

THE USE OF FIDELIS LLL LASER IN EVERYDAY DENTAL PRACTICE

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ABSTRACT

Laser as a relatively newer modality in dentistry that provides opportunities for application of a wide range of dental procedures that constitute an integral part of everyday practice.

In this review we present applicative performances of combined Fidelis III laser.

This pulsing laser is composed by two sistem: erbium (Er:YAG) and neodimium (Nd:YAG) and they are used in different dental procedures, every day, as modern, precice, pain-less methodology.

Key words: *laser, Er: YAG - erbium: yttrium-aluminium-garnet, Nd: YAG - neodimium: yttrium-aluminium-garnet, laser irradiation, laser emission.*

The most common disease of human populations - caries (made destruction and demineralization of hard dental tissues), making defects that had to be fulfilled with artificially dental materials.^{1,2} In order to provide a functional and aesthetic restoration of these defects, more than 100 years ago - Black recommended rules and postulates under which caries-formed cavities are processed and prepared. Along with the technological progress of dental materials, since than until nowadays, these preparation techniques gradually had changed in order to respond to numerous modern challenges, but at the same time to compensate physiological and aesthetic standards, which have more importance for the patients.^{1,2,3}

In the sixties of the last century, Theodor Mainman had constructed the first prototype of laser with a synthetic rubine.⁴ Red light that emit this laser was 107 times stronger than sunlight, and the wavelength was almost single and parallel to the central axis.⁴ A year later NJR.Bennet and DR. Heriott elaborated the first laser based on helium and neon . This research was followed by a variety of researches and a lot of new laser systems using different media elements such argon, carbon dioxide, erbium, neodimium and others. In 1964 Stern and Sonnes treated caries using vaporization with red laser light and noticed that teeth treated with it were more resistant to soluble effect of acidic agents.⁴ In fact it is the first application performed with laser technology in restorative dentistry.

Combined laser Fidelis III with a wide range of options is used in everyday dental practice. As a medium this laser is using Erbium (Er) and Niodimium (Nd), which part will be activated primarily depends on the indicative areas and therapeutic purposes. In this following text are presented applicative performance of laser technology in everyday therapeutic dental procedures through mine research and experiences.

Preparation of cavities

For conventional techniques of preparations caries defects different borers are used, whose working parts can be made by different materials too (steel, diamond dust, karborundum etc).^{1,2,3,4} Treating caries-exposed hard dental tissues is the procedure followed by pain, pressure, discomfort, sound effect, removing healthy tooth substance, and potentially spreading infectious material in the

immediate proximity. With regard of the stress in patients cavity-preparations ranks high on the scale of unpleasant interventions as one of the most unpleasant therapeutic procedures.

In 1988 Hibstt Keller had created and used Er: YAG (erbium: yttrium-aluminum-garnet) laser with a single applicative order for preparation of hard dental tissues.⁵ The mechanism of action to this laser is based on the specific thermomechanical removal of caries process without warming for thermal damage of enamel and dentine and at the same time sterilization and bacterial destruction is performed through permanent vaporization of the intracellular fluid.^{4,5}

When preparations of caries defects is made by laser light, that intervention is without pain and pressure, with cutting out of hard dental tissues, patient discomfort is minimal and the use of anesthesia it is not necessary. Precise and direct contact with the target tissue is very important because caries is removed just from affected areas without possibility of involvement of healthy dental tissue and warming of the pulp with adequate working technique.^{4,5} During laser cavity-preparation positive effect is achieved in the context of conditioning and preparation of the enamel surface for further restoration with adhesive systems and composite resins, and also sterilization and obturation of dentine tubules is one of the advantages of this preparation.^{6,7,8,9}

Investigations that we implemented in order to compare conventional and laser methodology of preparation in favor of the implementation of the laser light, specifically pulsating ErCHDZAG laser, at all levels; in context of patient's discomfort, stress, painful sensations, pressure, thermal irritation, quality of angular closure and duration of definitive restorations. In the 30 respondents who have at least two teeth with caries defects we have realized conventional and laser caries rehabilitation. We have used pulsating ErCHDZAG laser whose beam is highly absorbed by Hydroxyl-apatite, with wavelength of 2940 nm which resonance absorbent minimum of water presented in the hard dental tissues, 5-30Hz frequency and pulse energy 150-350 MJ, followed by permanent cooling. After comparison of the time of preparations we have noticed that it takes slightly more time for the laser procedure. In order to the morphological characteristics of the walls and edges of cavities after laser treatment they were irregular, mostly narrowed with cone shape.^{10,11} Microretentional ability of this way prepared cavities is higher, and the angular closing for a period of 3 and 6 months in both of preparation types doesn't show significant differences. In regard of discomfort, most patients felt vibrations, micro explosions, but intense and unpleasant pain is not noticed.

Teeth Whitening

Sparkling white smile, beautiness and aesthetics teeth is an imperative among dentists and in human populations worldwide. Tendency towards bright and white teeth is a dream of everyone's vanity. Hardly anyone is satisfied with the shades and the color of their teeth, thus means that teeth whitening and lightening are hyper actual in everyday dental practice.

Procedures for whitening teeth in relation to the vitality of the pulp is classified into two categories: bleaching of vital and bleaching of avital teeth.^{12,13} In the preparates that are used for bleaching primary component is carbamide peroxide or hydrogen peroxide. The duration and how many treatments will be necessary for achieving the desired shade mostly depends of the (1) initial state, (2) the type of the asset which is used, (3) cooperation with the patient and (4) from the skills of the physician.^{14,15,16} Regardless of the solution you will use, it is necessary, the procedure to be repeated at least three times if you wish more intense white teeth. In order to achieve successful bleaching and ideal shade in relatively shortest period of time we had used Nd:YAG (neodmium: Dzttrium-aluminum-garnet) laser, where by a fiber - optic manual supplement through which emits laser irradiation accelerates the whitening and bleaching procedure. The application of a laser ray on dental crowns is implemented in a period of 10 seconds, the maximum instance is 30 seconds per tooth. Finally, the effect of laser bleaching is a maximum, and patients are satisfied and more self-confident.

Hypersensitive teeth

Intense hypersensitivity on dental surfaces, usually in the gingival third of the tooth crowns, is one of the most uncomfortable manifestations in the oral environment typical for all age groups, especially for elderly population.^{17,18,19} Therapeutic modalities are different: impregnating with fluoride preparations, application products for reducing sensitivity, dental adhesive, liquid composite and of course more recently laser therapy on these conditions. Respecting the application possibilities and positive effects of laser that performs obturation and obliteration of dentin tubules, accompanied by their disinfection and sterilization hypersensitivity on dental crowns nowadays all of these techniques should be past.^{20,21,22,23} Optical wrist extension pulsating laser is placed in the gingival third of the targeted teeth and it is moving along the surface in a period of 5 seconds. For a complete and qualitatively sustained effect on hypersensitivity surfaces with laser can be repited in a period of several days.²⁴

Endodontic therapy

Endodontic therapeutic procedure is a mixture of chronological exactly determined procedures that are implemented step by step. After setting correct and precise diagnosis of pulp disease, transitory accessions cavities are done for evacuation of the contents from the endodontic space. In the next stage is realized intracanalicular preparations followed by irrigation, important in two aspects: in this way canal space is shaped and sterilized and also gets proper form and shape for the next phase- adequate three-dimensional obturation of the canalicular system. Final procedure of each endodontic therapy is the restoration of the crown.²⁵

According to the indicative parameters endodontic therapy can be implemented on teeth with vital or avital pulp. In chronically infected root canals accompanied by periapical lesions special attention is given on intracanalicular preparations, sterilization and disinfection. Conventional methods and techniques, manual or mechanical are insufficient and can not always fully remove and eliminate infected dentin, debris and microorganisms.^{26,27} Furthermore the presence of smear layer along the canalicular system is a medium in which a lot of different microorganisms, organic substances and infectious material can be incorporated, and that itself complicates the procedure for their elimination, especially from the lateral dentine tubules where they are present and locked.^{28,29,30} During endodontic therapy of periapical lessions , in everyday practice we are faced with the limiting effect of medications and irrigation resources, their are limited in responses to the specific microorganisms.

Nd: YAG (neodymium-aluminium-garnet) laser is a new modality in endodontic therapy procedure that allows efficient sterilization and disinfection and removal of smear layer, confirmed by a lot of experts in Endodontics.^{30,31,32} Unlike the Er: YAG which is operating by vaporisation , neodymium has the ability to act on chromatofors (its activity demonstrates on colored materials, pigments and this feature is used in endodontic therapy).

The primary task of the laser in endodontic therapy is the elimination of micro-organisms in the canalicular system, most dominant focusing on infective material in the lateral dentin tubules, more precisely deep in them. Nd: YAG laser shows most efficient transmission and reduction of microorganisms and at a depth of 1000 micro meters, 85% of germs are eliminated.

Laser beam with its features (monochromocity, coherence and linearity), as well as the possibility of direct contact between the optical fiber and the target tissue, the laser emission energy demonstrate the wide field of sterilization and disinfection deep inside the dentin tubules.³³

In order to make evaluation of effectiveness and application characteristics of Nd: YAG laser in clinical practice, in 40 patients with diagnosed periapical pathological changes from acute or chronic character in the stage of exacerbation, we made treatment in the context of conservative therapy. Adequate radiological changes and absence of clinical symptomatology was subject of examination in a period of 12 months after the treatment.

Because of the acute symptoms in the first session trepanation, elimination of the channel content and drainage were conducted at almost all patients. In the next stage, after intracanalicular preparations with manual instruments, that was accompanied by hypochlorite irrigation of the canalicular system, then canals had been dried and all of this was followed by laser therapy with Nd: YAG fiber -optic manual plugin.

Emission of laser beam in each channel is implemented in three sessions of 5 seconds. Nd: YAG laser in endodontic therapy is used With these following parameters: wavelength of 1064 nanometers, energy 0.25 W, impulse frequency 10-100 HZ range of impulse VSP Mode: 100 ms, but the variations in energy and frequency is dictated by the therapist based on individual assessment. After canal sterilization made by laser irradiation we obturated with definitive filling - AH plus or Fuji I-GC termafill gutaperca technique. Control radiographs were taken before treatment, immediately after completion of the treatment and after 3, 6, and 12 months. In the following photographs one part of the samples treated with Nd: YAG laser are presented, and situation of the periapical tissue and radiolucency after a certain time interval can be seen.

Conducted investigations does not show that Nd: YAG laser is more effective in the treatment of chronically infected root canals and periapical lesions. Using laser treatment sterilization the endodontic treatment was quicker, which is a positive situation for both the patient and therapist. Laser therapy reduces subjective symptoms and calms down the clinical manifestation and most importantly patients during therapy will not fill pain and any discomfort.

Laser as a relatively newer modality in dentistry that provides opportunities for application of a wide range of dental procedures that constitute an integral part of everyday practice. A superior dental therapy is achieved with it, thus minimizing side effects and risks of traditional dental methods. Application of laser irradiation in a numerous routine and non-routine dental procedures actually represents the incorporation and implementation of contemporary, modern and precise technology in clinical practice.

References

1. Matovska Q. Kariologija I del - Sigmapres, Skopje 2001
2. BotuĖanov P., Vladimirov S., Ivanova Z. Kariesologi® i operativno z†bole~enie AvtoSpektar Plovdiv 2000
3. Karadzov O., Kezele D., Kuburoviĉ D., Markoviĉ D. Preparacija kaviteta Deĉje novine Beograd 1989
4. TodeaLC.D. M. Laser applications in conservative dentistry TMJ 2004, Vol. 54, No. 4K
5. Beroccall I.M., Gonzalez J. M., Rodrigues M.D., Carriches C.L Sterilizing effects of the Erbium:Yag laser upon dental structures: An in vitro study Med Oral Patol Oral Cir Bucal 2006; 11:E 158-61
6. Aoki A., Ishikawa I., Yamadal T., Otsukil M., Watanabe H., Tagamil J., Ando Y., Yamamoto H. Comparison between Er:YAG Laser and conventional technique for root caries treatment in vitro J Dent Res1998 77(6): 1404-1414
7. Rohanizadehl R., LeGeros R.Z., Fan D., Jean A., Daculsil G. Ultrastructural properties of laser-irradiated and heat-treated dentin J Dent Res 1999 78(12): 1829-1835
8. Visuril S.R., Gilbert J.L., Wright D.D., Wigdor H.A., Walsh J.T. Shear strength of composite bonded to Er:YAG laser-prepared dentinPDent Res1996,r 75(1): 599-605 tion
9. Ceballos L, Toledano M., Osorio R., Tay F.R. Marshall G.W. Bonding to Er-YAG-laser treated dentin J Dent Res 2002, 81(2):119-122
10. Ronald E. Goldstein, Alternatives to Conventional Tooth Preparation (Including Air Abrasion and Lasers) Contemporary Esthetics and Restorative Practice 2004
11. Hossain Y.Y.M., Suzuki B.D.S., Kinoshita J.I., Nakamura Y., Matsumoto K. Removal of carious dentin by Er:YAG laser irradiation with and without Carisolv™ Journal of Clinical Laser Medicine & Surgery 2001 Vo 19, Number 3:127-131

12. Greenwall L. Bleaching techniques in restorative dentistry - book 2001 .
13. Buchalla W- External bleaching with activation by heat, light or laser Dent. Mater. 2007
14. Haywood V. Tooth dehydration and laser tooth whitening J.Esthet.Rest.Dent.2008
15. Sulieman M - Surface and pulp chamber temperature rises during bleaching using a diode laser Br. Dent J 2006
16. Tam L. - Effect of potassium nitrate and fluoride on bleaching Quintessence Int. 2001 11
17. Holland GR, Narhi MN, Addy M, Gangarosa L, Orchardson R. Guidelines for the design and conduct of clinical trials on dentine hypersensitivity. Journal of Clinical Periodontology 1997;24:808–13.
18. Prati C, Pervellati F, Sanasi V, Montebugnoli L. Treatment of cervical dentin hypersensitivity with resin adhesives: 4- week evaluation. American journal of Dentistry 2001;14:378–82.
19. Pashley H. D. Dentin hypersensitivity AEGIS publications 2008
20. Wigdor H. Patients' perception of lasers in dentistry. Lasers in Surgery and Medicine 1997; 20: 47–50.
21. Walsh L.J. The current status of low level laser therapy in dentistry. Part 2. Hard tissue applications Australian Dental Journal 1997; 42:5.
22. Kimura Y, Wilder-smith P, Yonaga K, Matsumoto K. Treatment of dentinal hypersensitivity by lasers: a review. Journal of Clinical Periodontology 2000; 27: 715–21.
23. Corona SA, Nascimmento TN, Catirso ABE, Lizarelli RFZ, Dinelli W, Palma-Dibb RG. Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity. Journal of Oral Rehabilitation 2003; 30: 1183–9
24. Duran I, Sengun A. The long-term effectiveness of five current desensitizing products on cervical dentine sensitivity. Journal of Oral Rehabilitation 2004; 31: 351–6.
25. Matovska Q. Endodonticija del. Sigmapres, Skopje 2002
26. Gutknecht N. Lasers in Endodontics Journal of the Laser and Health Academy 2008; No.4/1;
27. Walker M. The beneficial applications of low level laser therapy 2002
28. Gorgul G., Kivanc B., Maden M., Ulusoy O.I.A., Tinaz A.C. Effects of Nd: YAG laser irradiation on the adaptation of composite resins to root dentin Journal of Contemporary Dental Practice, 2005 Vol 6, No. 4, November 15
29. Madura H, Dzabrowski M., Dulski R., Żmuda S. Zaborowski P. Thermographic method for evaluation of thermal influence of Nd:YAG laser on a tooth root during sterilization process Infrared Physics & Technology 46 (2004) 167–171 12
30. Souza F.D., Pécora J.D., Silva R.G. The effect on coronal leakage of liquid adhesive application over root fillings after smear layer removal with EDTA or Er: YAG laser. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005; 99 (1): 125-8.
31. Wang X., Sun Y., Kimura Y., Kinoshita J. I., Ishizaki N.T., Matsumoto K. Effects of diode laser irradiation on smear layer removal from root canal walls and apical leakage after obturation. Photomedicine and Laser Surgery 2005; 23(6): 575-581.
32. Araki A.T., Ibraki Y., Kawakami T., Lage-Marquez Er:YAG laser irradiation of the microbiological apical biofilm Braz Dent J (2006) 17(4): 296-299
33. Gurbuz T., Ozdemir Y., Kara N., Zehir C., Kurudirek M. Evaluation of root canal dentin after Nd:YAG laser irradiation and treatment with five different irrigation solutions: A preliminary study J of Endod 2008 Vol 34, Issue 3, Pages 318-321
34. Midda M. Lasers in periodontics. Periodontal Clin Investig. 1992;14(1):14-20.
35. Aoki A, Sasaki KM, Watanabe H., Ihikawa I. Lasers in nonsurgical periodontal therapy. Periodontology 2000, Vol. 36, 2004, 59–97
36. Ishikawa I, Aoki A, Takasaki AA, Mizutani K, Sasaki KM, Izumi Y. Application of lasers in periodontics: True innovation or myth? Periodontology 2000.2009;50:90–126.