Laser-supported restorative dentistry

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Since the advent of laser in dentistry, one of the most benefited disciplines alongside oral surgery is restorative dentistry.

A plethora of existing wavelengths is providing excellent, but most significantly, essential service in a unique way. Starting from the visible light spectrum (445 nm) going to red (660 to 670 nm), near-infrared (810, 940, 980, 1,064 nm) up to the mid-infrared spectrum (2,780 to 2,940 nm), a variety of clinical situations can be dealt successfully, either with the unique use of laser or a combination of conventional approaches with laser. Numerous devices have been developed, either on a single wavelength or more versatile multiple diode laser devices with two or even three different wavelengths adding ease of use to clinical applications.

The purpose of this paper is to present an overview of laser-supported restorative dentistry, going through the available wavelengths and their different applications and capabilities by using exemplary clinical cases.

The “blue laser”

Recently, Dentsply Sirona introduced the SiroLaser Blue, a three wavelength device (445, 660, 970 nm) aiming to respond to a variety of clinical conditions requiring laser approach. As it is well known from the absorption chart (Fig. 1), 445 nm is being highly absorbed by melanin and haemoglobin establishing this device as a very useful tool for surgery and haemostasis.

In the field of restorative/operative dentistry, minor surgeries in the form of gingival contouring and especially haemostasis are necessary, but a significant use, as it appears from early research data, can also be light curing and energy provision to restorative materials. Composite resins and glass ionomers can be light cured by the SiroLaser Blue device in a very efficient way.

More in particular, conventional glass ionomer can benefit from the energy provided by the laser and increase significantly their surface microhardness and
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Dentine hypersensitivity

Dentine is a difficult and demanding dental tissue, presenting certain difficulties in its management due to its composite structure character. Alongside this fact, certain clinical entities related to dentine morphology, structure and interrelation with other oral tissues such as the gingiva are the root of difficult to solve clinical problems.

One of the major challenges in contemporary restorative dentistry is managing dentine hypersensitivity. Dentine hypersensitivity is a multifactorial clinical situation that affects a significant number of patients in almost all age groups. A variety of different treatment modalities have been suggested, starting from toothpastes and varnishes, going up to restorative procedures.

Low Level Laser Therapy (LLLT) seems to be a key way to manage these problems, especially in cases where there is no space available for the placement of "permanent" coverings. Patients are coming in, exhibiting different pain levels when thermal stimuli are applied, in particular cold ones.

The application of a "soft" laser (0.2 to 0.5 W, cw) for one to two minutes at the cervical area of each tooth provides an effective treatment in most cases. Certainly, because of the multifactorial character of the problem, there are cases that perhaps would respond positively on a different approach. But laser is a strong, valid way for dentine hypersensitivity's management.

Dentine disinfection

Following caries excavation, a dental practitioner is faced with dentinal walls still contaminated with remaining bacteria either in a "soft" layer of carious dentine or existing infiltrated inside dentinal tubuli. Light-activated disinfection (LAD) or photo-activated disinfection (PAD) are different names for the same procedure. The foundations of this approach refer to the use of a red laser in conjunction with a blue dye (e.g. toluidine blue or methylene blue).

In principle, the red light activates the dye in order to produce free oxygen radicals, a very potent disinfectant that would disinfect dentinal walls without affecting pulp's vitality or interfering with adhesive procedures and bond strength of contemporary bonding systems and materials. The same method is also being suggested for periodontal pockets and root canal disinfections following similar procedures (Fig. 2).

Subsequently, the red light "soft" laser can be useful in a variety of restorative cases providing either immediate pain relief in some difficult cases, or a safe environment for our restorative materials to function, providing extended longevity of restorations.

The "diode laser"

Diode laser devices at 810, 940 and 980 nm can be also referred to as the "standard" diode devices found in almost every laser equipped dental clinic. These wavelengths are the most common wavelengths
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available in the market, combining the versatile use for a numerous different everyday clinical cases (surgical, endo, perio, bleaching, etc.), with significantly reduced prices compared to other alternatives.

In restorative dentistry in particular, the diode laser can be used for the minimal gingival retouch near cavity margins (Fig. 3), haemostasis and gingival troughing before a restoration or impression taking as well as for bleaching procedures used always in combination with the respective bleaching agents and handpieces (Fig. 4). Especially in cases where gingival and bleeding management is crucial, these devices can provide a safe and predictable result much quicker than conventional approaches. Depending on case requirements, a number of different settings should be used.

Decay diagnosis

Concurrently, at the same range of the electromagnetic spectrum and in particular at 655 nm laser caries detection device has been developed. Dental decay lesion’s diagnosis and risk evaluation is the cornerstone of modern operative dentistry and the minimally-invasive approach. Accurate detection of site, extent and activity of the lesion is of paramount importance, in our effort to provide quality treatment to our patients. DIAGNOdent system utilises the principle of “laser fluorescence” in order to detect and classify decay lesions. Numerous research papers have shown that this is a valid alternative in the caries examination armamentarium. It exhibits clinically adequate ability to “probe” difficult to access areas, such as, pits and fissures and offer practitioners an extra objective aid to examine and evaluate suspicious areas, promoting minimally-invasive restorative treatment.

The “erbium family laser”

The erbium family laser devices (Er:YAG and Er,Cr:YSGG) are the protagonists in the restorative dentistry palette. Thus, they can be referred to as the “Swiss Army Knife” as they can perform all needed actions related to procedures in modern restorative dentistry. These results are based on the fact that erbium lasers are highly absorbed in water, a compound existing in variable amounts, in all human tissues.

Their only significant drawback that limits their use in a dental surgery is their relatively elevated price in the market. It goes without saying, of course, that as in all laser instances, prior to the acquisition and use of such devices a proper, well-structured and documented education and training is essential.

The erbium family laser devices can successfully perform all procedures both on soft and hard oral tissues. With the respective parameters and settings, an erbium family laser can manage gingival contouring and modelling (most of the times without the need for anaesthesia) and then proceed to cavity preparation in a clinically acceptable time span.

The cavity preparation is a less frustrating procedure for the patient as it lacks major issues of the conventional approach, for example anaesthesia, noise, vibrations, pressure, etc. (Fig. 5). Even when getting close to the pulp or on minor directly manageable pulp exposures, with the use of the appropriate settings, a pulpal “bandage” can be achieved in a safe way (Figs. 6–8).
The main characteristics of the cavity are the same as with the conventional approach, rendering possible the restoration with all available restorative techniques and materials. The only significant difference that should be taken into consideration is that laser cavity preparation is a “smear layer free” restoration.

Erbium family laser light is eliminating smear layer on enamel and especially on dentine, and currently this is an issue of research as for the pH of the bonding systems that should be used on such a surface. The findings, so far, suggest that self-adhesive systems exhibit better results than total-etch systems.

**Conclusion**

In conclusion, laser in dentistry has long now passed adolescence and has entered a period of maturity. Dentists start to appreciate the quality of treatment they can provide to their patients, and applications of diode lasers are growing significantly.

The erbium family lasers are strongly related to price, but still the interest shown proves that when they would become affordable for bigger numbers of practitioners then there would be a generalised use, something like the introduction of high-speed turbines some decades ago.

Still, we need to stress the point that the use of either diode or erbium or any other type of laser should be founded on a solid, well-structured, documented education and training, assuring the safety of both patients and dental professionals.

**Kurz & bündig**


Der Artikel gibt einen Überblick über die unterschiedlichen Lasertypen und -wellenlängen, die in der lasergestützten, Restaurativen Zahnheilkunde eingesetzt werden und erklärt anhand klinischer Fallbeispiele die unterschiedlichen Anwendungsmöglichkeiten. Einer der am meisten genutzten Laser in der dentalen Praxis ist dabei der Diodenlaser. Das vielseitigste, gleichzeitig aber auch teuerste Gerät ist der Erbiumlaser; er gilt als das „Schweizer Taschenmesser“ unter den Lasern. Für welches Gerät sich der Behandler auch entscheidet: Die Autoren betonen, dass in jedem Fall eine solide, gut strukturierte und dokumentierte Ausbildung notwendig ist, um die Sicherheit sowohl von Patient als auch Behandler sicherzustellen.