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The Use Of The Erbium: Yttrium-Aluminium-Garnet (2940nm) Laser In The Second Phase Of Implant Surgery

Seda Ozturan

Biruni University, Faculty of Dentistry, Department of Periodontology, Topkapı 34010, Istanbul, Turkey.
Tel: +90-212-444 8 276
Fax: +90-212-416 46 46
E-mail: sozturan@biruni.edu.tr

Abstract
The use of surgical lasers has been advocated to aid in the placement and second stage recovery of dental implants, together with soft tissue contouring. Although the second stage is comparatively less aggressive for the patient, postoperative pain and swelling can be further reduced by the use of laser instead of a scalpel. In this article, erbium:yttrium–aluminum–garnet (Er:YAG) laser was used to remove the soft tissue covering the implants in second-stage implant surgery. Er:YAG laser minimized postoperative pain, and the time to prosthetic rehabilitation was also shortened. The esthetic results were far superior, and no complications were recorded.

Key words: Laser, Oral surgery, Implant dentistry

Introduction

Osseo-integration dental implants have become a routinely recommended procedure in the clinical practice of dentistry (1-4), and have been utilized as a successful treatment modality over three decades, with a reported success rate of greater than 90% 5-7,8. The predictability and success of dental implants has secured their place as a standard treatment modality. Based on laser-tissue interaction characteristics, lasers are suitable for the second stage recovery of implants, provided care is exercised to avoid contact with the implant body (Figs 1-4). Using the Er:YAG laser represents several advantages vs. conventional treatment methods, and there are minimal post-operative complications coupled with a high rate of success. The ablation of soft tissue leads to precise and predictable healing and often this procedure can be carried out without anaesthesia.
The Erbium :YAG is one of the most appropriate laser in removing gingival tissue overlying the implant cover screw. The Erbium's energy is highly absorbed in the water component of

dental tissue and provides efficient ablation without the risk of significant thermal damage (1). The prime advantages of laser use in this procedure would be less bleeding, facilitating easier visual access to the cover screw, production of a protective coagulum as an aid to healing and patient comfort during and after treatment. Lasers such as the erbium:yttrium–aluminum–garnet (Er:YAG) and erbium, chromium:yttrium–scandium–gallium–garnet (Er,Cr: YSGG) are able to section both hard and soft tissues, as a result of the interaction between the laser energy and water spray. The action mechanism is based on the heat produced when this energy is absorbed by the tissue. These characteristics could constitute a clear advantage in second-stage implant surgery. However, in oral implantology, an uncontrolled increase in peri-implant bone temperature could have deleterious effects and alter implant osseo-integration. Eriksson and Albrektsson demon strated that a temperature of over 47°C for 1 min causes irreversible bone damage. Accordingly, an increase of only 10°C above physiological body temperature (37°C) is sufficient to produce irreversible bone damage. This is therefore regarded as the limiting value that must not be exceeded when lasers are applied to implants. The Er:YAG laser also has been proposed by other authors for use in second-stage oral implant surgery (4-6). This pulsed laser has a negligible thermal effect and allows precise sectioning of both hard and soft tissues around the implant sealing plug, without altering its structure or affecting osseo-integration. In this case-report study, Er:YAG laser was used to remove the soft tissue covering the implants, to create an under dimensioned operculum and for subsequent positioning of the healing screw.

Case description

45 years old male patient referred to our clinic for dental examination, presents to our observation with a missing tooth (45-46 teeth sides). After Examination, sufficient amount of bone loss was detected for implant theraphy. After X-ray observation (OPG), in accordance with the patient, we proceeded to the endosseous implant positioning (Bredent) in crestal position.

During the following months, one more intraoral X-ray investigations were performed. After 3 months we proceeded to the second step. The implants were fully covered with soft tissue and removal of the soft tissues was necessary. Er:YAG laser with 200 mj, 15 Hz, W/A: %10, %10, average power 3 W parameters was used to remove the soft tissue covering the implants for to ensure better postoperative and clinical outcomes. Local anaesthesia was not used, either by infiltration or superficial. The patient didn’t report any pain during the intervention and the less bleeding observed during all the procedure. After the creation of the operculum was finished, ginigival tissues around implant margins were reshaped with laser. The cover screw was removed and the healing one was positioned. During the following days the patient didn’t complain of any problem during alimentation and self-cleaning procedures.

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Figure 1. Occlusal view of second stage surgery side

Figure 2. Implant cover screw access obtained using Er:YAG laser

Figure 3. Occlusal post-operative view after Erbium laser operculisation: poor bleeding, good marginal precision and little underdimensioning of the operculum

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Figure 4. Positioning of the healing screws for tissue conditioning: the presence of poor bleeding can be easily manage by using an adequate screw diameter

Discussion

After introduction of laser technology in dental practice, its use in oral surgery has been fully consolidated, with demonstrated advantages over traditional techniques. However, laser application in certain areas, including implantology, has not yet been fully investigated.

In implant surgery, and particularly in second-stage surgical interventions, the use of the different laser systems has been the center of intense debate. Romanos et al. (7), on evaluating the effects of the Nd:YAG laser on three titanium discs subjected to different treatments, observed severe structural damage in all cases, with fusion, porosity, microfractures and cratering even at the minimum power settings. They therefore concluded that this laser is clearly contraindicated in procedures of this kind.

As a result of some studies, CO2 laser systems with controlled power settings of between 1.0 W and 2.0 W did not seem to induce morphological changes in the surfaces studied. The authors reported that both the CO2 laser and the Er:YAG laser can be used at limited power settings, and that the gallium–aluminum–arsenide (GaAlAs) diode laser (809 nm) does not produce structural damage to the surface of the implant (6, 8-11). In a subsequent study these same authors carried out a more detailed examination of the thermal effect of the Er:YAG laser at the bone–implant interface during simulated decontamination of three different types of implant surfaces. They concluded that this laser does not generate excessive heat in peri-implant tissue and therefore its clinical use is safe (6). Likewise, Arnabat-Dominguez et al. (5) published a clinical study on the application of the Er:YAG laser in second-stage implant surgery, observing many advantages with respect to the conventional technique.

High affinity for the water inside the soft tissues and, therefore, high cutting efficiency, photoablative and photoacoustic effects together, safety, because of small possibility of implant and surrounding tissues overheating, no side effects on fixture’s surface due to the total reflection phenomenon, fast

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and predictable healing process, the possibility to easily remove the bone grown over implants, due to the hidroxyapatite affinity, rapidity during surgery are advantages of Er:YAG lasers (1). Moreover, their biostimulating and biomodulating capabilities can improve the speed and the quality of tissue healing process and the conditioning of the tissues before the prosthetic rehabilitation, as well as reduce the need for anaesthesia. The procedures seem to be comfortable for the patients, manageable for the operators, fast and with few contraindications.

Conclusions

In our case report, Er:YAG laser demonstrated a good clinical performance to remove the soft tissue covering the implants during the second step in implantology. Many scientific studies demonstrated the capability of biostimulation and decontamination of these lasers, and therefore the important role in obtaining a good result for the final rehabilitation. Consequently, we conclude that this laser system can be used with the above specifications in second-stage implant surgery for the contouring of periimplant tissue because of the fast cutting execution, implant and tissue safety, patient comfort and very short healing time.

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Conflict of interest: The authors declare no conflict of interest related to this study.

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