HOW I DO IT

Anatomic GreenLight laser vaporization-incision technique for benign prostatic hyperplasia using the XPS LBO-180W system: How I do it

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For men experiencing lower urinary tract symptoms (LUTS) refractory to medical therapy, there have been numerous developments in the treatment options offered for benign prostatic hyperplasia (BPH) in the recent years. Transurethral resection of the prostate (TURP) has remained the reference standard for men with prostates sized 30 cc-80 cc, while open prostatectomy is universally guidelines-recommended in the absence of enucleation, for men with prostates larger than 80 cc-100 cc. While these techniques are effective, they have the potential for bleeding complications requiring transfusions, electrolyte abnormalities such as TURP syndrome, and often require prolonged hospitalization. GreenLight photoselective vaporization (GL-PVP) with the XPS LBO-180W system offers a minimally invasive treatment that can be carried out on essential any sized prostate gland. In addition, the GL-PVP procedure can be done as a same day discharge surgery requiring no overnight hospital admission and allows patients to continue any necessary anti-coagulants given the significantly reduced risks of bleeding complications or TURP syndrome. In 2005, the anatomic vaporization-incision technique (VIT) using the XPS LBO-180W system was described to address larger prostate volumes. VIT combines principles of traditional GL-PVP and enucleation techniques to identify the reference surgical capsule early-on into the surgery and resect portions of prostate adenoma without the need for tissue morcellation. Early studies comparing anatomic VIT to standard PVP outcomes demonstrated significant improvements of IPSS and uroflowmetry parameters, along with statistically significant greater PSA reduction at 6 months, particularly in prostate volumes greater than 80 cc. The objective of this article is to detail our surgical approach to the anatomic GreenLight laser vaporization-incision technique using the XPS LBO-180W system, based on extensive personal experience with both enucleation and vaporization techniques using various laser technologies. Standardization of the VIT based on proper cystoscopy, knowledge of prostate anatomy with preoperative ultrasound, and routine technique is essential to developing consistent, reproducible and optimal surgical outcomes.

Key Words: benign prostatic hyperplasia, lower urinary tract symptoms, vaporization-incision technique

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Introduction

The use of laser therapies has become a favorable alternative for the surgical management of benign prostatic hyperplasia (BPH), as its minimally invasive approach has been proven to be as effective as transurethral resection of the prostate (TURP), the gold standard for BPH treatment for small to medium sized glands.[1] Alternatives for surgical BPH management have been developed to treat patients presenting with comorbidities including cardiovascular diseases and anticoagulant therapy. Various developments in laser technology have been introduced over the last two decades, including the 80W KTP, 120W HPS and 180W XPS 532nm GreenLight (Boston Scientific, Marlborough, MA, USA) lasers systems.[2] Photoselective vaporization (PVP) of the prostate utilizing the 180W XPS system has been accepted by the American Urological Association (AUA) as a suitable alternative to TURP,[3] and techniques for this procedure have been previously described.[4,5] In 2005, the vaporization-incision technique (VIT) using the 180W XPS system was described in publication to address larger volume prostates.[6] This anatomic-based and standardized technique utilizes the vaporizing capacities of the GreenLight laser system to resect prostate adenoma tissue along the surgical capsule emulating somewhat an enucleation approach, as compared to direct vaporization of adenoma tissue from the prostatic urethra (standard PVP technique). Studies comparing the early functional outcomes of patients who underwent VIT as compared to PVP demonstrated significant improvements in IPSS, quality of life and uroflowmetry parameters, as well as significantly greater PSA reduction at 6 months.[7] As such, better tissue removal for more durable outcomes, particularly for prostate volumes > 80 cc.

To the best of our knowledge, few publications have described a standardized technique and approach to performing VIT.[6] We propose an 11-step systematic approach to VIT for the learning surgeon, accompanied with images of the procedure for reference. As highlighted in this tutorial, VIT is an anatomically guided procedure with clearly defined endpoints. The surgical approach of VIT is similar to that of PVP, though the technique is considered to be more complex with advanced laser fiber handling and improved appreciation of anatomic structures (particularly the surgical capsule). We recommend that the learning surgeon have experience with standard PVP treatment of prostates before attempting VIT.

GreenLight laser technology

GreenLight laser technology is characterized by its emission of 532nm light, interacting preferentially with hemoglobin containing tissues. Hemoglobin absorption of the light causes a rapid increase in intracellular temperature, leading to selective vaporization, thus termed photoselective vaporization of the prostate. Treatment for BPH takes advantage of these interactions as the vascularized prostatic adenoma tissue is surrounded by a non-vascular surgical capsule, restricting the lasers' effectiveness within the surgical capsule in lower power settings. Three iterations of GreenLight technology have been commercialized since 2006, the latest upgrade is the 180W XPS system. It offers 50% more power as compared to the previous 120W system, while offering a wider area of effect (0.44 mm^2 compared to the previous 0.28 mm^2). The depth of optical penetration is less than 2 mm, allowing for precise vaporization/coagulation. By modifying the power of the laser, a surgeon can easily switch from coagulation settings (30W) for hemostatic control, to vaporization settings (80W-180W). Additionally, the 180W XPS system utilizes MoXy liquid-cooled, steel-capped fibers. These have increased fiber longevity with improved protection from fracture and devitrefication.

Technique nomenclature

Although there is no official standardized nomenclature for the various techniques of laser adenoma removal, the multiple techniques in practice today can be broadly categorized as ablation, resection or enucleation. Simply put, ablation techniques use pure vaporization to remove adenoma tissue, resulting in a "TURP-like" cavity from the bladder neck down to the verumontanum. In classic PVP (an ablation modality), a channel is formed through the adenoma to relieve obstruction, leaving behind a variable layer of adenoma. In contrast, anatomic PVP is a technique in which adenoma is vaporized down to the surgical capsule, leaving no remaining adenoma. Because ablation utilizes pure vaporization, there are no adenoma tissue samples that can be sent for pathology. Ablation of the adenoma can be time consuming in larger prostates, as such, vaporization resection (vapor-resection) techniques such as the vaporization incision technique (VIT)[6] and the Seoul technique[8] have been developed. In vapor-resection techniques, the adenoma is removed using a combination of pure vaporization, and vaporization to resect "TURP-like" strips of adenoma, which are endoscopically collected at the end of the procedure. In adenoma enucleation, the prostate adenoma is separated from the surgical capsule using a combination of laser and cystoscopic sheath mechanical separation and is subsequently pushed into the bladder. The fragments of adenoma are removed with the use of intra-vesicle morcellation. In the classical en-bloc-technique, the entire prostate adenoma is enucleated as a single fragment before intravesicle morcellation.

Preoperative assessment of GreenLight XPS VIT candidates

Patients should receive a thorough medical history and physical exam as suggested by the AUA, European Association of Urology (EAU), and Canadian Urological Association (CUA) guidelines.[3,9,10] A validated IPSS questionnaire is used to assess lower urinary tract symptoms (LUTS) with attention not only to the obstructive but that of the irritative symptoms (frequency, urgency and nocturia) for possible coexisting overactive bladder. The prostate is also evaluated for abnormalities with a digital rectal exam (DRE). Preoperative PSA measurements are recommended with any suspicion of prostate cancer and should be evaluated with a preoperative prostate biopsy if necessary. Transrectal ultrasound (TRUS) imaging is strongly recommended to accurately assess the volume of the prostate (as it helps to predict surgical parameters, complications, operative time and fibre number). Urinalysis and treatment of infection is done prior to surgery.

During patient counseling, a thorough discussion regarding patient expectations should be carried out. This discussion should include the risks and benefits of the surgery; these include hematuria, dysuria, frequency/urgency, retrograde ejaculation, urinary tract infection, urinary retention and incontinence. Patients with comorbidities that may underlie a weak urinary sphincter should discuss treatment of the apex of the prostate (discussed later). Using clinical judgment, the urologist and medical consultants may hold anti-coagulation therapy in low thromboembolic risk patients to minimize operative and postoperative bleeding. For higher risk patients, anticoagulation may be continued safely with PVP.[11]

Fundamental surgical techniques

Laser-tissue distance

Despite laser collimation, laser treatment efficiency declines when distance from target tissue is greater than 3 mm. The optimal working distance between laser fiber and tissue is 1 mm-2 mm. Practically, visual use of the fiber cap width (1.8 mm) should be used as a reference for working distance.

Power settings

Initial settings for the treatment of the highly vascularized prostatic urethral mucosal surface should be 80W for vaporization (though more experienced users may initiate vaporization at higher power settings) and 30W for coagulation. Once creating a working space into the adenoma, vaporization settings are increased to 120W-180W (depending on experience) to treat deeper tissue along with defining incisions to the surgical capsule. Once capsular fibers are seen, power settings should be reduced to 120W to avoid perforation and/or bleeding. Precise treatment of highly fibrous tissue parallel to the surgical capsule to release BPH will utilize the 180W setting.

Rotational angle and wweep speed

A sweep speed of 2 seconds per each 30-degree arc rotation, or 4 mm sweep per second has been demonstrated to provide optimal tissue removal.[12] A slower, controlled pace is preferred as compared to traditional TURP. Experimental models demonstrated that a sweep angle of less than 30 degrees with a speed greater than 0.5 mm-1 mm per second was the most efficient for vaporization.[12]

Operative parameter estimates

Several studies have assessed the optimal energy usage for durable urinary function outcomes. Valdivieso et al[13] have reported that energy usage is estimated at 3kJ-4kJ/TRUS volume (cc). As such, estimating preoperative prostate volume helps direct surgical planning. For example, a 65 cc prostate should require an estimated 260kJ when performing anatomic vaporization. In our experience, total operative time is estimated at 1 min/cc (65 minutes for a 65 cc prostate), 50% of which would be lasing time (32 minutes).

Surgical complications

Despite the preferential vaporization of hemoglobin-containing structures, higher power settings still present a risk of capsular perforation, which may lead to complications of urinary extravasation or damage to adjacent structures. To mitigate these risks, proper laser distance with adequate sweep speed are essential; slower sweep speeds may lead to transmission of energy deeper than intended. For users accustomed to water-based laser techniques, it is fundamental to recognize that the GreenLight laser requires a continuous sweeping motion, as opposed to the more static motion of holmium or thulium lasers.

Management of bleeding

In most cases, the 30W coagulation setting will be sufficient to achieve capillary or venous hemostasis. Some smaller bleeds, if deemed insignificant, can be ignored if not impacting surgical vision. In scenarios of more difficult and persistent bleeds, increase hydrostatic pressure of the prostatic cavity by elevating irrigation bags and closing outflow. Once identified, the source of bleeding can be mechanically compressed with the fiber cap. Subsequent coagulation with the 30W setting should seal the bleed with vessel wall sealing. Another last resort option that can be implemented with the laser is the use of "long distance" vaporization using the 80W setting with a fast fiber sweep (much quicker than when actually vaporizing) to obtain a coagulation effect. From a distance, the laser is oriented at angle to avoid perpendicular contact with the underlying tissue, consequently increasing the laser footprint/surface area. The more powerful setting at an angle and quick fiber sweep over the bleed may prove effective in coagulation, without an additional use of the coagulation mode. It is important to note that in cases of important and significant bleeding, visibility is decreased. It is fundamental to maintain an awareness of the anatomical landmarks. If necessary, retract the laser to the verumontanum to reorient your position, and enter again.

Surgical preparation and equipment

The discharge procedure is carried out differently depending on the center and geographic region. The majority of GreenLight cases are performed as outpatient, same day discharge surgeries, while some institutions will keep patients overnight for a voiding trial in the morning. In our hands, GreenLight XPS VIT procedures are carried out at our institution as a same-day outpatient surgery. Preoperative antibiotics are administered with standard use of Ampicillin 1 g and 80 mg Tobtramycin IV. After anesthesia (dominantly spinal anesthesia) the patient is prepped with disinfectant (chlorhexidine 4%) and is placed into the dorsal lithotomy position. For men with indwelling catheters, the bladder and foley are irrigated with a sterile water/chlorhexidine mix to help reduce intravesical bacterial count/biofilm prior to catheter removal.

The surgeon should verify that all equipment is properly set up (cystoscope attached to working sheath, white balance, light cord, irrigation tube positioned, catheter for case conclusion and syringe filled with 30 cc normal saline); 3 L room temperature saline bags are hung above the patient through a Y-tube. The MoXy fiber is cooled using a 1-3 L bag of saline which should be hung at the same height as the irrigation bags.

The procedure

Cystoscopy and anatomy identification

Atraumatic cystoscope and laser fiber insertion under direct vision is essential to avoid unnecessary bleeding, particularly at the bladder neck and median lobe of the prostate. The bladder is then inspected for any pathology. Next, the left and right ureteral orifices (UO) are identified, while assessing the shape and size of the median lobe. In some cases, the UO may be masked by a large median lobe. Forceful identification of the UO is to be avoided as it can result in undesired mucosal bleeding, therefore it can be postponed until after the bladder neck has been debulked. Once the inspection is completed and the bladder has been inflated, the scope is placed with the verumontanum and laser fiber in the field of view.

Step 1: Identification and demarcation of critical distal landmarks (30W)

Using the 30W coagulation setting, demarcate a distal border at the apex mucosa of the prostate, just proximally from the verumontanum, Figure 1a, extending up to the lateral walls, Figure 1b. Care should be made not to injure the verumontanum, especially if antegrade ejaculation preservation is desired. Light scoring of the mucosa

Figure 1. Demarcation of critical landmarks. The cystoscopy has been parked at the verumontanum **(A)**. The laser is activated, with the 30W coagulation setting, 5 mm-10 mm proximal to the verumontanum along the prostate floor, extending up to the lateral walls to demarcate the distal vaporization border **(B)**. The horseshoe shaped landmark can be referenced throughout the procedure as the distal surgical border **(C)**.

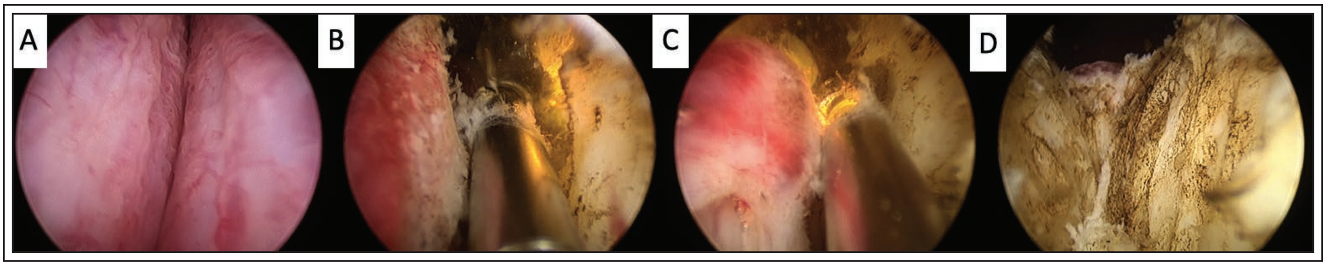

Figure 2. Debulking of the lateral prostate lobes. Patients undergoing surgical treatment for BPH often present with kissing lateral prostate lobes **(A)**. Vaporization of the initially convex left kissing lateral lobe **(B and C)** and right lateral lobe results in a concave channel that provides greater working space for the laser fiber **(D)**.

will create a horseshoe shaped visual landmark, Figure 1c, that can be referenced throughout the procedure to avoid undesired treatment of tissue distal to the apex of the prostate, namely the external urinary sphincter.

It is important to note that throughout the procedure, vaporization of the prostatic tissue is performed by activating the laser at the level of the bladder neck and retracting it with a sweeping motion until the apex of the prostate is reached. While the laser is active, intense light may obscure visualization proximal to the laser. However, on the contralateral side, visual acuity is maintained and should be referenced frequently to identify the true location of the verumontanum.

Step 2: Initial debulking of kissing lobes to create a working space (80W-120W)

Using 80W-120W vaporization settings, create a working space channel by debulking the lateral kissing lobes, Figure 2a, treating from bladder neck to apex of the prostate (demarcated by the horseshoe landmark). Begin with the left lateral lobe, retracting the laser from bladder neck to apex, while performing six to three o'clock sweeping motions with the laser fiber, Figure 2b-2c. Similarly, perform six to nine o'clock sweeping motions with the laser fiber to debulk the right lateral lobe. The endpoint of this step is to vaporize the urothelium (80W) and initial segment of the prostate tissue (120W). As a result, the initially concave lateral (kissing) lobes will now be convex, creating a channel that allows for improved laser fiber irrigation, Figure 2d. This provides more working space for the laser fiber in further steps of the procedure.

Step 3: Creation of five and seven o'clock grooves at the surgical capsule (120W)

Using the 120W vaporization setting, two independent grooves will be made from bladder neck to the apex, proximal to the verumontanum (horseshoe landmark), at five and seven o'clock, Figure 3. As the majority are right handed surgeons, begin with the creation of the five o'clock groove by activating the 120W laser at the bladder neck and retracting to the apex, Figure 3a. When performing the retraction motion, the laser should stay at a fairly constant distance from the lens. It is the camera hand that should guide the movement of the scope and laser from bladder neck to apex. Subsequently, activation of the laser fiber is repeatedly initiated at the bladder neck and retracted down toward the apex with a sweeping motion, vaporizing adenoma, Figure 3b. Repetition of the retraction from bladder neck to apex allows for the deepening of the initial groove, while the sweeping motion of the laser widens it. This should

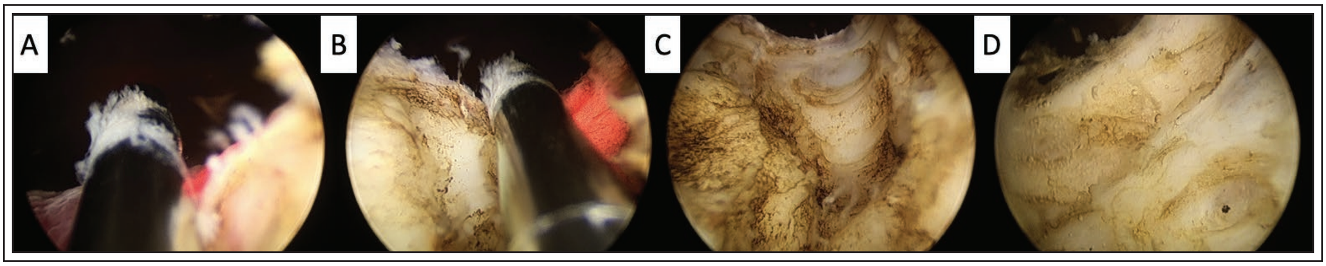

Figure 3. Creation of five o'clock groove. At the five o'clock position, create a groove by retracting the activated laser fiber from bladder neck to apex at 120W **(A)**. Deepen and widen the groove **(B)** by vaporizing adenoma **(C)** until the surgical capsule has been exposed **(D)**. The same procedures are repeated to achieve a seven o'clock groove.

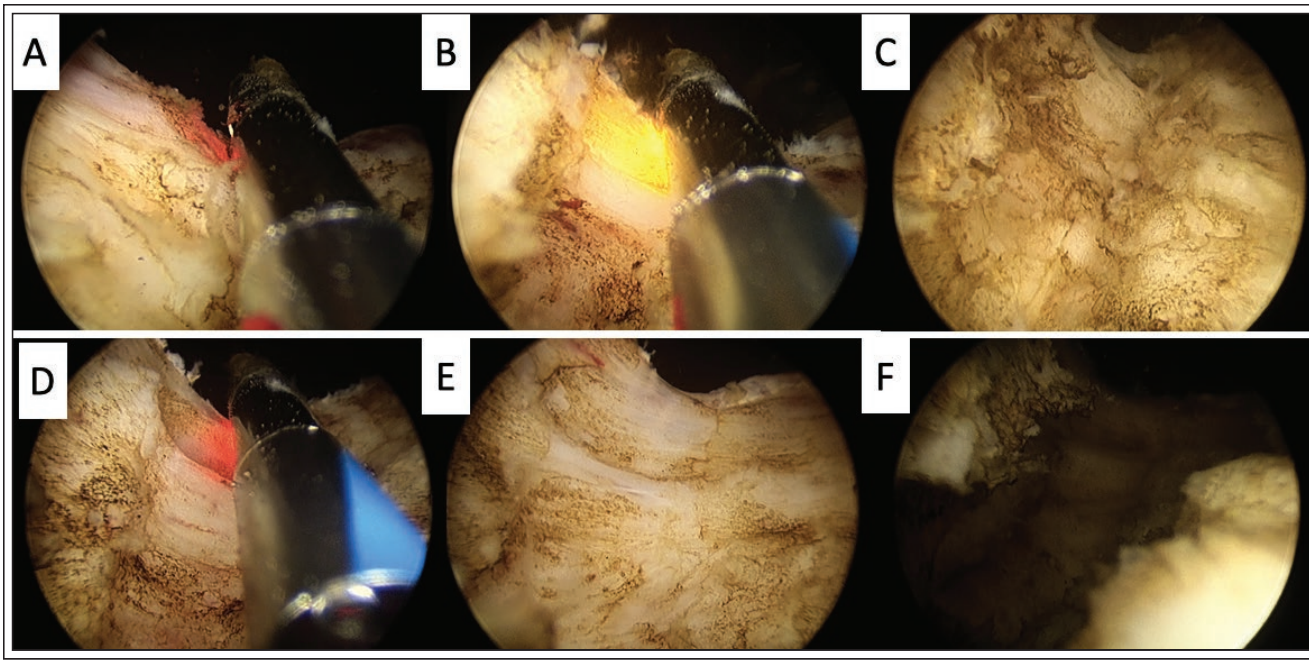

Figure 4. Creation of seven o'clock groove. At the seven o'clock position, create a groove by retracting the activated laser fiber from bladder neck to apex at 120W **(A)**. Deepen and widen the groove **(B)** by vaporizing adenoma **(C)** until the surgical capsule has been exposed **(D and E)**.

be repeated until the adenoma has been vaporized to the level of the surgical capsule, identified by its white transverse fibrous characteristics, Figure 3d, as compared to the yellow/brown fluffy adenoma tissue, Figure 3c. The same procedure is repeated to achieve a groove at the seven o'clock position, Figure 4. The endpoint of this step is to create two reference grooves which will define the depth to which adenoma should be removed in consequent vaporization steps, as well as to facilitate the removal of median lobe, if present.

If a median lobe is present, the five and seven o'clock grooves can be used as gutters for the laser fiber to advance into the bladder. The laser is to be directed towards the median lobe in a lateral, upwards orientation to avoid treatment of the surgical capsule, bladder and UOs.

Step 4: Treatment of the prostate floor adenoma (180W)

Using the five and seven o'clock reference grooves created in the previous step, treatment of the prostate floor adenoma is achieved with medially-directed laser firing, tangential to the surgical capsule using the 180W setting from bladder neck to apex, Figure 5a-c. This can be achieved by either vaporizing from the five o'clock groove to seven, or vice versa. The tangential angle of the laser reduces treatment beyond the surgical capsule. In most cases, the prostate adenoma tissue may be removed with vaporization alone, however, in cases of larger prostate, the surgeon can elect to resect the adenoma into smaller pieces, followed by its excision along the surgical capsule, Figure 5d. The result is free-floating wedges of prostate adenoma which can be pushed into the bladder for later retrieval. If possible, an attempt to keep the wedges of adenoma small enough to be rinsed out should be made, so that a grasper is not required at the end of the procedure. This will be discussed in the later sections.

Novice urologists may be hesitant of the 180W setting, however, it allows for more efficient vaporization of the adenoma, less necrosis of tissues that may not be fully vaporized at lower power settings, and smoother vaporization surfaces along the surgical capsule (thus hastening re-epithelialization postoperatively). All tissue between the five and seven o'clock reference grooves should be removed down to the surgical capsule before proceeding to the next step, Figure 5e-f.

Step 5: Creation of twelve o'clock groove at the surgical capsule (120W)

For this step, as a right-hand dominant surgeon, the camera light cord should be rotated to nine o'clock. Using the 120W vaporization setting, begin by creating an anterior groove from the bladder neck to the apex at

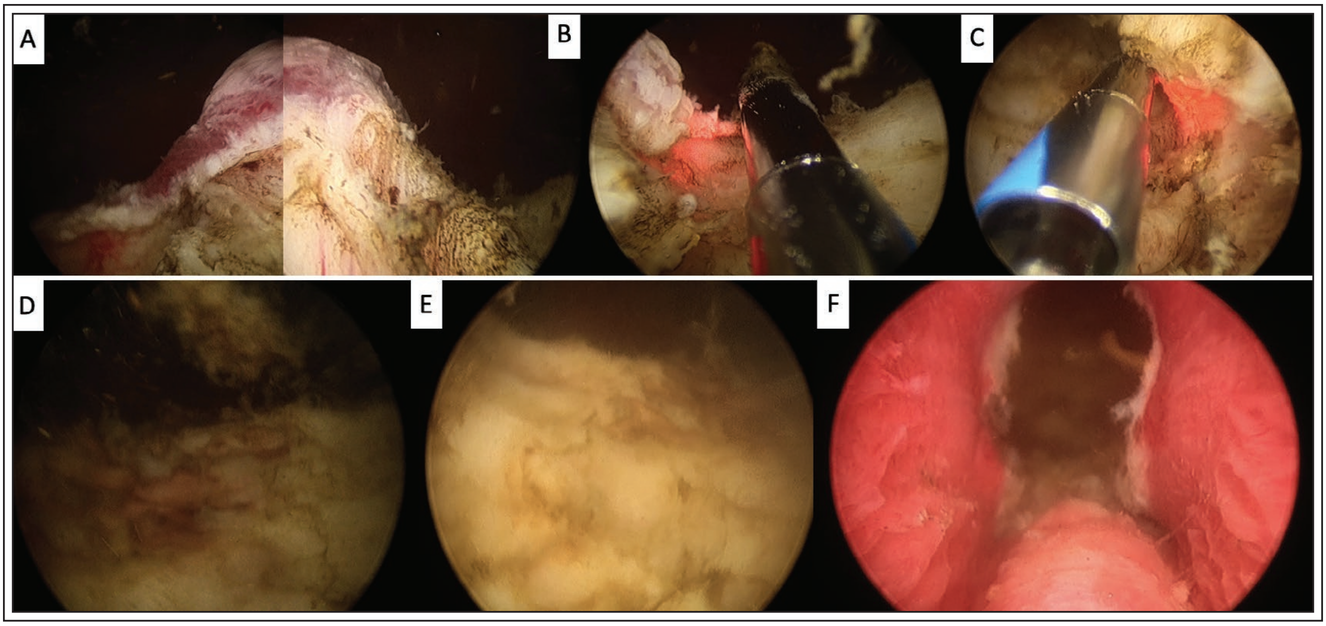

Figure 5. Treatment of the prostate floor adenoma. The prostate floor adenoma **(A)** removed with a medially-directed laser firing tangential to the surgical capsule at 180W **(B-C)**. Small tissues can be released into the bladder **(D)**. Vaporization or vapor-resection is continued until the prostate floor adenoma has been completely removed down to the surgical capsule **(E-F)**.

twelve o'clock, Figure 6a. Similar to step 3, the initial twelve o'clock incision is widened and deepened by repeatedly retracting the laser from the bladder neck to the apex with a sweeping motion until clearance of the adenoma to the level of the surgical capsule, Figure 6b. The laser is oriented tangential to the surgical capsule and adenoma is removed from bladder neck to apex until there is no more adenoma between the eleven and one o'clock groove. Large pieces of adenoma that cannot be removed through simple vaporization are to be vapor-resected, with the incised tissue pushed into the bladder for later retrieval. It is important to note that the distance to the apex on the anterior surface of the prostate is shorter than that of the prostate floor. Additionally, the horseshoe landmark was not delineated anteriorly therefore it is imperative to identify the apex of the prostate while creating the anterior groove to avoid inadvertently treating beyond the surgical field.

Step 6: Releasing the lateral lobes (180W)

From the one o'clock position at the level of the surgical capsule, continue vaporization/vapor-resection tangential to the surgical capsule from the bladder neck to the apex of the prostate, down to the three o'clock position, Figure 6c-d. The segment of adenoma between one and three o'clock should now be released. To complete the removal of the left lateral lobe, begin

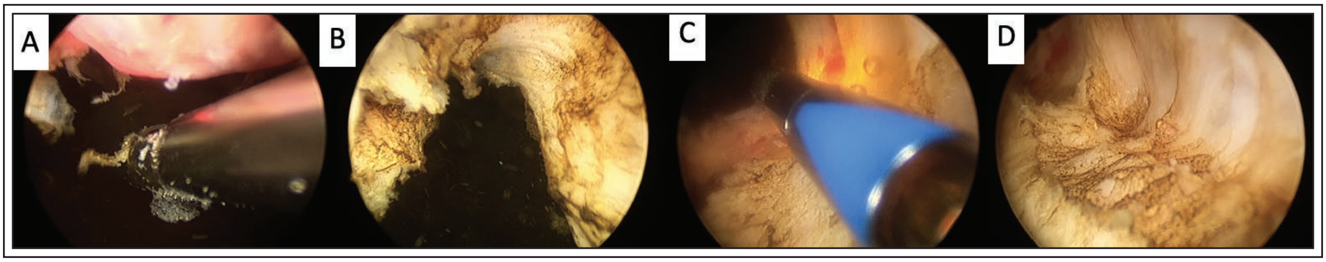

Figure 6. Creation of twelve o'clock groove. Camera cord rotated initially to nine o'clock. At the twelve o'clock position, create a groove by retracting the activated laser fiber from bladder neck to apex at 120W **(A)**. The twelve o'clock groove should be deepened to the surgical capsule and widened to the one and nine o'clock positions **(B)**.

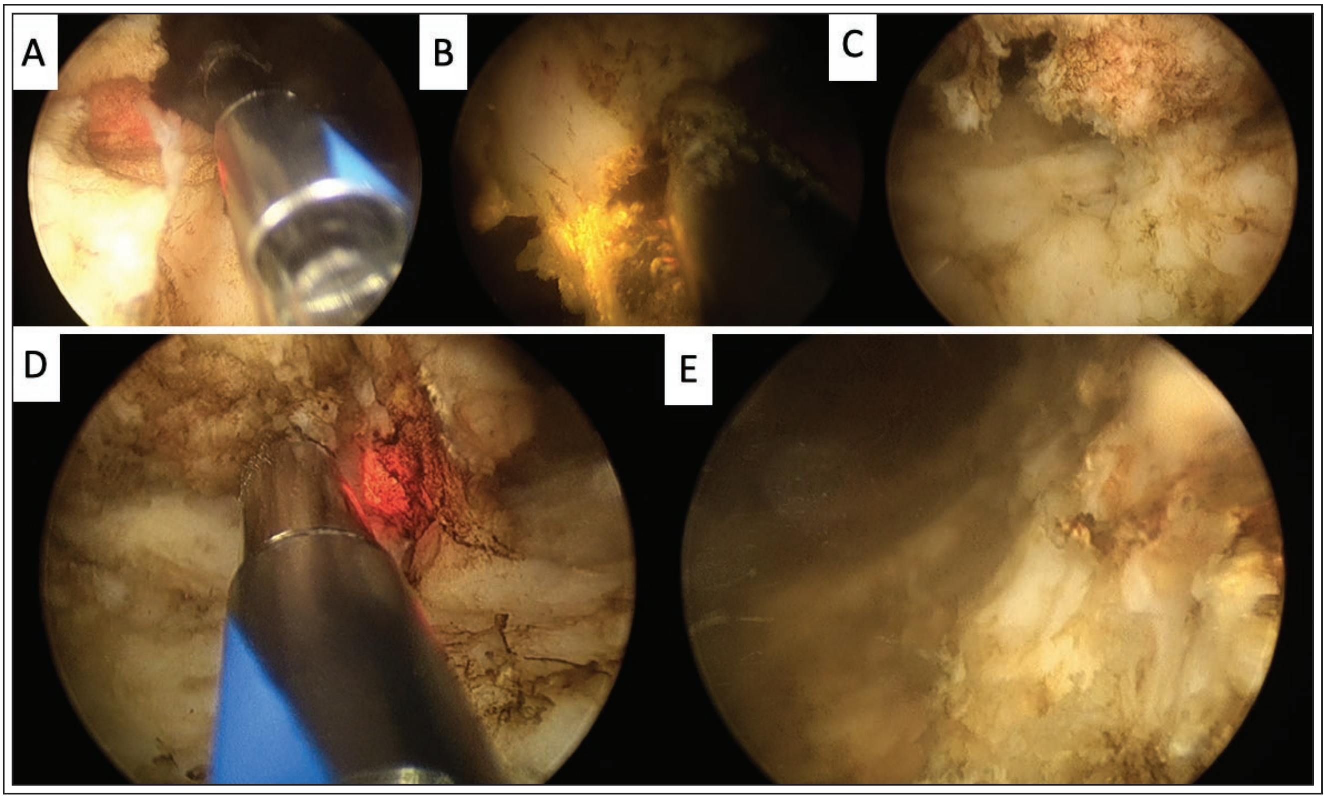

Figure 7. Completion of the left lateral lobe. From the three o'clock position, vaporize or vapor-resect the remaining prostate adenoma of the left lateral lobe using the 180W setting along the surgical capsule, until the left lobe has been completely removed **(A-E)**. The same technique is used to release the right lateral lobe between the eleven and seven o'clock position.

at the three o'clock margin at the level of the surgical capsule. Systematically vaporize adenoma until the five o'clock position is achieved. In cases where the prostate is large (100 g-150 g), the surgeon can elect to vapor-resect the isolated adenoma tissue into smaller pieces for later removal, using alligator grasper forceps or thick non-bendable resectoscope Storz Vaportrode loop (without electricity) for mechanical removal, Figure 7. For the right lateral lobe, the same technique described above should be implemented, working from the eleven to nine o'clock position, and subsequently until the seven o'clock position is achieved.

Step 7: Treatment of the apex and confirmation of the surgical endpoint

At this stage in the procedure, address residual adenoma tissue that may be present at the apex of the prostate. Treatment of the apex is an individualized process that is discussed with the patient prior to the surgery. In men with comorbidities that may underlie a weak urinary sphincter, less aggressive treatment of the apex is preferred to avoid inducing urinary incontinence. Treatment of the residual adenoma at the apex should be done with the lower 120W setting, especially for the novice urologist, beginning at the horseshoe landmark and vaporizing in an antegrade direction, unlike previous steps in which the laser fiber began at the bladder neck and was retracted down to the apex. Proper angulation of the scope at the apical prostate will allow one to direct the laser around the side of the apex to hollow it out. This is to avoid accidental treatment of the urinary sphincter.

Step 8: Procedure conclusion

The prostatic tissue should be assessed to ensure the completion of the transitional zone removal down to the surgical capsule, Figure 8a-c. A systematic, circumferential analysis of the prostatic fossa is recommended. Any residual adenoma tissue should be vaporized or vapor-resected if necessary. Hemostasis control is initiated by stopping inflow to decompress the bladder. The decreased hydrostatic pressure may reveal tissue bleeding. Analyze the prostatic fossa for any

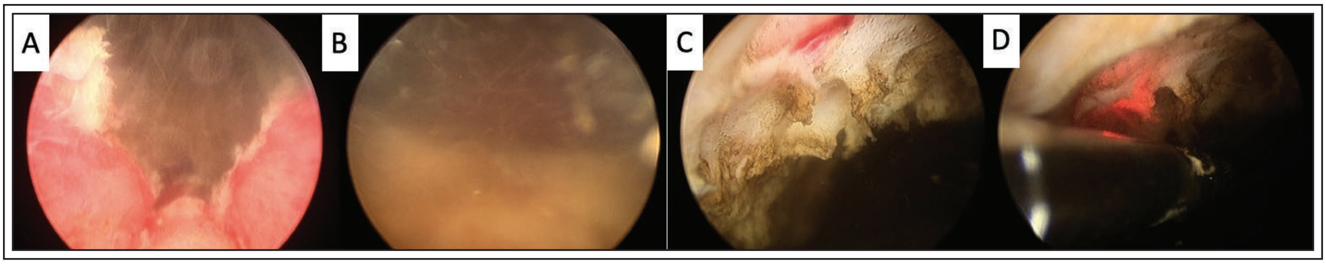

Figure 8. Hemostasis and concluding inspection. Assess for any remaining prostatic tissue from bladder neck to prostate apex **(A-B)**. Small venous bleeds are managed with the 30W coagulation setting **(C-D)**. Larger bleeds may require an increase in hydrostatic pressure as well as direct mechanical compression with the laser fiber cap in order to arrest bleeding.

signs of bleeding. Oozing venous bleeds, Figure 8c-d, should be addressed with the 30W coagulation setting, while larger arterial/pulsatile bleeds are treated with the 30W setting, as well as with physical compression of the bleed site using the laser fiber cap or scope tip.

Finally, inspect the bladder walls and the UOs. Tissue fragments from the vapor-resection procedures should be removed using cystoscopic alligator graspers, Figure 9a, or with a 26Fr TURP sheath resectoscope paired with a 24Fr 1.2 mm thick VaporCut loop for larger prostatic pieces, Figure 9b. Tissue should be sent for pathological evaluation.

Step 9: Foley Insertion and prostate fossa compression

Once the procedure is complete, the cystoscope is removed, and the bladder is kept full to maintain hydrostatic pressure within the prostate fossa. A two-way silicone 20Fr catheter is placed into the bladder using a stylet catheter guide and 30 cc of water is used to fill the balloon. Water inflow is inserted immediately to maintain hydrostatic pressure in the prostate and bladder neck for 5-10 minutes. To provide traction, a wet 4 cm x 8 cm piece of gauze is tied around the catheter. The knot is slid up to the meatus to provide traction (note that traction is not maintained with a latex catheter and is why we utilize the silicone Foley). The full bladder is maintained until after extubation and patient transfer to a stretcher, since from our experience, urine can quickly redden during these activities.

Postoperative management

Following transfer to the recovery room, the patient is hydrated intravenously (120 cc-150cc/h) and is encouraged to drink fluids. Foley catheter removal is planned for the following morning, depending on urine color, time of day, type of anesthesia and status of preoperative bladder function. Prior to discharge, the bladder is filled with 300 mL of saline and a bladder scan residual volume is obtained. Patients are discharged with fluoroquinolone (7 days) and a stool softener to avoid constipation. Men are advised to avoid narcotics (discomfort and constipation) and to avoid strenuous valsalva-like maneuvers (including sexual activity)

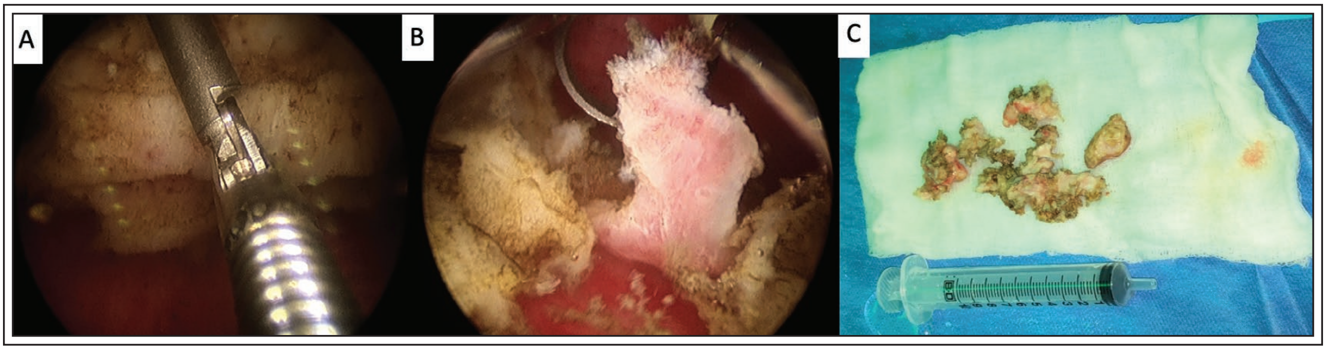

Figure 9. Retrieval of adenoma tissue from the bladder. Adenoma tissue that was resected during the procedure can be removed using ureteroscopy alligator graspers **(A)** or a VaporCut loop **(B)** for larger prostatic tissue pieces. Retrieved prostate tissue **(C)** should be sent for pathological evaluation.

for 2-3 weeks. If anticoagulation medication was stopped before surgery, it would be restarted following recommendations from the internist. A follow up appointment is scheduled 4 to 6 weeks after surgical discharge.

Follow up

Patients will occasionally report irritative urinary symptoms (frequency, terminal dysuria), which frequently tend to be self-limited. In men presenting with severe bladder symptoms, infection and retention are ruled out, and an antimuscarinic agent and anti-inflammatories are prescribed for 6 to 12 weeks. A close follow up is scheduled to revaluate symptoms. Flexible cystoscopy is performed if symptoms do not improve.

At 6 months, a PSA, urinary flow rate and AUA-SI questionnaire (IPSS) are ordered to evaluate status of bladder obstruction. A drop of at least 50% in preoperative PSA is expected to verify adequate adenoma removal.[14]

Given our institution's interest in clinical outcome, assessments are done at 12 months followed by yearly appointments to document long term results of the procedure.

Key messages

The GreenLight VIT procedure utilizes the same approach as PVP, while techniques of vapor-resection are more challenging than pure vaporization. Before attempting VIT procedures, the learning surgeon should be well acquainted with PVP procedure and approach, as a recent paper demonstrated that the PVP learning curve required at least 120 procedures until technique was comparable to experts in the field.[15] Initial cases should include patients with limited comorbidities (no anti-coagulation), no median lobe, and prostates of small sizes (less than 65 cc) as measured through preoperative ultrasonography.

We recommend digital video recordings of the VIT procedure as it offers tremendous value in surgeon education, through self-critique and peer evaluation. Similar to PVP, we encourage adopting a systematic approach to treatment, including all preoperative, perioperative and postoperative procedures. ☐

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