

# Impact of 120-W 2- $\mu$ m continuous wave laser vapoenucleation of the prostate on sexual function

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**Abstract** The objective of this work is to evaluate the impact of 120-W 2- $\mu$ m continuous wave (cw) laser vapoenucleation of the prostate in patients with benign prostatic hyperplasia (BPH) on sexual function. One hundred twenty-two consecutive patients with BPH were retrospectively collected in this study and were classified into two groups for surgical treatment with 2- $\mu$ m cw laser vapoenucleation or transurethral resection of the prostate (TURP). International Index of Erectile Function (IIEF) and general assessment questions were completed before and 12 months after treatment to determine the impact on sexual function. A total of 33 patients (52.4 %) in group 1 and 31 (52.5 %) in group 2 reported various degrees of erectile dysfunction before surgery. Interestingly, an increase in IIEF score by 2 points was reported by 16 (25.4 %) and 14 (23.7 %) patients, respectively, and mean EF score did show a marginal but not significant increase postoperatively in both groups. Differences about orgasmic intercourse satisfaction, sexual desire domain, and overall satisfaction scores in each group were not significant between preoperative and postoperative, but there was a significant decrease in the orgasmic function domain score at 12 months postoperation in both groups ( $p < 0.001$ ). The prevalence of postoperative retrograde ejaculation was significantly higher than at baseline assessment in two groups. This study demonstrates that there is no difference between 2  $\mu$ m laser vapoenucleation and TURP in terms of impact on sexual function. No significant erectile function improvement was observed after surgery, but these two

techniques significantly lowered the IIEF orgasmic function domain and this was mainly caused by retrograde ejaculation.

**Keyword** Benign prostatic hyperplasia · 2- $\mu$ m laser, 120 W · Vapoenucleation of the prostate · Sex function · Retrograde ejaculation · Thulium:YAG laser

## Introduction

Transurethral resection of the prostate (TURP) is still considered as the gold standard of surgical treatment of benign prostatic hyperplasia (BPH), but there are serious complications such as bleeding and TUR syndrome [1, 2]. In recent decades, various laser devices have been introduced to challenge conventional TURP for BPH [3]. A 120-W 2- $\mu$ m continuous wave (cw) laser possesses unique advantages such as narrow range of thermal injury and good hemostasis [4]. The 120-W 2- $\mu$ m cw laser vapoenucleation of the prostate is a novel excellent treatment for BPH as well as TURP, with advantages of significantly less blood loss, shorter hospitalization, shorter catheter indwelling time, and rapid recovery after surgery [5, 6]. As observed with TURP, some minimally invasive procedures such as holmium and potassium–titanyl–phosphate (KTP) laser therapies for treatment of BPH had analogous effect on male sexual function [7]. However, the impact on patient sexual function after 120-W 2- $\mu$ m cw laser vapoenucleation has not been investigated. Herein, we compared the impact of 120-W 2- $\mu$ m cw laser vapoenucleation and TURP in patients with symptomatic BPH on sex function.

## Materials and methods

From January 2010 to June 2011, 122 symptomatic BPH patients who underwent minimally invasive surgery and fitted our inclusion criteria were enrolled in this study. This

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study was approved by the ethical committee of the hospital. These patients were retrospectively collected and classified into two groups: 120-W 2- $\mu\text{m}$  cw laser vapoenucleation of the prostate group (group 1, 63 cases) and TURP group (group 2, 59 cases). Inclusion criteria were as follows: presence of moderate or severe lower urinary tract symptoms (LUTS) [International Prostate Symptom Score (I-PSS) >7], urinary peak flow rate ( $Q_{\text{max}}$ ) <15 ml/s, and previous medical therapy failure. Patients have regular sex partners and provided an informed written consent. Criteria for patient exclusion from the study included neurogenic bladder disorder, urethral strictures, prostate cancer or any previous prostatic, bladder neck, or urethral surgery. All patients underwent a routine preoperative assessment, including a clinical history, digital rectal examination, urine and blood analysis, prostate-specific antigen (PSA), and transrectal ultrasonography of the prostate. Urinary symptoms and quality of life (QoL) were assessed using I-PSS. The  $Q_{\text{max}}$  and postvoiding residual urine volume (PVR) were evaluated via urodynamic assessment. For evaluation of the sexual function, we used the International Index of Erectile Function (IIEF) questionnaire which has been validated and divided into the five domains of erectile function (EF), intercourse satisfaction, orgasmic function, sexual desire, and overall satisfaction [8]. A number of self-made general assessment questions specifically for ejaculate function which included ejaculatory volume, rapid ejaculation, and painful ejaculation were included. Retrograde ejaculation (RE) can be confirmed if many sperms are found in a urine sample after ejaculation. All other drugs such as 5 $\alpha$ -reductase inhibitors and  $\alpha$ -1 blockers that appeared to affect the parameters had been washed out at least 2 weeks before the preoperative or postoperative evaluation.

All surgical procedures were performed by two experienced surgeons. The surgical techniques used have been previously described in detail [6, 9]. A 2- $\mu\text{m}$  cw laser vapoenucleation was carried out using the 120-W 2- $\mu\text{m}$  cw thulium:YAG laser (RevoLix<sup>®</sup>, LISA Laser Products, Katlenburg, Germany) as energy source. A 26-F continuous-flow resectoscope (Karl Storz GmbH, Tuttlingen, Germany) with a separate working channel allowing for the 550- $\mu\text{m}$  laser fiber (RigiFib<sup>®</sup>, LISA Laser Products) was used. A maximum power setting of 120 W was employed using 0.9 % saline irrigation solution. TURP was performed under spinal or general anesthesia using a standard technique (26 F resectoscope, a standard wire loop, Olympus, Tokyo, Japan) without special modifications, as is described in general textbooks. During TURP, continuous irrigation was achieved with mannitol solution. Urologists provided extensive proper counseling regarding the importance of the operation and operation complication including information on sexual function when patients receive invasive treatment, which may reduce the level of patient's anxiety. Patients were requested to avoid riding a bicycle and sexual intercourse during the first month after surgery to decrease the

risk of hematuria and clot retention. All patients were assessed at 12-month follow-up after surgery.

All variables are presented as the mean $\pm$ SD. Statistical analysis was performed by the Student *t* and chi-square tests, Wilcoxon rank sum test, multiple linear regression, and logistic regression analysis using the SPSS 14.0 statistical software package (SPSS Inc, Chicago). Statistical significance was considered present at  $p < 0.05$ .

## Results

Table 1 lists the baseline characteristics of both groups; no statistically significant differences in age, total PSA, prostate volume, I-PSS, QoL,  $Q_{\text{max}}$ , and PVR between the two groups were found. At the 12-month follow-up, I-PSS, QoL,  $Q_{\text{max}}$ , and PVR were 6.2 $\pm$ 2.1, 1.8 $\pm$ 0.8, 18.4 $\pm$ 4.8 ml/s, and 21.3 $\pm$ 15.5 ml in the 2- $\mu\text{m}$  laser group and were 6.3 $\pm$ 1.8, 1.9 $\pm$ 1.2, 18.2 $\pm$ 4.3 ml/s, and 22.6 $\pm$ 14.3 ml in TURP group. All the four parameters improved significantly compared with that of preoperative in both groups ( $p < 0.01$ ), but no statistical differences could be found between the two groups ( $p > 0.05$ ). No major complications (grades 3–5 according to Clavien classification) were observed in both groups [9].

The preoperative and 12-month postoperative IIEF domain scores in both groups are shown in Table 2. There were no significant differences in baseline IIEF score between the two groups. However, 33 patients (52.4 %) in group 1 and 31 (52.5 %) in group 2 reported various preoperative degrees of erectile dysfunction (ED) severity. Analysis of 12-month postoperative IIEF scores showed no significant change in mean erectile function, intercourse satisfaction, sexual desire, and overall satisfaction domain score, except that significant deterioration in the mean IIEF orgasmic function domain score postoperatively was reported at each follow-up evaluation compared with baseline. There were no differences in postoperative IIEF score between the two surgical

**Table 1** Baseline characteristics of 120-W 2- $\mu\text{m}$  cw laser vapoenucleation and TURP groups

	2- $\mu\text{m}$ laser	TURP	<i>p</i> value
No. of patients	63	59	
Age (years)	65.8 $\pm$ 6.3	66.3 $\pm$ 5.8	0.651
Total PSA (ng/ml)	2.3 $\pm$ 2.1	2.2 $\pm$ 1.9	0.784
Prostate volume(ml)	62.3 $\pm$ 15.8	60.8 $\pm$ 14.3	0.586
I-PSS	18.6 $\pm$ 6.3	19.4 $\pm$ 5.2	0.448
QoL	4.6 $\pm$ 1.3	4.3 $\pm$ 1.6	0.257
$Q_{\text{max}}$ (ml/s)	6.5 $\pm$ 2.3	6.7 $\pm$ 1.2	0.552
PVR (ml)	146.4 $\pm$ 93.4	138.2 $\pm$ 75.1	0.600

**Table 2** The baseline and 12-month follow-up IIEF scores

	Baseline	12-month follow-up	Baseline vs. follow-up <i>p</i> value
<b>EF</b>			
2- $\mu$ m laser	22.5 $\pm$ 5.8	24.2 $\pm$ 4.3	0.064
TURP	21.6 $\pm$ 4.7	23.3 $\pm$ 5.2	0.065
<i>p</i> value	0.350	0.298	
<b>Intercourse satisfaction</b>			
2- $\mu$ m laser	8.2 $\pm$ 1.2	8.3 $\pm$ 1.3	0.655
TURP	8.4 $\pm$ 0.8	8.2 $\pm$ 2.1	0.496
<i>p</i> value	0.284	0.751	
<b>Orgasmic function</b>			
2- $\mu$ m laser	8.6 $\pm$ 2.7	5.9 $\pm$ 1.5	0.000
TURP	8.7 $\pm$ 1.8	5.5 $\pm$ 1.6	0.000
<i>p</i> value	0.8111	0.156	
<b>Sexual desire</b>			
2- $\mu$ m laser	6.5 $\pm$ 2.1	6.6 $\pm$ 1.6	0.764
TURP	6.7 $\pm$ 1.4	6.5 $\pm$ 1.1	0.390
<i>p</i> value	0.540	0.690	
<b>Overall satisfaction</b>			
2- $\mu$ m laser	7.3 $\pm$ 1.4	7.2 $\pm$ 1.6	0.710
TURP	7.1 $\pm$ 0.9	6.9 $\pm$ 1.3	0.333
<i>p</i> value	0.353	0.260	

procedures (Table 2). Interestingly, an increase in EF score was reported by 16 (25.4 %) in group 1 and 14 (23.7 %) patients in group 2. The prevalence of ED slightly decreased from 52.4 and 52.5 % at the preoperative evaluation to 47.6 and 50.8 % at the 12-month follow-up evaluation in groups 1 and 2, respectively. However, Wilcoxon rank sum test demonstrated that the prevalence and severity of ED did not show a significant change postoperatively in both groups (Table 3). Nevertheless, a marginal but not significant improvement in the mean EF score was reported in each group at postoperative assessments ( $p=0.064$  in group 1 and  $p=0.065$  in group 2). Furthermore, a positive linear correlation was found between mean I-PSS, QoL,  $Q_{max}$ , and IIEF-EF domain score improvement after operation in both groups by multivariate analysis, which suggests a potential influence of postoperative urinary symptoms and QoL amelioration on patient's EF. However, the correlation between EF score improvement and PVR was not significant ( $p=0.167$  in group 1 vs.  $p=0.243$  in group 2).

In regard to ejaculatory function, the incidence of baseline RE was 7.9 % (5 of 63 patients) and 8.5 % of patients (5 of 59 patients) in groups 1 and 2, respectively. Of the patients, 16 (25.4 %) and 14 (23.7 %) complained of preoperatively

decreased ejaculatory volume in groups 1 and 2, respectively. Meanwhile, two (3.2 %) of the enrolled patients in group 1 experienced rapid ejaculation preoperatively, and four (6.3 %) in group 1 and five (8.5 %) in group 2 had painful ejaculation preoperatively. At the 12-month follow-up, 33 of 63 (52.4 %) in group 1 and 32 of 59 (54.2 %) in group 2 experienced RE, which was significantly higher than at the baseline assessment with no difference between outcome of the two surgical procedures, respectively (vs. preoperatively  $p<0.001$ ). Instead, 8 of 63 (12.6 %) in group 1 and 7 of 58 (11.9 %) in group 2 reported a severe decrease in ejaculate volume at the 12-month follow-up evaluation. Mild painful ejaculation was reported by five (7.9 %) in group 1 and five (8.5 %) in group 2 at the 12-month follow-up visit. Rapid ejaculation was reported by three (4.8 %) in group 1 at the 12-month evaluation. Next, we analyzed the deterioration of orgasmic function postoperatively and its correlation with the incidence of RE, decreased ejaculatory volume, painful ejaculation, and rapid ejaculation in both groups. Logistic regression analysis demonstrated that there was a strong correlation between incidence of RE and deterioration of orgasmic function, and RE was an independent predictor for deterioration of orgasmic function after surgery in both 2- $\mu$ m cw laser vapoenucleation and TURP groups ( $p=0.003$ , odds ratio=8.136 and  $p=0.004$ , odds ratio=7.938, respectively). Thus, posttreatment orgasmic dysfunction seemed to be mainly attributable to impaired ejaculation function.

## Discussion

BPH is one of the most common diseases seen in men aged >50 years and is distinguished by progressive development of LUTS clinically. Meanwhile, high incidence of sex dysfunction was involved in old men [10]. Both BPH and sex dysfunction have a significant impact on the QoL of the aged. Several studies have verified that LUTS is independently associated with sex disorders including ED, ejaculatory function, and sexual desire decreasing [10–12]. In order to systematically investigate the relationship between LUTS and sexual problems in aging men, Rosen et al. [12] performed the multinational survey of 14,000 aging male and the results showed that the incidence rate of LUTS was 90 %, and 71 % of the aged experienced at least one erectile difficulty during the previous 4 weeks. Furthermore, 46, 5, and 6.7 % of all the investigated people reported decreased amount of ejaculate, absent ejaculation, and painful ejaculation, respectively. More interestingly, the study suggested that the frequency of sex dysfunction was strongly related to LUTS severity. As many research studies proved, our data indicate that the prevalence of ED in the subjects was more than 50 % and there is a high incidence of ejaculatory disorders in preoperative patients, and the higher the severity

**Table 3** The prevalence and severity of ED at baseline and 12-month follow-up

	2- $\mu$ m laser, <i>n</i> (%)			TURP, <i>n</i> (%)		
	Baseline	Follow-up	<i>p</i> value	Baseline	Follow-up	<i>p</i> value
No ED	30 (47.6)	33 (52.4)	>0.05*	28 (47.5)	29 (49.2)	>0.05^
Mild ED	13 (20.6)	15 (23.8)		13 (22.0)	16 (27.1)	
Mild to moderate ED	8 (12.7)	10 (15.9)		5 (8.5)	7 (11.9)	
Moderate ED	7 (11.1)	3 (4.8)		6 (14.6)	3 (5.1)	
Severe ED	5 (7.9)	2 (4.2)		7 (11.9)	4 (6.8)	

\* $p > 0.05$  (Wilcoxon rank sum test,  $u = 0.984 < 1.96$ ); ^ $p > 0.05$  (Wilcoxon rank sum test,  $u = 0.626 < 1.96$ )

of LUTS, the higher the presence and severity of preoperative ED.

Theoretically, sex function could be improved after operation because of amelioration of the LUTS, but sexual dysfunction is highly prevalent in patients with BPH after TURP or other minimally invasive procedures [7, 13–18]. A study data from some randomized control trials which compared the holmium laser with TURP showed that holmium laser surgery had the same effect as TURP on erectile function in men [7, 13, 14]. About 7.5 % (range from 3.9 to 11.2 %) and 7.7 % (range from 0 to 17 %) of patients experienced decreased erectile function after the holmium laser procedures and TURP, respectively. But there were about 7.1 % (range from 1.7 to 20 %) and 6.2 % (range from 0 to 19 %) of the patients reporting increased erectile function after each surgery. There were high incidences of ejaculatory dysfunction after both holmium laser (range from 50 to 96 %) and TURP (range from 50 to 86 %) procedures for BPH [7]. Similarly, in one study, the incidence of RE following KTP laser vaporization of the prostate was 56.7 %; interestingly this paper described an improvement in erectile function with this technique compared to preoperative baseline [16]. Transurethral microwave therapy and transurethral needle ablation of the prostate had less adverse effect on sexual function and had less incidence of ejaculatory dysfunction [17, 18]. The etiology of perceived erectile dysfunction after surgery was probably multifactorial, including patient's anxiety due to worrying about the invasive procedure and their pain by thermal injury [14, 15]. Conventional resection is not directly responsible for erectile dysfunction. The major reason of RE is that the internal sphincter in the neck of the bladder was injured and could not block semen flowing into the bladder [19, 20].

The RevoLix 2- $\mu$ m cw laser is a new surgical laser at a wavelength of 2,013 nm with the maximal output power of 120 W and it may have several advantages over the other laser procedures. It improves spatial beam quality, operates in cw pulsed modes, proving capable of more rapid vaporization, precise incision of prostate tissue, and using normal saline as irrigation fluid [21]. There is little objective evidence in the literature that sexual dysfunction occurs following 120-W

2- $\mu$ m cw laser. Recent prospective, randomized trials compared the efficacy and safety of 70-W 2- $\mu$ m cw laser vaporesection with TURP and found that there was no significant reduction in the IIEF-5 following either procedure. However, they did report a prevalence of 55 and 65 % of RE after 2- $\mu$ m laser vaporesection and TURP treatments, respectively [22]. Yee et al. [23] prospectively evaluated sexual function before and after 70-W 2- $\mu$ m cw laser vaporesection, although without preoperative and postoperative validated questionnaires. Fifty-four patients with an erection for intercourse prior to surgery were enrolled, 11 patients (20 %) experienced ED and 3 (6 %) reported an improvement in erectile function. A total of 30 patients (56 %) experienced either reduced or absent ejaculation secondary to RE. Because 120-W 2- $\mu$ m cw laser vapoenucleation is a new surgery for BPH and uses a different form of energy, we were interested in evaluating whether 120-W 2- $\mu$ m cw laser could be associated with a potential minor risk of local injury which may have impact on sex function including ejaculatory function. Interestingly, as reported by some studies [13–15], in our study, 25.4 % of 2- $\mu$ m laser group and 23.7 % of TURP group noticed some increase in EF after each surgery, and there was a marginal but no significant increase in the mean patient EF domain score after TURP and 120-W 2- $\mu$ m cw laser vapoenucleation. The reason for the favorable effect of TURP and 2- $\mu$ m cw laser vapoenucleation on EF in some patients is not clear, but the positive correlation between postoperative improvement in erectile and urinary functions also reported in our series, so improvement in voiding or a decrease in lower urinary tract symptoms could partly explain this finding. Moreover, proper preoperative counseling regarding this operation provided by our urologists could have reduced the level of patient's anxiety which may be one of the causes of ED after surgery. In addition, the neuropraxia induced by thermal injury following TURP or 2- $\mu$ m cw laser vapoenucleation may be temporary. However, a significant number of patients experienced RE or decrease in ejaculate volume after TURP or 2- $\mu$ m cw laser vapoenucleation, consistent with the majority report that a high incidence of ejaculatory dysfunction is commonly found after TURP, holmium laser enucleation, KTP laser vaporization, or 70-W 2- $\mu$ m cw laser vaporesection [13–16, 22, 23]. Our study also indicated that 120-



W 2- $\mu\text{m}$  cw laser vapoenucleation could not depress the degree of bladder neck resection and has no more favorable effect on ejaculatory function than other therapies. In this study, we found the strong association of RE with an adverse impact on orgasmic function. This objectively reported that decrease in orgasmic function reflects the high prevalence of postoperative retrograde ejaculation that was induced similarly by TURP and 2- $\mu\text{m}$  cw laser vapoenucleation. However, patients do not seem to be bothered by the ejaculatory dysfunction induced by both operations because in our series they did not show any decrease in intercourse satisfaction, sexual desire, and overall satisfaction.

## Conclusions

In summary, the 120-W 2- $\mu\text{m}$  cw laser vapoenucleation is a novel excellent treatment for BPH as well as TURP, there is no difference between these two surgical techniques regarding impact on sex function. Both of them do not affect the intercourse satisfaction, sexual desire, and overall satisfaction, but can slightly improve erectile function. These surgical approaches are similarly associated with a high risk of postoperative ejaculatory dysfunction, mainly retrograde ejaculation, which causes deterioration of orgasmic function after treatment. But this study was not a randomized trial, larger numbers of patients and prospective, randomized trials are necessary to reinforce the present finding.

**Conflict of Interest** All authors certify that there is no actual or potential conflict of interest in relation to this article.

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