

Laser Therapy: a Seminal Perspective in Modern Medical Technology

Modern diode lasers enable more gentle medical procedures

• **Laser light treatment is becoming more and more important in modern minimal invasive medicine. For instance, medical lasers have established themselves in ophthalmology. Their area of use, however, stretches even further: from the removal of tattoos to the systematic treatment of tumors. Today, laser applications can be found in virtually every medical discipline.**

Interdisciplinary applications benefit both doctors and patients

Compared to traditional surgical procedures, laser surgery offers numerous advantages. Thus, many procedures using minimally invasive surgery no longer require complex anesthesia. Via micro puncture, the surgeon uses a minimal opening to insert the laser and to position it at the place of treatment inside the body. This avoids large cuts and shortens the procedure. In addition, the absorption characteristics of specific wavelengths of modern diode lasers make them particularly suitable for human tissue. This lowers the number of potential side effects. There are, however, also other reasons why this comparatively gentle and precise surgical laser technology has come to play an important role in everyday surgery.

Modern laser equipment is being further developed to ensure that it facilitates the doctor's work and increases patient safety. For instance, devices of today work so much more quietly than they used to. Therefore, no more disruptive noise distracts the surgeon during surgery. There is another advantage to diode lasers: as the specific wavelength that is utilized here is invisible to the human eye – many of those in medical technology know mostly green and red laser light – it doesn't affect the surgeon's view during the operation.

Apart from traditional medical lasers, which were mostly restricted to a specific medical area, a new generation of diode lasers offers interdisciplinary use in various

fields. This slims down the equipment pool and has a positive effect on cost. In this way, suitable laser systems can also be applied to areas such as ENT, gynecology, gastroenterology, pneumology, inter-vertebral disc therapy, esthetics and proctology. Modern laser devices are also compact, easy to use and can be transported easily, which creates the flexibility to use them in a variety of surgical rooms. This makes hospital allocation planning more flexible and increases the efficiency of everyday tasks. Both – time savings as well as higher efficiency – benefit doctors and patients in equal measure.

Safely treating benign prostate enlargement and varicose veins

Some examples will serve to illustrate the advantages of using lasers in medical treatment: to allow the treatment of benign prostate enlargement with a surgical laser, it must first show a high water absorption rate to be able to optimally remove the soft tissue. Secondly, the hemoglobin absorption rate is equally significant. It enables carbonization-free coagulation and successful hemostasis. Thanks to coagulation, the tissue reseals directly and there is hardly any bleeding. Wounds heal faster and convalescence becomes shorter.

The 180-Watt Evolve diode laser system works on the basis of selective light vaporization (SLV). It therefore achieves its highest simultaneous water and hemoglobin absorption rate at a consistent wavelength of 980 nm (see figure 1). This enables effective removal and coagulation of tissue at the same time. Wavelength, pulse duration, and radiation characteristics are also coordinated exactly. This increases the optical penetration depth of the laser to avoid a large proportion of energy being absorbed by superficial tissue layers. To a large extent, this helps to prevent additional tissue damage and scar formation.

With modern diode lasers, varicose veins can also be removed gently and without any scarring. The consistent laser emission

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not only decreases the risk of vein perforation – in most cases, it even allows out-patient treatment. For instance, the laser energy of a special 1470-nm diode laser is best absorbed in the intra cellular vein wall liquid and in the water content of blood (see figure 2). The irreversible thermal damage induced by the laser energy causes the treated vein to seal completely. The body then absorbs it bit by bit. As the vein stays inside the body, there is no additional physical impact as with traditional vein stripping where the whole vein is pulled out.

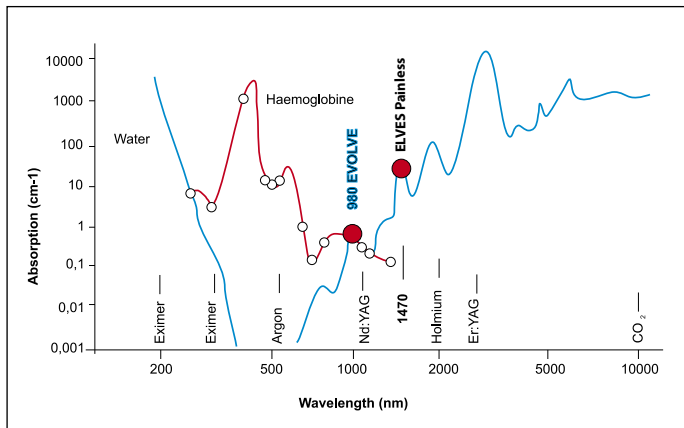


FIGURE 1: Light absorption in water and Haemoglobin. The diode laser wavelength of 980 nm is 2300 times more absorbed in H₂O than at 532 nm. Haemoglobin absorbs 74 times better at 532 nm compared to 980 nm.

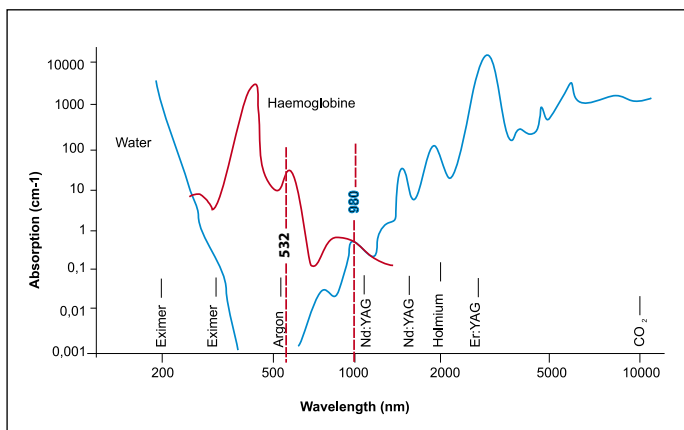


FIGURE 2: 1470 nm diode laser is even better absorbed in water than 980 nm. Hence, it is best absorbed in the intra cellular liquid of the vein walls and in the water proportion of the blood.

It all depends on the laser fiber

Recently, new, very powerful fibers have been developed with special characteristics for the respective fields of medicine. The success of a laser treatment largely depends on these fibers. Be it radiation characteristic, processing and energy transmission, or contact or non contact mode: all this decides the success of an operation and should be aligned with it as best as possible.

A fiber with the type name Twister, for example, is best suited for prostate treatment (see figure 3). It shows very high ablation rates, is equally reliable, and allows the user direct, tactile contact with the tissue to be removed or vaporized. In combination with laser systems suited to the fiber, ablation rates of two to three grams per minute can be achieved. Additionally, the duration of the procedure can be reduced by at least 50% in comparison to other prostate laser therapies.

For the treatment of varicose veins, on the other hand, a completely new kind of fiber that radiates homogenously (360°) has proven itself. The so called ELVeS (Endo Laser Vein System) Radial fiber, contrary to uni-lateral radiation, with 360° radiation optimally capitalizes on the applied energy. Energy transmission is accelerated and

THE COMPANY

biolitec AG

biolitec AG is a global leader in laser application. In photodynamic therapy (PDT), biolitec possesses all relevant core competencies: photo sensitizer, laser, and light wave conductor. Besides laser-based cancer treatment involving the drug Foscan, the company mainly researches and markets minimally invasive, gentle laser procedures. This includes a laser system used successfully around the world to treat venous insufficiency as well as a laser that has established itself in urology as a gentle treatment method. Gentle laser treatments in proctology, ENT, orthopedics and ophthalmology also form part of biolitec's business field.

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more precise, but unlike uni-lateral "point radiation", there is no risk of vein wall perforation and thermal irritation of the surrounding tissue.

When developing new fibers for endovascular laser systems, there is also more em-

phasis on increasing ultrasound visibility. This facilitates the doctor's work and increases patient safety. There are also some other features: monitoring is made easier through centimeter markings at the end of the fiber. An atraumatic fiber tip is specially suited for procedures in the smallest of tissue areas, and its improved conductivity ensures safe positioning inside the vein.

Laser for photodynamic therapy (PDT)

In oncology, lasers are used to treat different kinds of tumors, especially when they are difficult to remove surgically. For instance, liver tumors are thermally destroyed by laser. More often though, lasers are applied in combination with a photodynamic agent, the photo sensitizer. First, this photosensitive medication is administered either intravenously or locally, depending on the location of the tumor. Once the agent has accumulated in the tumor tissue, controlled radiation with laser beam takes place. This starts a phototoxic reaction. The laser selectively activates the agent, which releases radicals in the tumor to destroy the malign tissue. The tumor cells die off. In comparison to chemotherapy or surgical procedures, photodynamic therapy has specific advantages: nausea associated with chemotherapy does not develop, and the cosmetic results are superior to those of surgical procedures. Above all, however, the surrounding tissue stays intact.

To be able to activate the different photodynamic agents, lasers with various wavelengths are necessary. For this purpose, there are different laser systems with modern diode technology, which are compatible with common photo sensitizers. Specially designed software simplifies application and treatment. An integrated calibration port makes it easier to precisely measure out light exposure for different applicators, i.e. specially adapted optical fibers. These are used for surface radiation as well as for the radiation of intercostal tissue, or cavity radiation. For the latter, so-called balloon diffusers are used, which expand and fit themselves into the body cavity so that the laser beam is directed locally onto the tumor only without affecting the surrounding tissue.

The multipoint laser has an exceptional feature. Thanks to multiple connections, it allows the simultaneous radiation of a tumor with applicators that can be adjusted independently. The advantage: laser light can be applied uniformly into voluminous tumors from various positions. This facilitates and accelerates the treatment of complicated tumors.

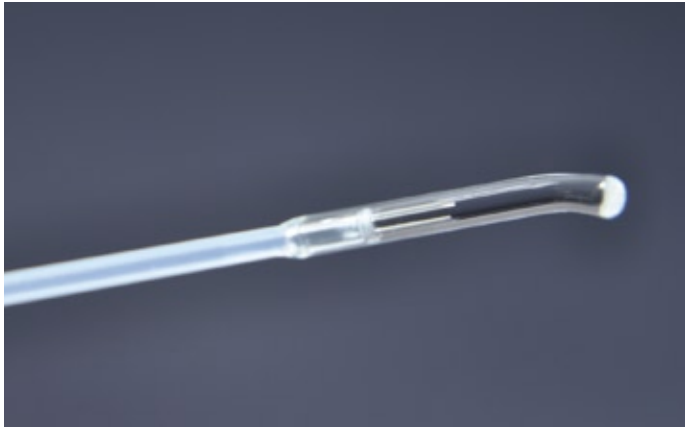


FIGURE 3:
Twister fiber tip.

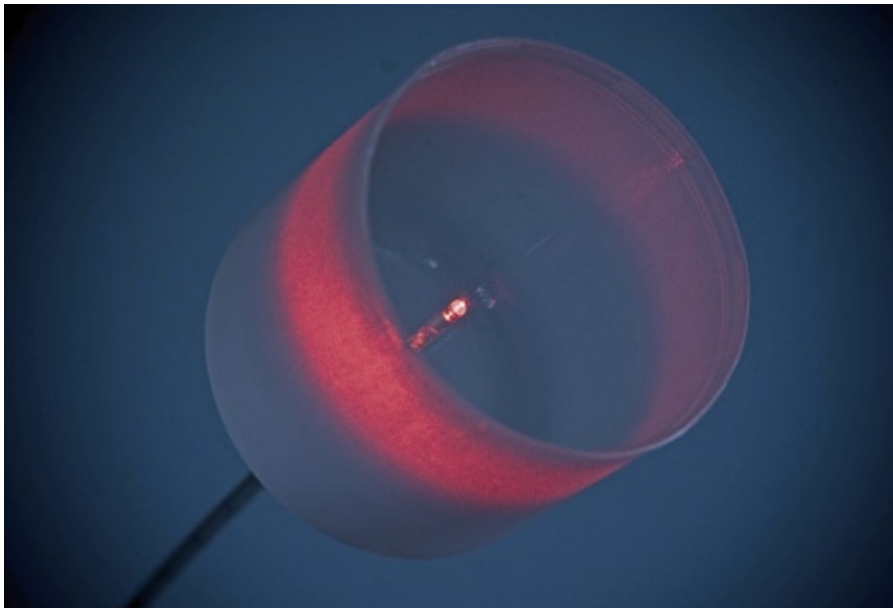


FIGURE 4: The homogenous circumferential (360°) energy emission of the ELVeS Radial fiber guarantees safe closure of the vein and eliminates perforation and charring.

Outlook

The future indicates an advancement of laser systems in various different ways: for instance, a laser system for urological therapy has already been developed that works with two different wavelengths in parallel (1470 nm and 980 nm). This allows even faster and complete tissue vaporization. The surgeon can work in a small, yet effective coagulation zone, which further minimizes possible side effects. Its high absorption rate especially in water prevents the laser beam from accidentally emitting into the bladder and/or other areas not under treatment.

Increasingly, laser systems in medical technology are also combined with other technologies. For example, RFID (Radio Frequency Identification) is already in use today to ensure the safety of laser treatment and to work even more cost-effectively. Laser probes are equipped with an electronic signature that ensures only original probes are used and no single probe is used more than once. This allows to eliminate improper use and to reduce attrition.

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