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TOPIC PAPER

Update on the use of diode laser in the management of benign prostate obstruction in 2014

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Abstract
Aim To determine the status quo in respect of various diode lasers and present the techniques in use, their results and complications. We assess how these compare with transurethral resection of the prostate and other types of laser in randomized controlled trials (RCTs). When adequate RCTs were not available, case studies and reports were evaluated.
Materials and methods Laser for the treatment of benign prostatic hyperplasia (BPH) has aroused the interest and curiosity of urologists as well as patients. The patient associates the term laser with a successful and modern procedure. The journey that started with coagulative necrosis of prostatic adenoma based on neodymium: yttrium–aluminum–garnet (Nd:YAG) laser has culminated in endoscopic "enucleation" with holmium laser. Diode laser is being used in urology for about 10 years now. Various techniques have been employed to relieve bladder outlet obstruction due to BPH.
Results The diode laser scenario is marked by a diversity of surgical techniques and wavelengths. We summarize the current published literature in respect of functional results and complications.
Conclusion More randomized controlled studies are needed to determine the position and the ideal technique of diode laser treatment for BPH.

Keywords Benign prostatic hyperplasia · Diode laser · Vaporization · Vaporesection · Enucleation · DiLEP

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Introduction

In diode lasers, a semiconductor laser diode is used to generate laser radiation.

The semiconductor material defines the wavelength. Electrical current is used to stimulate the semiconductor, which emits laser radiation after exceeding the threshold [1, 2].

Depending on wavelengths, commercial lasers emit light in a frequency range of 375–1,800 nm. Therefore, the type of wavelength used in clinical application is important. Depending on the type of laser generator, the efficiency of diode lasers is superior by more than one order of magnitude, while the absorption rates for hemoglobin and water are entirely different [2, 3].

Any approach of laser prostatectomy may be assigned to one of four principles, independent of the type of laser used. These principles are vaporization (removal of the adenoma from the prostatic urethra to the surgical capsule), resection (excision of small tissue chips from the prostatic urethra to the surgical capsule), vapoenucleation (removal of the adenoma by cutting the layer of the surgical capsule and consecutive morcellation, but collaterally producing vaporization), and enucleation (which mimics finger movement during open adenomectomy) [3].

Materials and methods

Surgical technique of diode laser

Vaporization

Several systems have been introduced for diode laser vaporization of the prostate, employing different maximum power outputs. The wavelengths of the laser systems used for vaporization range from 940 to 1,470 nm [2]. The technique requires the application of energy to the tissue, pointing the laser beam on prostatic tissue to create an area of vaporization as well as achieve underlying coagulative necrosis.

Diode laser was initially evaluated using side-firing fibers in the noncontact mode. In two preliminary nonrandomized single-center prospective studies, the effect of 980-nm diode laser was compared with that of HPS Green Light laser in vaporization of the prostate [4, 5]. Similar perioperative results were obtained. Intraoperative visualization was better in the diode laser group because of perfect hemostatic features [4, 5].

Two cohort studies evaluating the efficacy of diode laser vaporization reported favorable perioperative and functional results, claiming mild dysuria as the only disadvantage [6, 7]. Notably, both studies were marked by a limited follow-up period (6 months) and limited case numbers (<100).

In a randomized single-center investigation comprising 120 patients, Shaker et al. [5] compared a novel type of end-firing fiber with 30-degree angulation to the side-firing fiber.

This novel type of fiber is coated with quartz for concentrating energy at its tip, and functions only in the contact mode.

Significantly, better results were obtained with the quartz head fiber in regard to perioperative data fibers used per case (1.13 vs. 1.42, $P < 0.001$), lasering time (32.04 vs. 27.37 min, $P < 0.05$), and applied energy (351.63 vs. 281.18 kJ, $P < 0.05$). After a follow-up period of 6 months, the authors noted significant improvements in voiding parameters and micturition symptoms in both groups. However, complication rates were significantly higher (26.31 vs. 10.71 %, $P < 0.05$) in the side-firing group, thus confirming previous studies on the subject [4, 5]. Notwithstanding its perioperative safety, the technique needs to be compared with standard transurethral resection.

Lee et al. [9] enrolled 741 patients and compared three laser types (Green Light HPS using high-powered 120 W, thulium laser with 2,000 nm wavelength, and a 980-nm diode laser). No significant differences were noted between the three groups in regard to maximal flow rates (Q_{max}), lower postvoid residual urine, or postoperative PSA levels during the entire follow-up period ($P < 0.05$). Besides, no significant differences in postoperative international symptom scores (IPSS), quality of life (QoL), or bladder neck contracture ($P = 0.23$) were observed.

Kim et al. [10] retrospectively evaluated the clinical data of 84 men with symptomatic benign prostatic hyperplasia (BPH) who underwent vaporization with the 980-nm diode laser. The mean operating time was 23.3 ± 19.1 min, and the total quantity of energy 128 ± 85 kJ. Mean catheterization time was 23.7 ± 5.9 h. At 1 month, significant improvements were noted in IPSS (11.5 ± 6.8), QoL scores (2.2 ± 1.3), Q_{max} (12.9 ± 6.5 mL/s), and post-void residual volumes (PVR) (41.2 ± 31.3 mL). Six- and 12-month data revealed sustained improvement of postoperative follow-up parameters.

With the aim of reducing sloughing of tissue and reoperation rates due to residual necrotic tissue, Chen et al. [11] performed vaporization of the prostate with a 980-nm continuous-wave diode laser and removed superficial residual necrotic tissue using bipolar transurethral resection of the prostate (TURP) in 37 patients. The authors compared the combined procedure of laser vaporization with bipolar TURP in 36 patients treated with monopolar TURP. The mean operating time for monopolar TURP was significantly shorter, whereas the time taken for catheter removal and the duration of hospital stays were in favor of the combined laser/TURP procedure. Compared with baseline data, significant improvements were noted in IPSS, Q_{max}, PVR urine volume, and QoLs at any interval in both groups. No significant difference was registered between the two types of treatment in regard to functional parameters at any follow-up time point.

Vaporesection

Laser resection is the laser version of TURP. Its obvious advantage over vaporization is that it provides tissue for histological examination. Holmium: yttrium–aluminum–garnet (YAG) laser was the first application of laser for excisional prostate surgery and was introduced in 1994 [12]. However, this technique has not gained popularity in the diode group.

Shih et al. [13] developed a combined technique of 980-nm diode laser-assisted bipolar TURP with an oyster procedure for large prostate glands (>80 mL). The median weight of resected tissue was 71 g and the median operating time 117 min. Resected tissue was not morcellated, but was small enough to be retrieved from the bladder through the resectoscope. Interestingly, the learning curve in regard to resection times improved from 38.1 to 24 min from the first 10 to the last 13 cases.

Leonardi et al. [14] treated 86 consecutive patients with a 980-nm diode laser to obtain tissue for histological evaluation by performing transurethral laser resection. A side-firing fiber was used with a lifting movement, first moving from the bladder neck to the seminal colliculus and creating a deep furrow, then rotating the fiber by 90° and, with the same movement of lifting in contact mode, achieving effective progressive vaporization of the base of prostate tissue. As with the TURP procedure, resected pieces of prostate tissue remained in the bladder until the end of the procedure, at which time they were extracted.

The mean prostate size as estimated by transrectal ultrasound in patients treated with the 980-nm diode laser was 71.2 g (range 60–100 g). Based on prostate size and lasering time, the mean (range) vaporization rate was 1.08 (1–2) g/min. Blood loss during the procedure was minimal. The mean reduction in hematocrit was <0.5 %. Samples obtained with the 980-nm diode laser ranged in size from 4 to 30 mm and had smooth brownish margins. Lasered tissue had a coagulation rim of 0.5 mm (range 0.2–1 mm). Coagulated connective tissue and glandular epithelia were seen adjacent to vaporized tissue.

Vapoenucleation or diode laser enucleation

Buisan et al. [15] were the first to perform laser enucleation of the prostate with 980-nm diode-pulsed laser (DiLEP) by the procedure commonly used for Holmium laser. The authors studied 17 patients aged on average 74.2 years. The mean volume of the prostate was 61.26 cc (range 47–110 cc). The mean loss of hemoglobin was 2.1 g/dL (range 1.4–3.1 g/dL). Sustained improvements were noted in IPSS (22.3 ± 4.1 vs. 7.1 ± 1.06) and Q_{max} (7.14 ± 2.6 vs. 21.4 ± 3.6).

In a safety and efficacy study, we used a well-known continuous-wave diode laser with a wavelength of 1,318 nm for prostate enucleation [16]. This laser has been employed in the past in lung and liver surgery and was recently introduced in urology for partial nephrectomy in renal cancer [17].

We investigated 60 patients with lower urinary tract symptoms suggesting bladder outlet obstruction and a mean prostate size of 59.5 mL on transrectal ultrasound. Patients were randomized to Eraser laser prostate enucleation or bipolar transurethral prostate resection [16]. Eraser laser prostate enucleation was equivalent to bipolar transurethral prostate resection as regards improvements in the IPSS, Q_{max}, and QoL. Laser enucleation was significantly superior to bipolar transurethral resection in terms of measured blood loss (mean ± SD 116.83 ± 97.02 vs. 409.83 ± 148.61 mL), catheterization time (mean 32.80 ± 8.74 vs. 65.73 ± 13.72 h), and hospital stay (mean 45.13 ± 14.77 vs. 91.20 ± 11.76 h, each $P < 0.05$).

Yang et al. [18] used a 980-nm diode laser coupled with a bare fiber to enucleate the prostate and compared surgical outcomes and perioperative complications with a contemporary series of patients undergoing TURP. They included 74 patients in the DiLEP group and 54 in the TURP group. Demographic data and perioperative parameters were similar in the two groups, except that DiLEP resulted in a significantly lower drop in hemoglobin levels (0.9 ± 1.0 vs. 1.6 ± 2.4 g/dL, $P = 0.03$), shorter catheterization times (41.2 ± 19.9 vs. 67.7 ± 33.3 h, $P < 0.01$), and shorter postoperative stays (2.9 ± 1.9 vs. 4.1 ± 6.2 days, $P = 0.01$). Delayed postoperative sloughing of necrotic tissue was not observed in the DiLEP group. One year after DiLEP, the IPSS had reduced from 21.8 to 5.0, Q_{max} had increased from 6.9 to 16.0 mL/s, and PVR reduced from 103.2 to 36.6 ml (all $P < 0.01$).

The same group was analyzed retrospectively; 120 patients were divided into two groups according to prostate volume [19]. Patients in group 2 had a larger mean prostate volume (85.0 ± 24.6 vs. 40.9 ± 10.8 mL), a longer mean operating time (117.7 ± 48.2 vs. 60.7 ± 25.0 min), and a greater mean retrieved prostate weight (37.3 ± 16.1 vs. 12.5 ± 7.3 gm) than patients in group 1. Postoperative reduction in hemoglobin did not differ in the two groups. Functional parameters were comparable in the two groups. Twenty-three patients reported sexual activity before and after the operation. The postoperative change in international index of erectile function (IIEF-5) did not differ between the two groups ($P = 0.60$).

Recently, Xu et al. [20] prospectively enrolled 80 patients, who were then randomized into two groups. Patients were assigned to DiLEP (using a 980-nm continuous-wave diode laser) or so-called plasmakinetic enucleation of the prostate (PKERP). The hemoglobin drop was significantly lower in the DiLEP group than it was in the PKERP group ($P = 0.002$). The duration of enucleation was similar in the two groups ($P = 0.117$), whereas the total operating time was significantly shorter in the DiLEP group than in the PKERP group ($P < 0.01$). No significant difference was noted between groups in regard to the weight or percentage of resected tissue ($P = 0.493$ and $P = 0.127$). Catheterization was significantly shorter in the DiLEP group. No significant difference was observed in IPSS, QoL, Q_{max}, PVR, prostate volume, or PSA levels ($P > 0.05$) during the 12-month follow-up period.

Results and discussion

Intraoperative complications (Table 1)

Vaporization

In a randomized controlled trial (RCT) performed to compare the safety and efficacy of 980-nm diode laser versus 120-W LBO laser, intraoperative bleeding rates were significantly lower in the latter group (0 vs. 13 %). Anticoagulant medication was being taken by 23.6 % of patients receiving diode laser treatment and 25.0 % of those in the LBO photoselective vaporization (PVP) group [4].

These findings are supported by a non-RCT [5], which yielded almost identical results (0 vs. 11.9 %); 52 % of patients in the laser diode treatment arm and 43 % in the LBP PVP treatment arm were on anticoagulant medication

Table 1 Intraoperative complications

Study	Wavelength diode laser (nm)	n	Mean prostate volume (mL)	Mean follow-up (months)	Complication type	Functional outcomes
Vaporization						
Ruszat et al. [4]	980	55	65	6	Blood transfusion: 0 % Conversion to TURP: 4 %	IPSS, QoL, Q_{max}, and PVR improved
Chiang et al. [5]	980	55	66	9	Blood transfusion: 0 %	IPSS, QoL, Q_{max}, and PVR improved
Lee et al. [6]	980	70	74	24	Blood transfusion: 0 % TURP syndrome: 0 %	IPSS, QoL, Q_{max}, and PVR improved
Vaporesection						
Shih et al. [13]	980	43	99	12	Subtrigonal injury: 4.6 %	IPSS, QoL, Q_{max}, and PVR improved
Leonardi et al. [9]	980	86	71		Blood transfusion: 0 % Conversion to TURP: 0 %	
Vapoenucleation or DiLEP						
Buisan et al. [10]	980	17	61	3	Blood transfusion: 0 %	IPSS and Q_{max} improved
Lusuardi et al. [11]	1318	30	59.5	6	Blood transfusion: 0 % Conversion to TURP: 0 %	IPSS, QoL, Q_{max}, and PVR improved
Yang et al. [13]	980	74	70	7	Blood transfusion: 2.8 % Bladder mucosal injury: 9.5 %	IPSS, QoL, Q_{max}, and PVR improved
Xu et al. [15]	980	40		12	Blood transfusion: 0 % Conversion to TURP: 0 % Capsule perforation: 5 %	

[5]. The latter investigation is supported by preclinical studies on novel sources of laser energy, showing almost equivalent hemostatic potential and coagulation features as those registered for Nd:YAG laser [21]. Furthermore, one comparative non-RCT reported no capsule perforation with the 980-nm diode laser. The need for conversion to TURP was registered in 4 (980-nm diode) and 8 % LBO PVP of patients [4].

Lee et al. [9] compared three laser types and technologies. No significant differences were noted between Green Light HPS PVP, thulium enucleation, and diode laser vaporization of the prostate with a 980-nm laser. The only intraoperative blood transfusion was performed during PVP while no TURP syndrome occurred.

Vaporesection

Subtrigonal injury during prostatic enucleation was registered twice in a retrospective analysis of results obtained using an "oyster" technique [13]; secondary bladder neck contracture secondary occurred in these two patients (Clavien–Dindo grade III). Leonardi et al. [14] selected 86 patients for transurethral laser resection and compared the results to those of ten patients treated with monopolar TURP. The only complication in the laser group was a minimal mean reduction in hematocrit, which was <0.5 % compared with preoperative values.

Vapoenucleation or diode laser enucleation

Buisan et al. [15] reported a mean hemoglobin loss of 2.1 g/dL (range 1.4–3.1 g/dL) in the first 17 patients treated by diode (980 nm) laser enucleation. In a further RCT, blood transfusion rates were slightly, but not significantly, lower in the DiLEP (980-nm laser) group than in the TURP group (2.8 vs. 5.8 %; $P = 0.40$) [18]. The same author reported eight cases of inadvertent injury to bladder mucosa during enucleated prostatic tissue retrieval [19]. Two patients in the larger prostate group needed blood transfusions [14].

A further RCT [20] reported two (5 %) cases of intraoperative capsule perforation in the DiLEP group (980-nm laser), and in one (2.5 %) patient in the bipolar transurethral enucleation and prostate resection group; the difference was not statistically significant ($P = 0.556$).

Early postoperative complications (Table 2)

Vaporization

In a non-RCT comparing 980-nm diode laser and LBO PVP, the following complications were noted: postoperative hematuria in 20 versus 19 %, transient incontinence in 14.5 versus 2.4 % ($P < 0.05$), transient urgency in 34.5 versus 16.7 % ($P < 0.05$), scrotal edema in 3.6 versus 0 %, anal pain in 3.6 versus 0 %, and epididymitis in 1.2 versus 9.1 % [5].

Table 2 Early postoperative complications

Study	Wavelength diode laser (nm)	n	Mean prostate volume (ml)	Mean follow-up (months)	Complication type	Functional outcomes
Vaporization						
Ruszat et al. [4]	980	55	65	6	Retention: 20 % Dysuria: 24 % Transient incontinence: 7 %	IPSS, QoL, Q_{max}, and PVR improved
Chiang et al. [5]	980	55	66	9	Retention: 11 % Transient incontinence: 14.5 Transient urgency: 34.5 % Sloughing tissues: 18 % Epididymitis: 9 %	IPSS, QoL, Q_{max}, and PVR improved
Erol et al. [6]	980	47	51	6	Transient urgency: 23.4 % Retention: 4.2 % Transient incontinence: 4.2 %	IPSS, QoL, Q_{max}, and PVR improved
Yang et al. [7]	980	120	70	6	Transient incontinence: 4.9 % UTI 5.1 % Retention: 19 %	IPSS, QoL, Q_{max}, and PVR improved
Shaker et al. [5]	980	113		6	Transient urgency: 32.1 % Acute retention: 26.8 % Chronic retention: 15.8 % Transient incontinence: 17.8 %	IPSS, QoL, Q_{max}, and PVR improved
Lee et al. [6]	980	70	74	24	Retention: 17 % UTI 1.4 %	IPSS, QoL, Q_{max}, and PVR improved
Vaporesection						
Shih et al. [13]	980	43	99	12	Retention: 4.6 % Transient urgency: 23 %	IPSS, QoL, Q_{max}, and PVR improved
Vapoenucleation or DiLEP						
Buisan et al. [10]	980	17	61	3	Transient urgency: 5.9 %	IPSS and Q_{max} improved
Lusuardi et al. [11]	1,318	30	59.5	6	UTI 3.3 % Transient incontinence: 3.3 %	IPSS, QoL, Q_{max}, and PVR improved
Yang et al. [13]	980	74	70	7	Retention: 10.9 %	IPSS, QoL, Q_{max}, and PVR improved
Yang et al. [14]	980	120	70	7	Transient incontinence: 4.9 % UTI 5.1 % Retention: 19 %	IPSS, QoL, Q_{max}, and PVR improved
Xu et al. [15]	980	40		12	Transient incontinence: 7.5 % Transient urgency: 12.5 %	IPSS, QoL, Q_{max}, and PVR improved

In a comparative investigation of 980-nm diode laser and LBO PVP, dysuria was registered in 24 versus 18 %, urinary incontinence in 7 versus 0 %, and blood transfusion rates of 0 versus 2 % [5]. Re-catheterization rates were between 4.3 [6] and 20 % [4].

Mild dysuria rates ranging from 16.7 [7] to 31.6 % [8] have been reported in several studies. In a comparative investigation of 980-nm diode laser versus thulium enucleation and PVP, a re-catheterization rate of 17.1 % was noted in the diode laser vaporization group [9].

Vaporesection

In the few reports on diode laser vaporesection, early postoperative complications were very rare. Specifically, no blood transfusions, TURP syndrome, or sepsis were observed [13, 14].

Vapoenucleation or diode laser enucleation

Early postoperative complications of the enucleation technique were incontinence (treated conservatively with one pad a day; Clavien–Dindo Id) in one patient who underwent enucleation with a 1,318-nm diode laser, and a symptomatic UTI in one member of the laser enucleation group treated with oral antibiotics (Clavien–Dindo II) [16]. Among patients undergoing DiLEP, two (2.7 %) developed transient urge incontinence which subsided by one month postoperatively [18, 19]. As regards grade IIIa complications, temporary urinary

Table 3 Late complications

Study	Wavelength diode laser (nm)	n	Mean prostate volume (mL)	Mean follow-up (months)	Complication type	Functional outcomes
Vaporization						
Ruszat et al. [4]	980	55	65	6	Bladder neck contracture: 15 % Re-treatment: 18 %	IPSS, QoL, Q_{max}, and PVR improved
Chiang et al. [5]	980	55	66	9	Urethral stricture: 5.5 % Bladder neck contracture: 9 %	IPSS, QoL, Q_{max}, and PVR improved
Erol et al. [6]	980	47	51	6	Late bleeding 2.1 %	IPSS, QoL, Q_{max}, and PVR improved
Yang et al. [7]	980	120	70	6	Bladder neck contracture: 1.5 % Urethral stricture: 3.1 % Late bleeding 3.3 %	IPSS, QoL, Q_{max}, and PVR improved
Lee et al. [6]	980	70	74	24	Re-treatment: 5.7 %	IPSS, QoL, Q_{max}, and PVR improved
Rieken et al. [17]	980	56	65	12	Re-treatment: 32.1 % Bladder Neck contracture: 12.5 % Obstructive necrotic tissue: 19.6 % Urinary incontinence: 10.7 %	IPSS, QoL, Q_{max}, and PVR improved
Chiang et al. [18]	980	55	66	9	Re-treatment: 9.1 % Urethral Stricture: 5.5 % Bladder neck contracture: 9.1 % Anal pain 3.6 % Urinary incontinence: 1.8 %	IPSS, QoL, Q_{max}, and PVR improved
Chen et al. [19]	980	55	66	7.5	Re-treatment: 7.3 % Urethral stricture: 3.6 % Bladder neck contracture: 3.6 %	IPSS, QoL, Q_{max}, and PVR improved
Seitz et al. [20]	1,470	10	48	12	Re-treatment: 20 %	IPSS, QoL, Q_{max}, and PVR improved
Vaporesection						
Shih et al. [13]	980	43	99	12	Bladder neck contracture: 4.6 % Retention: 4.6 % Transient urgency: 23 %	IPSS, QoL, Q_{max}, and PVR improved
Vapoenucleation or DiLEP						
Buisan et al. [10]	980	17	61	3	Urethral stricture: 5.9 % Transient urgency: 5.9 %	IPSS and Q_{max} improved
Yang et al. [13]	980	74	70	7	Blood transfusion: 2.8 % Bladder mucosal injury: 9.5 % Retention: 10.9 %	IPSS, QoL, Q_{max}, and PVR improved
Yang et al. [14]	980	120	70	7	Bladder neck contracture: 1.5 % Urethral stricture: 3.1 %	IPSS, QoL, Q_{max}, and PVR improved

retention developed more often in patients with a smaller prostate [14].

Late complications (Table 3)

Vaporization

In a case series, 32.1 % of patients needed reoperation due to obstructive necrotic tissue or bladder neck stricture within a follow-up period of 12 months after treatment with 980-nm diode laser [22].

This finding is supported by a RCT comparing 980-nm diode laser with LBO; 9.1 versus 3.6 % of patients, respectively, required reoperation with TURP due to bladder neck obstruction; 5.5 versus 2.4 % developed urethral strictures, and 1.8 versus 0 % developed urethral stones [23].

In another study comparing diode laser to LBO PVP, the former technique was associated with higher rates of bladder neck stricture (14.5 vs. 1.6 %, $P < 0.01$), higher re-treatment rates (18.2 vs. 1.6 %, $P < 0.01$), and persistent stress urinary incontinence (9.1 vs. 0 %; $p < 0.05$) [4].

Yet other studies have shown no more than transient combined urge and stress incontinence, ranging from 4.3 % of patients for 2 weeks [6] to 17.8 % of patients who recovered spontaneously within 4 weeks [10].

Urethrotomy for postoperative urethral stricture was required in 1.2 % of patients, but the rate of bladder neck stricture was 10.7 %; a significantly higher rate was noted in patients with a small prostate ($p < 0.05$) [10].

A further case series revealed sloughed-off tissue in 14.5 % who underwent cystoscopic intervention, and reoperation with TURP in 7.3 % of patients. Urinary stress incontinence persisted during the 6-month follow-up period in 1.8 % of patient [24]. Furthermore, 20 % of patients required repeat TURP over a 1-year period after treatment with 1,470-nm diode laser [25].

Vaporesection

As the number of studies with this technique using a diode laser is small, the number of reported complications is correspondingly low.

Ten patients presented with transient urge incontinence. The symptoms subsided within 3 months in nine patients [13]; only one patient used antimuscarinic drugs for longer than 3 months (Clavien–Dindo grade II).

Vapoenucleation or diode laser enucleation

In a RCT, in patients undergoing DiLEP, Yang et al. [18] registered transient urge incontinence, which subsided by 1 month postsurgery in two patients (2.7 %). The authors reported Clavien grade IIIb complications, including bladder neck contracture 6 months postsurgery in 1.5 % and urethral stricture in a further 3,1 % of patients [19]. Irritative urinary symptoms were observed in 12.5 % of patients treated with DiLEP [19].

Conclusions

Comparisons of published studies are rendered difficult by the different wavelengths and different surgical techniques used for diode lasers. Initially, diode lasers were employed for vaporization of the prostate. However, as published data reveal high complication rates for vaporization, the procedure cannot be regarded as a standard treatment option for BPH. Re-treatment rates of 35 % have been reported in the published literature. As vaporesection of the prostate never became popular because of its longer operating time compared with vaporization, no conclusions can be drawn about this technique. Laser enucleation of the prostate appears to be more promising because it mimics adenomectomy, but the variety of employed wavelengths hinders comparison at the present time (3).

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standard All included human and animal studies have been approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1,964 Declaration of Helsinki and its later amendments.All persons gave their informed consent prior to their inclusion in the presented studies.Details that might disclose the identity of the subjects under study are omitted.The corresponding author takes on the above responsibilities.

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