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Surgery in Motion

# Endoscopic Vaporesection of the Prostate Using the Continuous-Wave 2-μm Thulium Laser: Outcome and Demonstration of the Surgical Technique

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## Abstract

***Background:*** The potential of a new continuous-wave (CW) 70-W, 2.013-μm thulium-doped yttrium aluminium garnet (Tm:YAG) laser for the endoscopic treatment of benign prostatic hyperplasia (BPH) is investigated.
***Objective:*** The simultaneous combination of vaporisation and resection of prostatic tissue in a retrograde fashion is the main characteristic of this new laser technique. We provide a DVD that shows the main steps of this procedure.
***Design, setting, and participants:*** We retrospectively evaluated 56 nonconsecutive patients who were treated by thulium laser vaporesection of the prostate in our institution between 2005 and 2007.
***Surgical procedure:*** Vaporesection of the prostate is performed by moving the fibre semicircumferentially from the verumontanum towards the bladder neck, thereby undermining tissue and cutting chips.
***Measurements:*** Blood loss, postvoiding residual urine (PVRU), maximum flow rate ($Q_{max}$), and the International Prostate Symptom Score (IPSS) were measured as well as prostate volume and prostate-specific antigen (PSA). The duration of the procedure, need for postoperative irrigation, duration of catheterisation, and hospital stay were recorded.
***Results and limitations:*** The median procedure time was 60 min, postoperative irrigation was necessary in 19 out of 56 patients, and the median duration of catheterisation was 23 hr. At the day of discharge, the mean haemoglobin value decreased by 0.2 mg/dl ($p = 0.13$), the average $Q_{max}$ improved from 8.1 to 19.3 ml/s ($p < 0.001$), and the PVRU decreased from 152 ml to 57 ml ($p < 0.05$). The blood transfusion rate was 3.6%, and two patients needed a recatheterisation postoperatively (3.6%). After a median follow-up of 9 mo, the IPSS improved from 19.8 at baseline to 8.6 ($p < 0.001$). Four patients had a repeat transurethral resection of the prostate (TURP) during the learning curve, but this was not necessary in any of the later patients. One patient developed a urethral stricture, and another developed a bladder neck contracture.
***Conclusions:*** The thulium laser seems to be a suitable tool for the endoscopic treatment of BPH.


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## 1. Introduction

The majority of men >60 yr of age are affected by benign prostate hyperplasia (BPH) [1], and according to the European Association of Urology (EAU) guidelines, transurethral resection of the prostate (TURP) and suprapubic prostatectomy are still considered the gold standard for surgical treatment of the lower urinary tract symptoms (LUTS) caused by BPH [2,3]. Over the past decade, different laser systems for transurethral ablation, vaporisation, or enucleation of the prostate have been successfully introduced [4].

Every new laser technology comes with certain advantages, but each also has natural limitations resulting from its individual laser physics. Despite a growing commercial market and increasing patient demand for supposedly modern laser surgery rather than electroresection of the prostate, none of the presently available laser systems has attained unchallenged supremacy so far.

Presently, among the most commonly used lasers in transurethral prostate surgery are variations of the neodymium-doped yttrium aluminium garnet (Nd:YAG) laser [5], the holmium-doped YAG (Ho:YAG) laser [6], and the potassium titanyl phosphate laser (KTP, or ''green-light'' laser) [7] as well as the high-performance (HPS) version of the KTP laser [4]. These lasers substantially differ in their function, application technique, and tissue absorption as a result of the power, wavelength, type of energy emission (continuous wave versus pulsed wave), and type of ion the laser uses [8]. Which laser system should be used will doubtlessly depend on various factors, such as the short- and long-term functional outcome, safety of the procedure, complication rate, length of the operation, duration of catheterisation and hospitalisation, and simplicity and cost-effectiveness of the procedure.

We investigated the potential of the new continuous-wave (CW) thulium-doped YAG laser (Tm:YAG; RevoLix, LISA laser products OHG, Katlenburg-Lindau, Germany) for endoscopic treatment of BPH using the vaporesection technique, which consists of a combination of tissue ablation and cutting chips of prostate tissue in a retrograde fashion. The data of 56 patients are presented in this work. Furthermore, we demonstrate the surgical technique and the potential of this procedure in the attached DVD.

## 2. Methods

The 70-W CW Tm:YAG laser emits a wavelength of 2.013 μm and is highly absorbed by water, which is ubiquitous in any tissue (Fig. 1). Therefore, it is well suited for tissue ablation, while tissue damage is restricted to <1 mm beneath the cut. We used the Tm:YAG laser in combination with a conventional 24F resectoscope using a 12.5° angulate optic (Karl Storz GmbH, Tuttlingen, Germany). Intermittent irrigation with physiologic saline solution ensured good visibility. An additional trocar cystostomy for a continuous-flow setup was not necessary. The laser beam was delivered though the laser insert containing a reusable 440-μm core diameter bare-ended quartz fibre, which was in direct contact with the tissue, with slight pressure, at an angle of 30–90°.

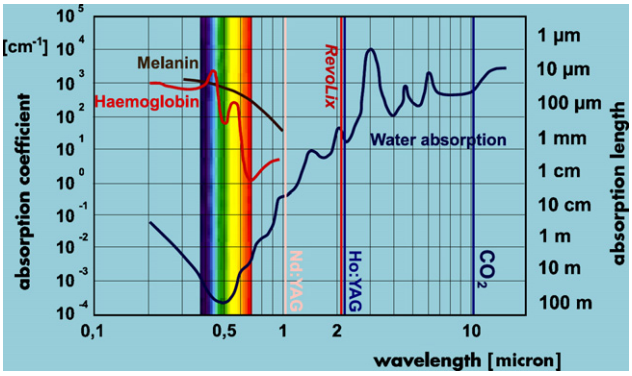


**Fig. 1 – Wavelength and water absorption coefficient of the 2.013-μm Tm:YAG laser compared with the Ho:YAG, Nd:YAG, and $CO_2$ lasers (courtesy of LISA laser products, Germany).**
**Tm:YAG = thulium-doped yttrium aluminium garnet; Ho:YAG = holmium-doped yttrium aluminium garnet; Nd:YAG = neodymium-doped yttrium aluminium garnet.**

The first 56 patients who were treated by thulium laser vaporesection in our institution are reported in this retrospective case-control study. Two endourologically experienced surgeons performed the operations between April 2005 and October 2007. Only patients who provided oral and written informed consent to be treated by this investigative laser surgery technique with unknown long-term results were included in this study; however, the majority of patients with bladder outlet obstruction (BOO) resulting from BPH were treated by classic TURP.

Inclusion criteria consisted of a symptomatic BPH with a maximum flow rate ($Q_{max}$) <15 ml/s and an International Prostate Symptom Score (IPSS) >7. We also included patients with elevated prostate-specific antigen (PSA) levels, a transrectal adenomas volume exceeding 100 ml, and prior urinary retention with the presence of an indwelling catheter. No age limit was set. Patients with a neurogenic bladder and any urethral, bladder neck, or prostatic surgery were excluded. Patients <75 yr with an abnormal finding on digital rectal examination (DRE) and/or PSA levels >4 ng/ml were subjected to a preoperative prostate biopsy. Oral anticoagulant medication was interrupted preoperatively. Before treatment, the patients provided a complete medical history and underwent a physical examination, including DRE, transrectal ultrasound (TRUS) of the prostate, urine analysis, PSA measurement, blood chemistry studies, and postvoiding residual urine (PVR) as well as $Q_{max}$ measurements. We used the postoperative