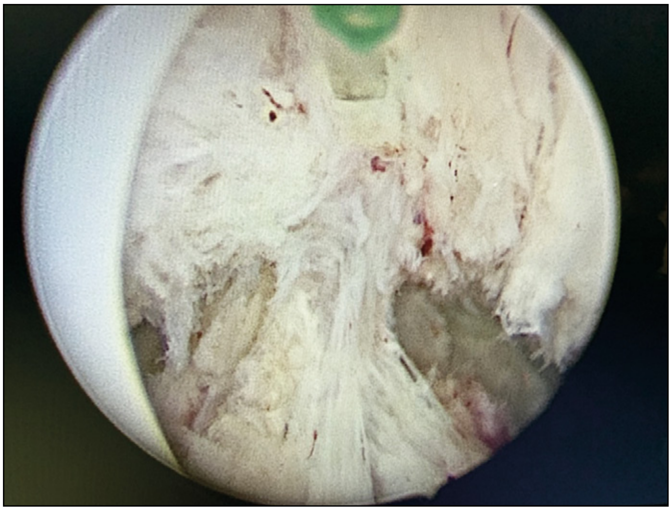

Figure 6. *Final detachment of the lateral lobe from the level of ventral apex of the prostate to the bladder neck.*

bladder, we proceed to a careful coagulation for hemostasis of the prostatic fossa. Hemostasis is performed with Holmium laser with setting 60 W long pulse. Rarely, if laser energy is insufficient, monopolar or bipolar resectoscopes were used to complete hemostasis. Intravesical morcellation and extraction by suction of the prostate tissue is then performed.

RESULTS

A total of 567 HoLEP procedures were performed during the study period. Preoperative characteristics of the 567 evaluated patients are reported in Table 1. Specifically, the median prostate volume was 80 mL (IQR 60–105), while the median preoperative International Prostatic Symptoms Score (IPSS) was 21 (17–26). Forty-five percent of patients had a median lobe.

The median operative time (OT) was 80 minutes (IQR 64–105); 50 minutes (IQR 35–70) and 15 minutes (IQR 10–20) for enucleation and the morcellation phase, respectively. Conversion to TURP was necessary in 3/567 (0.6%) patients. With regards to intraoperative complications, capsule perforation occurred in 12/567 (2%) of cases, while bladder perforation during morcellation occurred in 8/567 (1.4%) of cases. Intraoperative complications are summarized in Table 2.

Postoperative complications were observed in 20/567 (3.5%) of patients. Specifically, grade 1–2 occurred in 19/567 (3.3%) and grade 3 was recorded in 1/567 (0.2%). Postoperative complications and relative treatments are summarized in Table 3.

Table 1. *Clinical and pathological characteristics of the 567 patients*

Variable	Total
Median patient age (years) (IQR)	69 (63–74)
Median prostate volume (mL) (IQR)	80 (60–105)
Median max flow rate (mL/sec) (IQR)	8 (6–11)
Median post-void residual volume (mL) (IQR)	100 (39-200)
Median IPSS (IQR)	21 (17–26)
Median PSA (ng/mL) (IQR)	4 (2.3–6.2)
Presence of median lobe (%)	257/567 (45%)

IQR – interquartile range; IPSS – International Prostate Symptom Score; PSA – prostate-specific antigen

Table 2. *Intraoperative parameters and complications of the 567 patients*

Variable	Total
Median operative time (min) (IQR)	80 (64–105)
Median enucleation time (min) (IQR)	50 (35–70)
Median morcellation time (min) (IQR)	15 (10–20)
Conversion to TURP (%)	3/567 (0.6%)
Capsule perforation	12/567 (2%)
Bladder perforation	8/567 (1.4%)
Ureteral orifice lesion	0

min – minutes; IQR – interquartile range; TURP – transurethral resection of the prostate

Table 3. *Postoperative complications of the 567 patients according to the Clavien-Dindo classification*

Grade	Overall complication, 20/567 (3.5%)	Complication type	Treatment
2	19/567 (3.3%)	Hematuria Epididymitis Acute urinary retention	Conservative Antibiotic therapy Catheterization
3	1/567 (0.2%)	Hematuria	Cystoscopy and hemostasis

DISCUSSION

This study demonstrated that HoLEP, performed by expert surgeons, has an excellent perioperative profile with a very low complications rate and grade. Despite HoLEP gaining wide acceptance nowadays, having established a new size independent surgical gold standard for BPH treatment, its worldwide propagation is relatively limited due to its learning curve. In a recent systematic review of the literature, Enikeev et al. show that 30–40 cases are necessary to achieve a level of experience [12].

The traditional 'three-lobe' technique described by Fraudorfer and Gilling [13] was modified by several authors in order to make the enucleation phase easier and to reduce some postoperative side effects other than the learning curve. The main difficulty of HoLEP during enucleation is represented by orientation, especially in large prostates.

Scoffone and colleague describe an en bloc HoLEP technique [14]. Enucleation begins at the left apex close to the verumontanum and laterally follows the plane between the surgical capsule and adenoma of the left lobe; after overpassing the anterior commissure toward the right side, enucleation is completed by means of median en bloc with the incision of the parasphincteric anterior mucosal strip. They reported 0.4% of stress urinary incontinence in a series of 270 patients with a mean adenoma weight of 52.4 grams. En bloc enucleation is probably a feasible technique for expert surgeons, despite the fact that large prostates can limit orienting and increase traction on the sphincter with a possible major risk for postoperative stress incontinence.

Tunc et al. [15] recently introduced a new HoLEP technique called the 'Omega Sign technique'. The technique consists of an early mucosa incision through all the boundaries of enucleation based on the topographic anatomy of the external sphincter. After a comparative analysis, they reported better postoperative outcomes in terms of stress urinary incontinence risk evaluated at catheter removal and compared to Gilling's technique after one month.

Our technique favored the creation of certain landmarks before enucleation. In our opinion, orientation is one of the principal limits of all endoscopic enucleation techniques, especially during the terminal enucleation phase of each lobe. This critical aspect becomes fundamental in the case of a large prostate and can lengthen the learning curve as well as increase the risk of intraoperative complications, such as capsule perforation. The creation of some landmarks at the beginning of the procedure provides the possibility of orienting the plane of dissection between the limits of incisions previously performed. Orienting becomes difficult during enucleation of lateral lobes when floating adenoma masses increase on approaching the bladder neck. At this point, beginners usually struggle to strip the adenoma from the capsule. Our technique is particularly helpful in this phase, allowing for better identification of lobe boundaries. Mobilized lobes tend to hang down in the urethral lumen, revealing the T-cut landmark previously prepared at the 12 o'clock position: the operator just needs to identify the residual adenoma pedicle still attached to the capsule and join the two incisions on its sides, completing the enucleation.

Another aspect that has to be considered with the 'three-lobe' technique is the possibility of splitting the procedure into three different parts. During the learning curve, the beginner can position the technique landmarks and proceed to third lobe enucleation before starting with one of the lateral lobes. In fact, one of the main reasons for unsuccessful procedures is predominantly the prolongation of operative time [8].

Stress urinary incontinence following HoLEP is one of the more frequent postoperative complications, It is transient in about 8% of patients and definitive in about 1.5% [16–19]. It is principally related to prostate volume and the enucleation ratio [20]. This relationship could be explained by the possible traction on the urinary sphincter performed during enucleation. The splitting of enucleation into three lobes inevitably reduces the angle of movement of the resectoscope, thus reducing traction on the sphincter.

In a comparative study, Ito et al. reported the perioperative and postoperative outcomes of three different HoLEP techniques: conventional three-lobe technique; conventional en bloc technique and complete en bloc technique with direct bladder neck incision. They reported a different, although not statistically significant, continence recovery rate in favor of the three-lobe technique [21].

In our series, the choice to use a two-pedal holmium laser system (120–60 W) allows for the modulation of power and subsequently, the velocity of enucleation. Furthermore, the use of a low power setting (60 W) during hemostasis enables the reduction of energy to the capsule and the risk of its perforation, in addition to possible irritative postoperative symptoms.

This study is not without limitations, such as its retrospective design and the absence of a control group. The observed promising results justify larger exploration and assessment studies comparing the new technique with the standard three-lobe procedure or other techniques.

CONCLUSIONS

The positioning of landmarks before HoLEP could be useful for orienting purposes during enucleation. This technique is feasible, rapid and simple with excellent perioperative outcomes. The promising results achieved by this single centre study need to be confirmed in larger studies comparing the T-L technique to other enucleation techniques for HoLEP commonly used by other authors.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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