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# Holmium Laser

## Interstitial Holmium Laser Treatment of BPH

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### Introduction

During the past ten years several so-called minimally invasive procedures for the treatment of BPH have been introduced, many of them utilizing laser technology.

The term "laser treatment of BPH", however, summarizes a variety of techniques using different laser wavelengths, application systems and surgical techniques to achieve contrasting tissue effects such as incision, resection, vaporization, or coagulation.

Dependent on various factors such as the laser wavelength or its penetration depth, the power density, which is a function of laser output power, the applicator size, or beam divergence, the distance between applicator and irradiated surface, and the application technique, the resulting tissue effect is either coagulation or vaporization.

### Coagulation – Vaporization

Coagulation can be achieved by superficial or interstitial laser application. Using free beam or contact laser irradiation, vaporization can occur; being broad it's called ablation, being narrow it's called incision when moving the applicator.

Two or more incisions connected with each other are resulting in a resection of tissue or enucleation, provided that the whole adenoma is removed.

### Interstitial Coagulation

The objective of **interstitial laser coagulation (ILC)** is to achieve coagulation necrosis inside the adenoma rather than at its urethral surface. The interstitial coagulation results in secondary atrophy and regression of the prostatic lobes. Both **Nd:YAG** and **diode lasers** can be used for ILC because of their relatively deep penetration and efficient volumetric tissue heating.

The goal of **creating the largest coagulative volume in the shortest amount of surgical time** is accomplished by initiating irradiation with a relatively high power to heat the tissue rapidly and coagulate the blood vessels, followed by laser power reduction in order to maintain the temperature in the center of the lesion at a high level just below the carbonization threshold and allow further lesion expansion.

### Holmium Laser

The holmium laser is usually employed **to incise or resect, respectively, prostatic tissue** (HoLEP = holmium laser enucleation of the prostate). During the procedure, however, hemostasis is achieved by non-contact irradiation of the bleeding vessel because of the beam divergency. In theory, holmium laser radiation of

low energy density should be capable to achieve **volume coagulation**. Combined with specific applicators a low-power holmium laser could be used for **interstitial laser coagulation**.

For interstitial holmium laser irradiation a specifically designed scattering device was mounted to the tip of a standard holmium laser fiber. According to interstitial **Nd:YAG** and **diode laser fibers**, the applicator length was 2 cm, the diameter approximately 6 Fr (manufactured by WaveLight Laser Technologie AG, Erlangen, Germany).

In animal testing these applicators turned out to withstand high temperatures leading to carbonization without fracturing. The source of laser energy was a **variopulse** holmium laser manufactured in former times by Baasel, now it is the updated model **AURIGA** by WaveLight, Erlangen, Germany.

Dependent on the energy per pulse, on the frequency and the total number of laser pulses it is possible to achieve a relatively large coagulation zone or an ablation resulting in a cavity.

High laser pulse energies, e.g. 2 J/pulse, at a high pulse frequency and a relatively long irradiation time, e.g. 1 minute, are capable to create an intraprostatic cavity of ellipsoidal shape of approximately 18 x 10 mm. At 1 J/pulse and a frequency of 10 Hz a relatively large volume of 15 x 10 mm is coagulated in 10 s.

## Clinical Application

For clinical application the standard ILC technique is used. Transurethrally via a 17 Fr compact cystoscope the applicators are repeatedly placed into the bulk of the prostatic lobes. The order of punctures is in the discretion of the surgeon, either one lobe is treated after the other or the lobes are treated in an alternating mode, e.g. starting at the apex ventrally and proceeding towards the bladder neck.

As in other coagulation techniques, not only those using laser technology, an initial increase of obstruction due to the heat associated edema and tissue hardening must be expected. The volume reduction does not occur immediately but delayed. This requires postoperative catheterization according to the detrusor function. However, preliminary clinical experiences demonstrate the capability of the variopulse holmium laser for interstitial laser treatment of BPH.

Further studies in process.

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