Case Report

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Er:YAG and Diode Lasers in Treatment of Peri-Implantitis–A Case Report

Dentistry Section

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ABSTRACT

One of the leading causes of dental implant loss in the present time is peri-implantitis. This paper describes a clinical case of peri-implantitis treatment using Er:YAG and a 980-nm diode laser. In the present case report, it is explained how to use these two different wavelengths on soft tissue and on the implant surface. The use of diode and Er:YAG lasers allows the removal of inflamed tissue and the bacterial biofilm from the implant surface which results in bone regeneration/reparation in the peri-implant area. In the present report, it is recommended using Er:YAG and diode lasers at 2W power to be used in the therapy of peri-implantitis.

Keywords: Bone loss, Dental implants, Peri-mucositis, Titanium, Wavelength

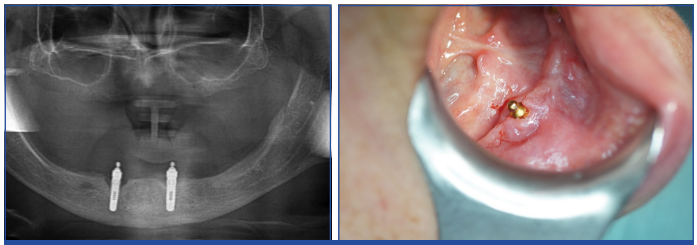
CASE REPORT

A 65-year-old female patient wearing an overdenture supported on two dental implants, was referred to our dental office (AN Private Practice) from a general dentist to treat inflammation around the implant in the right anterior side of the mandible. The dental implants were placed four years ago and loaded two months post implant insertion. The symptoms presented to us were inflammation and pain during chewing around right abutment which was recorded by the patient three months before seeking treatment.

Medical history revealed that she suffered from hypertension which were all under medical control. In addition, she had no other systemic diseases, was non-smoker and did not use any anti-inflammatory drugs and antibiotics in the previous 24 months.

The intraoral examination revealed partially unscrewed right ball type abutment and peri-mucositis. The soft tissue around the left abutment was without any visual signs of inflammation however, in OPG (orthopantomogram) bone loss at the level of first implant thread was discovered. Prior to treatment, the peri-implant pocket depth was measured utilising a periodontal probe and amounted to 6 mm with bleeding on probing on the right implant while the probing depth around the left implant amounted to 4 mm without bleeding on probing.

After the intraoral examination OPG (Kodak 9000 3D, Carestream/Trophy, Marne-la-Vallée, France) was done and evaluated In OPG examination it was found that there was bone loss of 4 mm and 2 mm in height around right and left implant in mandible, respectively [Table/Fig-1,2].



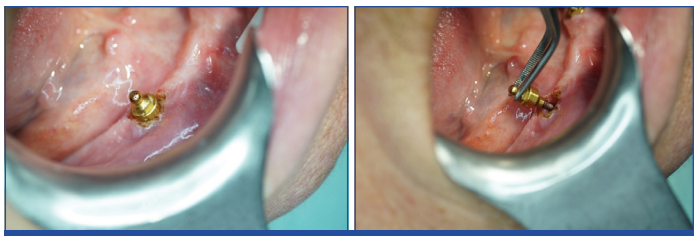
[Table/Fig-1]: Radiography examination of the implant with the ball abutment in position 43 (FDI classification). **[Table/Fig-2]:** Intraoral view of the ball abutment of the implant in position 43 (FDI classification). (Images from left to right)

The patient signed an informed written consent form before the treatment.

A combination of two wavelengths of 980-nm (SmartM, Lasotronix, Poland) and 2940-nm (LiteTouch, Light Instruments, Israel) was applied to remove inflammation and to decontaminate the titanium surface of the implant [Table/Fig-3]. The combination of the advantages of diode laser with a wavelength of 980-nm, which is well absorbed by haemoglobin and melanin and that of Er:YAG laser (2940-nm) with the highest absorbance coefficient in water allows us to perform the soft and hard tissue surgery in maximum efficient manner [1,2].

In the first stage of this therapy, the inflammed peri-implant soft tissue was vaporised under local infiltrative anaesthesia with articaine hydrochloride 4% plus epinephrine 1:200000 (Ubistesin®, 3M, USA) with the diode laser operated at following set parameters; power: 2W in contact mode, Continuous Wave (CW), distance: 0 mm, power density: 12700 W/cm^2, tip angle set at 90°, fiber: 200µm, without cooling. The operator was removing the soft tissue with a glass fiber placed parallelly to the implant axis. Next, the ball type fixture was unscrewed by using the appropriate screwdriver and a hand ratchet [Table/Fig-4-6].

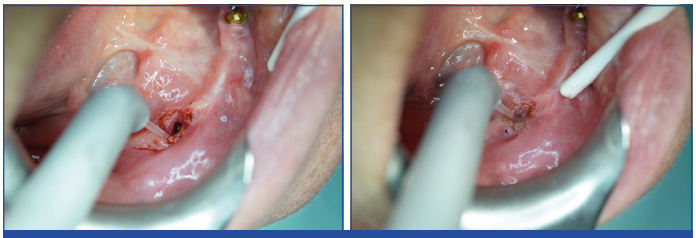
[Table/Fig-3]: The lasers used in the treatment: a) Er:YAG laser (Litetouch, Light Instruments, Israel); b) Diode laser (SmartM, Lasotronix, Poland).
[Table/Fig-4]: Inflammation of the soft tissue vaporised using 980-nm diode laser. (Images from left to right)



[Table/Fig-5]: The soft tissue removed by the diode laser; **[Table/Fig-6]:** View of the unscrew ball abutment. (Images from left to right)

In the second stage of treatment the implant surface was debrided by means of Er:YAG laser (LightTouch, Syneron, Israel) with the following set parameters; operation mode for Soft Tissues (ST), energy: 100 mJ, frequency: 20 Hz, energy density per pulse: 12.73 J/cm^2, water spray cooling: 30 mL/min, tip angle set at 10°, size of the tip: 1.0×17 mm, distance: 0 mm (in contact mode), time of irradiation: 60 seconds. Laser parameters were described following the previous paper published in JCDR by Matys J et al., [3].

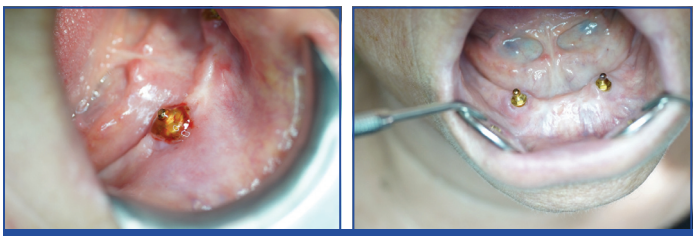
Debridement of the peri-implant pocket and the implant surface was conducted by moving the sapphire tip of Er:YAG laser around the implant. During this process as a result of a photoacoustic phenomenon, the bubble flow continues and was visible [Table/Fig-7,8].



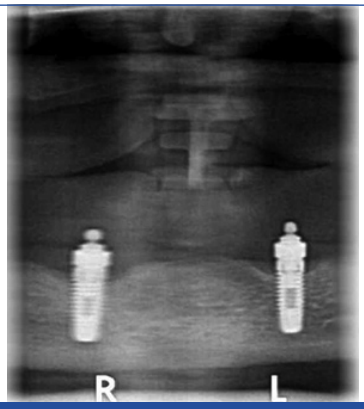
[Table/Fig-7]: Debridement of the peri-implant pocket and the implant surface using Er:YAGLiteTouch™ laser. **[Table/Fig-8]:** The bubbles flow evoked by Er:YAGLiteTouch™ laser (photoacoustic effect). (Images from left to right)

In the final stage, the ball type fixture was screwed back on to the implant and 0.2% chlorhexidine (PerioKIN, Labolatorios KIN, Espana) gel was applied to the periodontal pocket. [Table/Fig-9]. The lower denture was loaded immediately after the surgery without relining.

Dual laser wavelength application resulted in obtaining proper healing of the peri-implant soft tissue and regeneration of the peri-implant bone after two weeks and six months, respectively [Table/Fig-10,11].



[Table/Fig-9]: View of the 0.2% chlorhexidine gel applied to the periodontal pocket. **[Table/Fig-10]:** View of the impression tray with implant analogs. (Image from left to right)



[Table/Fig-11]: Six-months follow-up radiography examination of the implant in position 43 revealed regeneration of the peri-implant bone.

DISCUSSION

Replacement of missing teeth has became a standard procedure in modern day dentistry. However, the growing number of implants placed every year by inexperienced dentists has a significant affect on the increased rate of treatment failures. Many clinical studies revealed that despite a proper implant osseointegration and appropriate patients hygiene regime, peri-implantitis rate ranged from 11.3 to 47.1% [4]. Roos-Jansåker AM indicates that after 9 to 14 years post-implant installation, peri-implant lesions are a common clinical entity [4]. Peri-implantitis is a common cause of implant loss which has some resemblance to periodontitis. Although, there are some exceptions which require the use of a different treatment technique. The connective tissue in a peri-implant area has an extension of crevicular epithelial cells, different arrangement, number of fibers and diminished blood supply in contrast to a healthy periodontium. Furthermore, nearby the implant there is neither periodontium nor cementum [5]. The intricate architecture of an implant surface causes performing a decontamination protocol difficult. Hence, traditional instruments such as curettes and scalers are inadequate to debride an implant surface [4]. The above mentioned studies indicate that both clinicians and researchers should pay particular attention to practical discerning methods of peri-implantitis treatment using modern dental technologies.

Nowadays, the use of various laser wavelengths in implant dentistry has become not only more popular but an obtainable method of treatment by practitioners around the world. In implantology, lasers are used for implant uncovering [5,6], ridge splitting [7], sinus floor elevation [8] and implant insertion [9]. However, utilizing the high power laser systems evoking an increase in the temperature of treated tissues requires establishing proper laser parameters and a treatment protocol which determines safety and predictability of a surgical site healing [10].

A key point in a long-term survival rate of dental implants is to emphasize on maintaining sufficient oral hygiene. However, a significant issue arises when peri-implantitis or peri-mucositis occur an the failure to eliminate bacterial biofilm from forming in the inflamed pockets [11,12]. The inordinate rise of the implant temperature, induced by laser application, may result in irreversible changes of the bone tissue [7]. Therefore, Matys J et al., stated that before the treatment of peri-implantitis, proper (safe) laser parameters should be chosen, depending on the implant titanium grade and their diameter [13].

Schwarz F et al., assessed the clinical effect of a 2940-nm laser at 1W (100mJ, 10 Hz) and plastic curettes with rinsing with CHX 0.2% during non-surgical therapy of peri-implantitis [14]. They obtained a significant improvement of (PI=Plaque Index, BOP=Bleeding On Probing, PD=Probing Depth, GR=Gingival Recession, CAL=Clinical Attachment Level) six month after therapy in both groups [14]. However, a significantly higher reduction of BOP (52%) in contrast to mechanotherapy (22%) was found for Er:YAG laser after six-month follow-up [14].

In different studies published by a group of Schwarz F et al., confirmed a 94.2% efficiency of Er:YAG laser application in residual plaque biofilm eradication at a fluence of 12.7 J/cm^2 (100 mJ, 10 Hz) [15]. These results of laser parameters are in accordance with recommendations of Matys J et al., [13].

Also, the wavelength (absorption coefficient in water or/and haemoglobin) of laser influence the safeness of this therapy [13]. The combination of advantages of a diode laser with a wavelength of 980-nm, which is well absorbed by haemoglobin and melanin (soft tissues) or the Er:YAG laser (2940-nm) with the highest absorbance coefficient in water (soft and hard tissues) allows to perform the surgery in soft and hard tissues in maximal effective manner [2,13]. This clinical report describes the effectiveness and safeness both 980-nm and 2940-nm wavelengths at 2W produce. The power setting used in this paper was 2-fold higher than recommended in some other studies [13,15]. However, these studies were conducted in an ex-vivo model, where the rise of temperature in the bone is higher because of a lack of blood perfusion [13,15]. The circulation of the blood in the vital tissue allows reducing a thermal relaxation time of irradiated tissues. Therefore, irradiation of a peri-implant area by using Er:YAG and 980-nm diode laser resulted in a minimal risk of a bone overheating.

Particular attention should be paid to prevent overheating of the bone when applying lasers in peri-implantitis. It was proven that Er:YAG lasers resulted in a smaller rise in tissue temperature than diode, CO2, Nd:YAG lasers [2]. The potential of different laser wavelenghts to decontaminate titanium implant surfaces was verified by various studies included besides by one using Nd:YAG laser [2]. Moreover, Er:YAG laser seems to be more effective in removing calcified deposits than a diode laser which is usually suggested only

as supplementary treatment instruments for conventional scaling and debridement [2]. Both, Er:YAG and diode lasers do not cause surface changes of titanium even at the high energy level [2].

It should be highlighted that the role of Er:YAG in maintaining proper clinical attachment level at the implant area is underrated. This system was proven to perform almost 100% efficiency in the eradication of any bacteria on the rough titanium surface [15]. Due to the irregular surface topography of the titanium implant surface, trying to clean it by using conventional methods is inappropriate. Er:YAG laser can kill bacteria by increasing temperature of the water inside these organisms evoking vaporisation and destruction of the irradiated cells.

Further randomised control clinical trials should be conducted to assess the effectiveness of a diode and Er:YAG lasers during one- and two-piece dental implants, as well as to analyse increases in implant temperature in vivo.

CONCLUSION

The use of the diode 980-nm and Er:YAG is effective and safe in the therapy of peri-implantitis. We recommend using Er:YAG laser at 100 mJ, 20 Hz, 2W in a pulsed-wave mode for debridement of a peri-implant zone and 980-nm diode laser for soft tissue vaporisation at 2W.

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