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LASERS IN DENTAL MEDICINE – A VIEW BEYOND THE VISIBLE CLINICAL EFFECTS

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Abstract

The non-invasive treatment of oral diseases is a major goal of modern dentistry. The search of a new therapy encourages the intensive study of the laser systems, which currently offer prospects for their implementation in all aspects of the dental practice. This article aims to review their influence on the soft and hard tissues in the oral cavity at a subclinical level.

Lasers are increasingly used in operative dentistry – as a means of prevention of caries and its precise removal, as etching and antibacterial agents. They can be used successfully in root canal therapy and treatment of periodontal diseases. The low level laser therapy has anti-inflammatory effect on the pulp - periodontal complex, the oral mucosa and bone – laser biostimulation accelerates healing processes and guides stem cells proliferation.

Lasers' effects have not yet been sufficiently studied, but they have potential to establish themselves as a better alternative to conventional therapy.

Key words: *dentistry, lasers, low level laser therapy, biostimulation, perspectives, subclinical*

1. INTRODUCTION

Currently, laser systems have aroused intense interest in scientific community, and their application has been integrated in many areas, one of which is medicine. While in recent years laser technology has undergone rapid development, the range of application in everyday practice is wide enough. Experimental studies about introduction of lasers have been conducted in each area of dentistry. There are great expectations concerning the possibility that purposeful effects be caused on soft and hard tissues by using different wavelengths. The higher requirement of patients, the growing market share of dental lasers, and the rapidly increasing number of publications on this topic require a scientific summary of the advantages and disadvantages of modern laser systems in dentistry.

The aim of the present review is to summarize the achievements in the development of laser systems, the clinical indications for their application as well as their effects on tissues at a subclinical level, and thus to assess the prospect that they displace conventional invasive therapy.

2. TYPES OF LASERS

Current application of lasers in dentistry involves diagnosis, prevention, therapy and surgical treatment of soft and hard tissue diseases as well as accelerating recovery in the postoperative period. The laser systems, being different in structure, influence the tissues, depending on many factors – characteristics of the used laser, its wavelength, effective radiated power, radiation intensity and duration of treatment. The characteristics of the target tissue are also important – the amount of water, hemoglobin and pigments contained therein (Table 1).

Table 1. Types of lasers according to their structure and effects.

Types	**Structure**	**Wave lenght(λ)**	**Application**
1. Solid-state lasers	***Nd:Yag*** laser Neodymium : yttrium - aluminum- garnet	1064 nm	Soft tissue ablation (the depth of penetration into the soft tissue makes it possible); Treatment of metallic prosthetic components.
	Er:Yag laser Erbium: yttrium - aluminum- garnet	2940 nm	Absorption peak of laser energy in water, optimal for the removal of caries matter Operating close to the pulp (due to the shallow penetration depth).
2. Gas lasers	Active environment of neutral atoms ***He-Ne laser*** Helium–neon laser	632.8 nm	Diagnosis of caries.
	Active environment of free ions ***Argon Laser***	488 nm and 514 nm	Catalyst for composite material polymerization; Detection of caries (by the laser fluorescence method).
	Active environment of free molecules **CO_2** ***laser***	10.6 μm	Periodontal surgery.
3. Semiconductor lasers	***Diode laser***	980 nm	Cutting the tissue and coagulation without charring of the surface layer; Laser Doppler flowmetry (Pulpal blood flow measurement)
4. Liquid organic dye lasers	***Dye lasers***	Visible spectrum and adjacent ranges (according to the color)	Manipulation of oral soft tissues. They are characterized by "adaptability". (The right choice of color and concentration makes it possible to generate laser light in the wide range of λ).

The use of lasers in medicine, and in particular – in dentistry, is based upon the accurate absorption of the laser beam by the water contained in the tissues, by the hemoglobin in blood, and by the pigments which are contained in certain tissues (Boaria et al. 2009). This feature requires consideration – one by one, of the effects laser systems have on the individual tissues and structures in oral cavity: enamel, dentin, pulp, periodontium, bone tissue, soft tissues, and oral microbiota.

3. LASER EFFECTS ON TISSUES IN ORAL CAVITY

3.1. Possible kinds of effects

Electromechanical effect of lasers leads to a dielectric breakdown in the tissue caused by the shock wave that propagates in the plasma and causes a localized mechanical rupture.

Photo-ablative effect causes light-dependent collapse of intermolecular bonds in the tissue. Ablation is a term which stands for removal of material or tissue from a surface or body part.

Photochemical effect induces photochemical processes in target cells or materials. Photopolymerization in activation of laser teeth whitening system could be given as an example. As a result of the laser radiation, chemical bonds in the molecules are ruptured.

Photodynamic therapy is a method for generation of biochemical reactive oxygen species by the use of a photosensitive agent and light for its activation. This type of therapy is used in oncology. Photo-thermal effect converts light energy into thermal, which results in heating and volatilization of the tissue structures.

When a laser beam is directed to tissues, the water which has a high percentage in their content, absorbs energy, whereby its temperature rises. With intensity of a few W/mm2, water contained in the tissue instantly boils and evaporates (Featherstone et al. 1997). Macroscopic biological effects of photo-thermal type can be classified in accordance with to some differences of thermodynamic processes. Table 2 presents the major histological changes in the tissues resulting from the effect of the laser beam.

Table 2. Histological changes induced by the laser beam (Featherstone et al. 1997).

Operating temperature	**Changes**
43 - 45°C	Structural changes in the cell; Overheating, causing cell death.
50°C	Termination of the activity of enzyme systems
60°C	Protein denaturation; Protein coagulation; Collagen denaturation; Changes in membrane permeability.
100°C	Extracellular vacuole formation.
>100°C	Cleavage of vacuolar membrane.
300 - 1000°C	Thermoablation of tissue.
3350°C	Carbonising.

In summarizing the data from Table 2 one recognizes the need for high precision in the choice of the operating wavelength and that even the slightest variation may have irreversible effects.

3.2. Laser effects on individual tissues

3.2.1. Lasers and enamel

Tooth enamel is composed of approximately 85-95 volume percent hydroxyapatite, 8-12 volume percent water and 3 volume percent organic components (Schröder 1992). Hydroxyapatite has an absorption maximum at approximately 2,8 μm, and water - about 3 μm (Secilmis et al. 2008). When heavily absorbed laser energy is applied to the enamel, it is converted to thermal energy that dramatically brings the water contained in the tissue to the boiling point. Boiling water forms high pressure steam, which in turn leads to the process of ablation, when the pressure exceeds the maximum value for the hard tooth tissue. During this process water evaporates explosively from tooth structure. The strength in the very "withdrawal" of particles in ablation, resembling lift-off, results in the formation of craters on the surface, and it takes a scaly form with a roughened and micro-fissure morphology. When using working modes of lasers under the absorption maximum of hydroxyapatite,

enamel surface is not damaged, but there are changes in subsurface enamel layer related to the chemical composition and organization (Secilmis et al., 2008; Boaria et al., 2009).

Prevention of caries is the major goal of modern dentistry. Presently, the essential tools in the fight to prevent its occurrence are the fluorinated products. There are some lasers that come as a possible alternative, and their potential in this area is confirmed by various studies - Nd: YAG laser (Boaria et al. 2009) and CO2 - laser (Rechmann et al. 2013). Due to the length of the wave generated by the Nd: YAG laser -1024 nm, with the capacity to modulate the permeability, solubility and crystallization of the enamel, which increases its resistance to demineralization and reduces hypersensitivity in the neck region of the teeth. The high resistance of enamel is due to the reduced solubility of the subsurface enamel resulting from changes in the mineral phase, such as loss of organic matter and carbonates and changes in calcium-phosphorus ratio. The absorbance of the Nd: YAG laser beam by water and hydroxylapatite is low, but it is good in a black pigment (Boaria et al. 2009). Therefore, in order for it to be improved, various dyes are used as photoabsorbators. Without them, the laser energy cannot be completely absorbed by the enamel and the unused amount can reflect or dissipate in dentin, which jeopardizes the pulp vitality. Rechmann et al. (2013) report that the use of specific microsecond short-pulsed 9.6 μm CO2-laser irradiation markedly inhibits caries progression in pits and fissures in comparison to fluoride varnish alone over 12 months.

Attempts in the same direction made by Secilmis et al. (2008) with other lasers - Er, Cr: YSGG, lead to conflicting data, while some of them even show microscopic cracks and microcraters in enamel.

The process of "etching" lies in roughening the surface of hard tooth tissues. It seeks to increase the area for micromechanical retentions, providing a link between dental tissues and composite materials used in dentistry. Classical etching agents include acids, such as phosphoric and maleic. The assumption that lasers also can have a good effect in etching has been subjected to a number of studies. Results obtained by Attrill et al. (2000) show an energy-based pattern, whereby the use of additional factors also plays a role, for example – a water jet in Er: YAG or a special gel for laser etching with Nd: YAG.

When comparing the etching process with lasers and chemicals – acids, one distinguishes the advantages of conventional acidic agents over laser systems. An entirely different macro- and microscopic topography of the etched surface is achieved, with acid-etched groups presenting a more evenly roughened surface and a stronger bond between the composite material and the enamel - 16.6 MPa, as compared with the maximum of 11.5 MPa for the Er: Yag, at optimum performance by irradiation with 24 J/cm2. In laser etching with Er: Yag and Nd: YAG unevenness, lacunes and cracks may occur on the surface, which are manifestations of areas with local internal tensions of thermal nature, as a result of irradiation. In studies of Attrill et al. (2000) associated with the use of the two laser systems, the data are in favor of the Er: YAG laser, as compared to the Nd: YAG laser, whereby melted enamel "microspheres" and dehiscence are discovered, even with the use of a special gel.

A novelty in prosthetic dentistry has been presented by Wang et al. (2014). They have developed a miniature robotic device, which can manipulate a femtosecond laser beam to drill a decayed tooth to realize clinical tooth crown preparation. A precise 3D motion control of a laser focal point is achieved, which is small enough to be used in the narrow workspace of the oral cavity.

At this stage the range of procedures performed successfully on enamel with lasers include: initial caries removal, etching, laser analgesia (with Nd: YAG, Er: YAG and Er, Cr: YSGG lasers), laser activated teeth whitening accelerated with laser teeth fluoridation (with Er: YAG, Er, Cr: YSGG, CO2 and argon lasers) (Walsh 2003) .

3.2.2. Lasers and dentine

Lasers, in particular Er: YAG, are increasingly used in Operative Dentistry, due to the lack of any noise and pain unpleasant for the patient that accompany conventional mill. The absorption peak in water, characteristic of the length of radiation of the Er: YAG laser, makes it especially suitable for use with hard tooth tissues. Removal of caries mass from them becomes possible due to the high concentration of water contained therein.

What remains to be more thoroughly studied are the changes accompanying laser irradiation in dentin at the molecular level. A method called dispersive Raman spectroscopy provides information on these processes. This method makes it possible to examine the effect of the laser beam onto the dentine according to the set length of the radiation. The results of the study of Soares et al. (2006) indicate that by increasing the energy the organic and mineral components are reduced in the working zone, the superficial collagen fibrils are melted, and there are partially denatured collagen fibrils observed underneath, which are fused and loosely tied to the underlying healthy dentin. Dentinal tubules retain the direction of their course to the surface, and odontoblasts are not affected.

Biochemical studies of the floor of the cavity in dentin stuffed for Er: YAG caries removal, show that the content of denatured collagen in cavity floor is similar to that in healthy dentin. The study was conducted by lyophilization and hydrolysis of samples of carious pulp, healthy dentin and irradiated dentin as well as scanning for collagen fibers in the ultrafiltrates reflected by the levels of hidroxilicil-piridolin (HP) and licipiridinolin (LP). In carious dentin 100% of HP and LP were found, in contrast to the healthy dentin, which has 0.33% of HP and 0.68% of LP. Dentine layer remained after laser caries removal indicates 0.84% of HP and 1.26% of LP – results similar to those of the healthy one (Jepsen et al. 2008).

It can be concluded that the Er: YAG laser is a reliable tool for removing carious altered tissue with great precision at its border. The effectiveness of its removal can be increased by the use of a system for fluorescence-controlled removal of carious pulp (Jepsen et al. 2008). Dentin hypersensitivity in the cervical area of the teeth can be affected by Nd: YAG, Er: YAG, Er, Cr: YSGG, CO_2 as well as diode lasers (Boaria et al. 2005; Walsh 2003).

A research of Sarmadi et al. (2014) on patients' experiences and opinions during caries laser treatment concludes that patients felt generally safe with laser and were able to relax during the treatment. A positive impression of the laser was described. Laser treatment was considered less painful.

3.2.3. Lasers and pulp tissue

One of the major drawbacks in the use of lasers in the treatment of dental hard tissue is the generation of heat which can cause thermal damage to the pulp. Increasing the normal temperature by more than 5.6° C is considered to be potentially aggressive for its vitality, while temperature rise by more than 16° C may lead to its complete necrosis (Zach & Cohen, 1965). While working with a laser one should keep in mind the relationship between the tissue temperature rise and the chosen working mode of the laser system, which includes a wavelength, pulse frequency and energy.

In vivo experiments were conducted by Kina et al. (2008) to compare the changes in the pulp-dentin complex in the preparation of Class I cavities – with conventional water-cooled turbines and Er: YAG laser. The results demonstrate the effectiveness of both systems, and yet in the turbine mill more disorganization was observed in the structure of the pulpal tissue. As regards both systems, no sensitive inflammatory changes in the pulp are reported. Yet, emphasis should be placed upon the correlation with the thickness of the remaining dentin.

Considering the thermal conductivity of dentin and the wide variety in size and density of human teeth, the clinician should evaluate each case very well in order to determine the exact time of exposure to radiation and avoid any negative effects on the soft tissues.

Future development of the treatment of pulp cells offers low level laser therapy (Low Level Laser Therapy - LLLT). Studies of Eduardo et al. (2008), being focused on the diode laser phototherapy with a wavelength of 660 nm, indicate a positive response in the differentiation and growth of the pulp stem cells, judging by their cellular mitochondrial activity. The possibility for pulp stem cells to be directed by lasers in their differentiation opens up a perspective in the therapeutic approaches to the treatment of dental pulp diseases (Georgiev & Stamatova, 2011).

Numerous studies have demonstrated the anti-inflammatory effect of low level laser therapy, but there has been no thorough researched as regards the way radiation regulates expression of inflammatory cytokines. To elucidate the mechanism of the anti-inflammatory effect of the low-level Nd: YAG laser, Shiba et al. (2009) examine the intracellular signaling pathways of the release of the inflammatory factor interleukin (IL) -6 in human pulp cells, stimulated with peptidoglycan (PGN). Under stressful stimuli, such as heat, osmotic shock, UV radiation or cytokines, a class of molecules is activated in pulp cells that are sensitive to them - p38 mitogen-activated protein kinases being also involved in the apoptosis process. Their release is stimulated by peptidoglycan which also increases the release of inflammatory factors IL- 6. Laser irradiation inhibits the effect of the PGN, and hence, in an indirect way, the activity of p38 mitogen-activated kinase. Thus, inhibition of IL-6 increase is achieved, which implies that low level lasers regulate the intracellular molecular interaction, and exert their anti-inflammatory effect thereby.

Penetration of bacteria into the pulp and colonization may occur for several reasons - the progress of carious lesions, trauma, reaching the pulp in the course of a dentis`s operation. It is believed that only about 50 bacterial species are responsible for the root canal infections, despite their wide variety in the oral microflora. *Enterococcus faecalis* has been isolated from the canals in 1/3 of all the cases of endodontic treatment failure (Arnabat et al. 2010). Disinfection of the root canal is the main and most responsible task in endodontic treatment. To this end, various chemical agents have been commonly employed in practice, such as sodium hypochlorite as well as ultrasonic waves. Present-day studies have reported successful application of laser systems in root canal medication. Nd:Yag, Er,Cr:YSGG, and Er:YAG lasers as well as diode lasers are pointed out as possessing similar properties (Eldeniz et al., 2007, Kuvvetli at al., 2009). In *in vitro* studies of Kuvvetli et al, 2009, a comparison is made between the effect of the diode laser, Er: YAG, and 5.25% sodium hypochlorite (NaOCl), being widely used in practice, on the strength of the antibacterial effect in the medication of contaminated root with lasers and classical chemical agents. Data is obtained for achieving the best antimicrobial effect with NaOCl, followed by the diode laser, and the Er: YAG laser is in third place. 5% sodium hypochlorite solution remains the means for disinfection of root canals with best bactericidal effect. Guidelines for the development of laser systems in terms of dental pulp stem aim its cells to differentiate and increase the regenerative possibilities.

The dimensions of laser systems development in terms of dental pulp are aimed at stimulating its stem cells to differentiate and increase its regenerative capacities.

3.2.4. Lasers and osseous tissue

Biostimulation by low level laser therapy helps to accelerate the healing of bone defects. Some of the effects are as follows: stimulation of perfusion in the exposed area, activation of osteoblasts, osteosynthesis, decreasing osteoclast activity, anti-inflammatory effect, modulation of the immune system and suppressing pain impulses (Nayer et al. 2009).

Collagen is an essential component of the extracellular matrix of the bone issue, and the increase in its amount can be achieved as a result of low level laser therapy. It is possible that the increase in the number of collagen fibers be implemented in the construction of new bone after mineralization of the collagen matrix.

Experimental studies *in vivo* of Rochkind et al. (2004) trace the process of bone healing in rats. Being with uniformly generated bone defects, the animals were divided into two groups - with naturally healing and laser radiated fractures. The results indicate that in the group subjected to LLLT a more mature ossification is observed significantly earlier, which has a denser trabecular network and enhanced collagen formation, as compared with the control group without LLLT. At the end of the healing process, there is no apparent difference between the two output groups to be observed.

It is appropriate that postoperative radiation therapy is implemented for the purposes of reduction and prevention of pathological processes in bones. The energy of the low-intensity laser is absorbed by the cell structures, and in activating the biochemical processes of the osteoblast nucleus, DNA – RNA – protein synthesis accelerates bone collagen organization. Mineralization is facilitated, being manifested in the enhanced bone healing (Rochkind et al. 2004).

Data obtained from *in vitro* studies of Obradović et al. (2009) on the osseointegration of biomaterials indicate a tendency to an increased cellular attachment to the material, proliferation, differentiation and production of TGF-β1. This is indicative of the ability of low level laser therapy to modulate the activity of cells and tissues surrounding the implant material.

Bone tissue is affected positively by low level laser therapy, and evidence for that is detectable at a both visible and subcellular level.

3.2.5. Lasers and periodontal complex

Ever since birth human oral cavity is colonized by microorganisms whose composition is enriched with age and constitutes the normal oral microflora. Oral cavity creates optimal conditions for the development of many types of microorganisms, due to the relatively constant temperature, pH and plenty of nutrients. Under certain conditions, however, they could trigger a series of pathological processes of microbial etiology.

Periodontal therapy has the primary objective of reducing as much as possible the periodontopathogenic bacteria in the gingival fluid as well as removing the supra- and subgingival calculus. There is a whole range of systems being applied to remove it – manual, mechanical, sonic, ultrasonic, and laser systems.

CO_2, Nd: YAG and Er: YAG laser systems belong to these which have been tested and introduced into clinical practice for the advantage of periodontology (Ivanova & Firkova 2007, Schwarz et al. 2005). The application of the first two systems results in a significant cement deterioration due to the impossibility of controlling the side-effects, such as thermal burns. Their implementation is limited to laser curettage of the periodontal pocket and use in the oral surgery (Ivanova & Firkova 2007).

Er: YAG has a promising potential in periodontology. Its wavelength of 2.94 nm provides an absorption peak of the wave in water. It is known that the bacterial biofilm, just as the supra- and subgingival concrements have a high water content. Irradiation with a wavelength of 2.94 nm has a bactericidal effect on periodontopathogenic bacteria because it destroys their lipopolysaccharides. It indicates a high potential of removing bacterial biofilm and tartar (Ivanova & Firkova 2007).

The results of non-surgical and surgical treatment with Er: YAG of periodontitis and peri-implantitis show a clinically significant improvement, by way of a pocket depth reduction in drilling, as a result of the improved epithelial attachment (Schwarz et al. 2005).

What should be taken into account in the instrumentation of the root surface is the influence of the laser beam on the pulp and periodontal tissue. The generation of heat in the pulp should be in the range of its physiological tolerance. The increase in intrapulpal temperature depends on both energetic characteristics of the laser beam and the thickness of the cement and dentine tissue, characteristics varing for each individual tooth. In using water-cooling in parallel with the laser treatment, an increase in the temperature of the root surface is observed from approximately 2 to 4 °C, and as to the pulp it is ranging from 0.8 ° C to 4-5.5 ° C, maximum temperature, depending on the specified energetic characteristics (Schröder 1992).

A system presents itself as an innovation to improve laser therapy. It feeds back selective information about the presence of subgingival calculus. The principle lies in the ability of certain bacterial metabolic products for fluorescence (Schwarz et al. 2005, Folwaczny et al. 2002). Due to this mechanism, it is possible to delicately differentiate between concretion and bone cement. The application of fluorescence -controlled Er: YAG irradiation is under investigation as a coadjuvant in cleaning up and smoothing the root surfaces. Interventions performed thereby were followed by investigation of the levels in the subgingival fluid – of the proinflammatory cytokines (interleukin 1β, TNFα), the total antioxidant status as well as the plaque index and the microbiological composition of the plaque. The outcome indicates that this type of therapy, as compared to the classical, results in the less intensive release of inflammatory factors, and delays the re-colonization of bacteria (Domínguez et al. 2010).

Microbial colonization is considered a major causal factor in the pathogenesis of implant-associated infection. The major role is performed by Anaerobic Gram-negative bacteria. Hence, a crucial step in the treatment of peri-implantitis infections proves to be the removal of bacterial deposits. In the course of development of lasers, various laser systems are being offered as alleged solutions for implant surface decontamination. Non-surgical treatment with an Er: YAG laser, used with a special nozzle, furnishes preliminary results for a successful removal of subgingival calculus without adverse thermal effects on titanium implants. One of the advantages of the system is the elimination of any risk of scratching the surface of the implant, which may be the result of using conventional tools, for example; while the rough surface of the implant retains more bacteria than a smooth surface. When handling, it is extremely important not to disturb the biocompatibility of titanium surface with osteoblasts and thereby slow down or halt the process of adoption of the implant. Studies with osteoblast-like cells (osteosarcoma SaOs-2 cells) conclude that there is no such danger (Schwarz et al. 2004).

In conclusion, Er: YAG laser can be successfully implemented and used as an alternative therapy in the treatment of periodontal diseases. Moreover, due to its gentle action to dental hard tissues, it has advantages for the patient over conventional instrumentation. Despite the convincing evidence obtained from experimental and clinical studies, there is a need for further research on the precise histological effects of laser on periodontal tissues.

3.2.6. Lasers and oral mucosa

Diseases of the oral mucosa are of diverse etiologies, but what they have in common is that they cause significant discomfort to the patients.The oral mucositis is a painful condition that can cause difficulties in eating, drinking and swallowing, and may also be associated with infections. Treatment for cancer, for example, often causes oral mucositis - severe ulcers in the mouth. The occurrence and severity of oral complications in patients with head and neck cancer undergoing radiotherapy can be decreased by the use of laser therapy as an adjuvant treatment for the control of oral complications (Oton-Leite et al. 2013; Worthington et al. 2011).

The pathogenic fungi of the genus Candida are among the common inhabitants of human skin and mucous membranes. Upon strong immune system suppression, they can cause candidiasis to the oral cavity, which is most often manifested in grey-yellowish deposits on the buccal mucosa and underlying tissue tenderness. In *in vitro* studies (Yan, 2007) on the influence upon the microorganisms of the genus *Candida tropicalis* by irradiation with an He-Ne laser, the results indicate not only a lack of any microbicidal effect, but also increasing in the biochemical activity of the microorganism as well as an upper threshold for stability to phenol toxicity, as compared to the parental strain.

Methicillin-resistant Staphylococcus aureus (MRSA) show dose-dependent sensitivity to blue light with a wavelength of 470 nm. At lower doses the bactericidal effect is more markedly perceptible, which implies the possibility for its application in the treatment of cutaneous and subcutaneous MRSA- infections (Enwemeka et al. 2009).

Due to the abundance of microorganisms being common inhabitants of the oral microflora, what should be taken into account is their ability for rapid mutations, which requires a more thorough study of the antimicrobial effect of lasers at different wavelengths, pulse frequency as well as level of energy and absorption.

4. CONCLUSIONS

Presently laser systems, being highly diverse in nature, are stirring up keen interest in medical circles as a means of prevention, therapy, physical therapy, surgery and relief in the postoperative period. They offer significant opportunities for improving the work quality, and thereby for improving the patients` quality of life. The range of procedures performed successfully with lasers on dental hard tissues is continuously expanding – from precise caries removal to taxidermy of teeth for artificial crowns. Dentin hypersensitivity in tooth necks can also be reduced. Teeth whitening and fluoridation are performed faster when they are laser photoactivated. Er: YAG laser assisted tartar removal is a successful alternative therapy in treating periodontal disease based on a gentle action to both dental hard tissues and dental implants. The dimensions of laser systems development in terms of dental pulp are aimed at stimulating its stem cells to differentiate and increase its regenerative capacities. Low intensity laser therapy has a marked anti-inflammatory and healing-stimulating effect and is used in the treatment of diseases of bone issue, dental pulp and oral mucosa.

In spite of the great expectations for their implementation in all areas of dentistry, the effects of lasers are still being researched. They have the potential to assert themselves as a better alternative to conventional therapies in the near future.

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