Original Article

# Initial Experience of High Power Diode Laser for Vaporization of Prostate

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**Abstract**

**Objectives:** Prospective evaluation and experience of high power diode, 980nm diode laser for bladder outlet obstruction due to enlarged prostate. **Methods:** Total of 50 patients were included in the study. International prostate symptom score, quality of life, international index of erectile function-5, prostate specific antigen and prostate volume were compared with values at three months and six months postoperatively. **Results:** At the end of three months of postoperative period, the mean± SD international prostate symptom score decreased significantly from 20.83±3.77 to 9.23± 2.79(p=0.0001). The mean maximal flow rate increased significantly from 8.23 ±2.12 to 18.56± 5.09 ml per sec (p=0.0001). Quality of life score changed considerably as compared to baseline. There was no deterioration in erectile function according to the international index of erectile function-5 short form. **Conclusion:** The high power diode laser provides significant improvements in International Prostate Symptom Score and the maximal flow rate with low morbidity. **Key Words:** Lasers, prostatic hyperplasia, urinary bladder neck obstruction

## INTRODUCTION

Benign prostatic hyperplasia (BPH) places a significant burden on men's health. Population based data indicates that 75% of men older than 70 years have at least one lower urinary tract symptom (LUTS) related to BPH.[1] BPH can cause voiding dysfunction and urinary tract infection. Most patients receive surgical or pharmacological treatment. Although recent research has presented new therapeutic options for BPH but transurethral resection of prostate (TUR-P) still seems to be the gold standard treatment.[2, 3] It is a challenge for alternative treatment modalities to try and to match the efficacy of TUR-P but with less perioperative morbidity. [4] Several laser devices working at different wavelengths have been introduced in the last few years. [5, 6] A recently introduced diode laser system operates at a wavelength of 980nm.[7]

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A recently introduced diode laser system operates at a wavelength of 980nm.[7] As the energy of this wavelength offers high simultaneous absorption by water and hemoglobin, it is postulated that the diode laser combines high tissue ablative properties with good homeostasis.

## MATERIALS AND METHODS

Total of 50 patients between ages of 50 to 80 years who underwent laser prostatectomy with 980nm diode laser between August 2012 to April 2013 were included in this study. Preoperative evaluation consisted of medical history, physical examination with focus on neurological status and digital rectal examination. Prostate volume was determined by transrectal ultrasound (TRUS), post-voiding residual (PVR) was measured by transabdominal ultrasound after free uroflowmetry. Blood chemistry including prostate specific antigen (PSA), renal function tests, complete blood count and urinalysis was done. All patients received spinal anesthesia. Study inclusion criteria were peak flow rate (Qmax) 12 mlper second or less with voided volume more than150 ml. I-PSS

International Prostate symptom score of 15 or greater. QOL score (Quality of life) was 3 or more than three. Those patients whose plasma prostate-specific antigen (PSA) was less than 4.0 ng /ml were thoroughly evaluated by TRUS and a subsequent needle biopsy was done to rule out the possibility of malignancy. Patients with a history of neurogenic voiding dysfunction, chronic prostatitis, and prostate and/or bladder cancer were excluded from study.

Preoperative Qmax, PVR, I-PSS, QOL, IIEF-5 and prostate volume were compared during follow up at three and six months. Complications associated with the procedure were documented.

The same surgeon operated all patients. All patients received 3rd generation cephalosporin prophylactic antibiotics before surgery and for 3 days thereafter. Cessation of anticoagulant medicines was recommended 1 week before surgery.

A 23 fr continuous flow laser cystoscope was used with saline irrigation. A 980 nm diode laser generator was used at a power setup of between 80 and 140 W in continuous mode thorough out the procedure. A fusion side firing optical fiber with a 70-degree deflecting angle was used for light transmission. Vaporization started at the bladder neck level with continues flow with partially filled bladder with saline. Starting from lateral lobes the area between the 1 and 11o, clock positions was vaporized. The fiber tip was kept 0.5 mm away from tissue as far as possible for efficient vaporization. Direct contact with tissue was avoided as much as possible. Power was decreased to 80 W at bladder neck level and around sphinteric area. At the end of procedure biopsy was taken.

An indwelling urethral catheter was inserted and left for a day. All patients were discharged except three on the next day. Statistical analysis was done using the paired t test with $p<0.05$ considered statistically significant.

## RESULTS

Fifty patients were operated and follow up was done at the end of three and six months. Mean +_ SD patient age was 65 +_8 (range 50-80).Mean patient PSA was 2.54+_1.43 ng/ml.

The procedure was completed successfully in all patients with no intraoperative complications. Blood transfusion was not necessary. Mean operative time was 52.55+_13.34 minutes. The mean energy delivered was 242.957 +_92.366 J.One fiber was used in 2 sessions each for 4 hours. Mean preoperative and postoperative hemoglobin and sodium did not differ significantly. The urethral catheter was removed after 48 hours, although in 03 patients urinary retention required catheterization for an additional 02 days.

Table 1 shows procedure efficacy at 03 and 06 months. Early assessment at month 3 revealed that mean I-PSS significantly decreased from 20.83 ± 3.77 to 9.23 ± 2.79 (p=0.0001).

**Table 1**

| | **Mean ± SD Preoperative** | **Mean ± SD 03 month** | **P Value** | **Mean ± SD 06 month** | **P Value** |
|---|---|---|---|---|---|
| I-PSS | 20.83 ± 3.77 | 9.23 ± 2.79 | 0.0001 | 8.86 ± 2.18 | 0.0001 |
| QOL | 5.18 ± 0.84 | 2.22 ± 1.16 | 0.0001 | 2.12 ± 1.10 | 0.0001 |
| Amax( ml/s) | 8.23 ± 2.12 | 18.56 ± 5.09 | 0.0001 | 19.37 ± 4.93 | 0.0001 |
| PVR (ml) | 117.29 ± 105.63 | 40.32 ± 25.37 | 0.0001 | 25.55 ± 15.56 | 0.0001 |
| Prostate volume (cc) | 51.04 ± 23.14 | 32.06 ± 11.37 | 0.0001 | 31.06 ± 10.12 | 0.0001 |
| PSA (ng/ml) | 2.54 ± 1.43 | 1.85 ± 1.13 | 0.0001 | 1.77 ± 1.03 | 0.0001 |
| IIEF-5 | 16.42 ± 7.78 | 17.74 ± 8.64 | 0.554 | 17.21 ± 8.72 | 0.550 |

Mean Qmax value increased significantly from 8.23 ± 2.12 to 18.56 ± 5.09 ml per second (0.0001). The mean QOL score changed significantly as compared to baseline (5.18±0.84 vs2.22 ± 1.16, (p=0.0001). These values were slightly improved at end of six months. The mean prostate volume reduced significantly at the end of three months on TRUS. The values were (51.04 ± 23.14 vs 32.06 ± 11.37cc, p=0.0001). Baseline PSA was also decreased significantly during follow up. It was 2.54 ± 1.43 to 1.85 ± 1.13 ng/ml at 03 months, (p=0.0001). PVR decreased from

117.29 ± 105.63 to 40.32 ± 25.37 and this decrease was significant (p=0.0001).

There was no deterioration in erectile function according to the IIEF short form. The mean values were 16.42+_7.78 vs 17.74+_8.64 with p value of p=0.550 pre and at six months respectively. Table 02 shows postoperative complications. Retrograde ejaculation in 15 of 45 sexually active patients was (33.3%) and irritative symptoms were in 13(26%) patients. Fortunately irritative symptoms were mild to moderate and gradually resolved in first six weeks of follow up. Re-catheterization was done in 3 patients due to urinary retention which settled down after 48 hours. Three patients had temporarily urge and stress incontinence for 03 weeks. No secondary bleeding was found in any patient.

**Table 2**

| Complications | No(%) |
|---|---|
| Retrograde ejaculation | 15 (33.3%) |
| Irritative symptoms | 13 (26%) |
| Temporary urinary retention | 03 (6%) |
| Temporary urinary incontinence | 03 (6%) |

## DISCUSSION

While looking at mortality and morbidity of gold standard treatment for BPH which is TURP. The new alternatives are appreciated. Early postoperative morbidity and mortality rate was reported 18% and 0.2% mortality respectively by Mebust et al in 1989.[8] Similarly short term morbidity (11.1%) and mortality (0.10%) along with (03%) transfusion rate was reported recently.[9] In our series there was no mortality and no blood transfusion was needed. There is 10% to 15% probability of repeat intervention within 10 years.[4] To compare this we need long term follow up. In early 1990 visual laser ablation of the prostate with Nd:YAG was described as an alternative. Because of long lasting irritative symptoms due to late tissue sloughing, it was abandoned. It is possible to resect, incise, coagulate and vaporize the prostatic tissue with laser so many alternative laser techniques have been used. The 2,140nm Ho:YAG laser was first combined with the Nd:YAG laser for the ablation of prostate which was followed by holmium resection of the prostate in 1995 and holmium laser 1996. Holmium laser enucleation of the prostate was advocated as most efficient of all techniques using the Ho:YAG laser. But it has a long steep learning curve and in addition to this stricture is reported in large percent of the patients (05% to 10%).[10, 11] As compare to these our series showed that there was smooth and short learning curve with no stricture up to six months follow up period.

The 532 nm KTP laser for vaporization of prostate led to a new era of BPH treatment. Even in high risk patients, 532 nm KTP laser photo selective vaporization of the prostate has been successful.[12,13] However efficiency decreases as prostatic volume increases. When it was compared to TURP for volume greater than 70 ml an 18% reoperation rate was reported which was very higher as it was (0%) for TURP.[3] This may be related to the gradual loss of fiber power output which was measured in 40 cases during procedure of the fibers 90 % had 80 % decreased power at the end of life span (275 kj), whereas only 10 % maintained a stable power output. There was also a significant difference in the quality of individual fibers.[14] Power loss result in coagulation rather than vaporization, which leads to delayed tissue sloughing and irritative symptoms along with increased risk of urinary retention.[15] So tremendous efforts are ongoing to develop the best laser technology for BPH. The last step was the introduction of the high power diode laser at 980 nm for prostate vaporization. Wendt and Nordahl et al compared various characteristics of KTP lasers (532nm and 80 W vs diode 980nm and 120 W) in a well-established, isolated, perfused porcine kidney model[3].They reported parallel bleeding rates(0.21 vs 0.14 gm per minute) and a thinner coagulation zone(666.9 vs 290.1 um, each $p<0.05$). They suggested that the 980nm diode laser as a novel technology for prostate vaporization.

The lightweight of the 980nm diode laser generator (60 pounds) makes transportation easy. It uses regular electrical power (220/110 v and 50 to 60 Hz) together with air-cooling. The probe has a hand positioning knob, lines indicating beam direction and a retraction indicator line for scope

safety. An important key to success is to keep the distance between fiber and tissue at 0.5 mm for efficient vaporization. We prefer to vaporize the 2 lateral lobes as we proceed distal.[16]

Mild to moderate irritative symptoms may arise due to tissue sloughing it usually lasts no longer than 2 weeks. Urinary retention is not common in patients who undergo 980nm diode laser prostate vaporization as compared to former VLAP technique using the Nd:YAG laser. If retention occurs patients should be re-catheterized for a couple of days until edemaits long-term efficacy for recurrent urethral stricture was reported by Guazzieri et al [19].Subsides.

The most common complication in our series was retrograde ejaculation (33.3%). Irritative symptoms in 26% patients were due to edema in the beginning and necrotic tissue sloughing thereafter. Temporary urinary retention developed in 03 patients after urethral catheter removal. The patients were catheterized for an additional 2 days. The second attempt at catheter removal resulted in spontaneous micturition. The most bothersome complication of any prostate operation is the incontinence. So it is crucial to pay particular attention to the sphincter area and power should be decreased and no attempts should be made to vaporize the little tissue remnants close to the sphincter. Temporary combined incontinence in our 03 patients (06%) lasted about 2 weeks showing that we decreased power down to 80 W while working close to sphincter. Lastly IIEF scores did not change significantly in sexually active patients.

Briefly, we can say that high power diode laser vaporization of the prostate is safe and effective. In our study the improvement in I-PSS was slightly greater than the improvement in Qmax (55% vs 51%).Our results are better and complications are low because all the patients were infection free with negative urine culture. Percentage of irritative symptoms is low in our study as compared to many of study because we kept urethral catheter for 2 days [16].As the 06-month data indicates that patients improved even more in the long term.

## CONCLUSION

High power diode laser vaporization of the prostate provides significant improvements in I-PSS and Qmax. The complication rate was relatively less. The technique was also associated with shorter period catheterization and hospitalization. According to our experience it is a safe procedure for patients as well as easy to learn.

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