# Er,Cr:YSGG laser assisted GTR in periodontal surgery

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## _Abstract

*Objectives:* This case report describes the application of an Er,C;YSGG laser in regenerative periodontal surgical therapy.

*Materials and methods:* A patient with extensive periodontal tissue breakdown is treated with an Er,Cr:YSGG laser for granulation tissue removal, bone decorticalization and root decontamination. In the regenerative procedure demineralised bovine bone mineral and collagen membranes were used. Following clinical parameters were recorded at baseline, at 3 months, 6 months, 1year, and at 2 years and 5 years: Plaque Index (PI), Bleeding On Probing (BOP), Periodontal Pocket Probing Depth (PPD), Recession (REC), Clinical Attachment Level (CAL).

*Results:* The operated sites demonstrated uneventful healing. Radiographically remineralisation was observed at six months. At one year follow up, significant periodontal pocket reductions and clinical attachment level gains were registered.

*Conclusion:* In this case reports it may be acknowledged that the Er,Cr:YSGG laser could be applied for debridement and decontamination of both the root and the bone defect in guided tissue regeneration procedures. Further investigation is needed to identify in which treatment protocol in periodontology the Er,Cr:YSGG laser can be integrated and with what benefits.


## _Background

The application of laser in periodontology is widely discussed especially as the several laser systems with their specific wavelength have a different impact on periodontal tissues. Excellent knowledge of laser applications is essential, which requires the operator to go through a learning curve to avoid adverse effects. During laser irradiation the power settings play a significant role and must be regulated appropriately in order to avoid detrimental effects to the irradiated tissues (Ishikawa I. 2002). Periodontal tissue destruction is treated according to the type of defect and the location, posterior or an-


Fig. 1


Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6


Fig. 7


Fig. 8


Fig. 9

terior, in the mouth. Regenerative therapy is indicated in case of intraosseous defects of which the radiographic angle and number of walls determine which kind of procedure needs to be applied and which kind of materials need to be used. The difficulty of guided tissue regeneration and other treatments of the periodontium lies in the fact that we are dealing with roots, which have an avascular surface in which, both the multiple specialized celltypes and the microbial environment are involved in all healing processes.

## _Materials and methods

The Er,Cr:YSGG laser (Biolase Inc. San Clemente, CA) with a 2,780 nm wavelength, in the far-infrared spectrum, is a class 4 laser, with a pulse repetition rate of 10 Hz to 50 Hz and power output from 0.25 to 8 Watt, and pulse energy of 300 mJ. The flexible optical trunk fibre is connected to a straight or angled hand piece. The laser beam is accompanied by a water and air spray. The water/air spray represents a hydrating and cooling agent reducing thermal effects. Both Air and Water settings can be modified from 0-100 %. Radiation of the Er,Cr:YSGG laser is absorbed mainly by water and calcium hydroxyapatite. With a pulse duration of 90 or 150 µsec the Er,Cr:YSGG laser has a high ablation efficiency and low thermal impact on the surrounding tissues (Straßl, 2004) "Comparison of the emission characteristics of three Erbium laser systems—a physicals case report." (JOLA 2004).

A 44 year, female, with incidental, severe adult periodontitis (Vd Velden U., 2005). As far as medical conditions and life style concerned: the patient was negative for tobacco but she suffered from severe II grade obesity (BMI 35–39.9) and stress. Family history resulted positive for periodontitis. Intraoral exams (Fig. 1) demonstrated the central upper left incisor with extensive bone-loss on the distal, resulting in a black triangle at the soft tissue out-


Fig. 10


Fig. 11


Fig. 12

| mesial | baseline | 12 mnts | 24 mnts | 60 mnts |
|---|---|---|---|---|
| PPD | 3 mm | 3 mm | 4 mm | 3mm |
| REC | 0 mm | 1 mm | 0 mm | 1 mm |
| CAL | 3 mm | 4 mm | 4 mm | 4 mm |

**Tab. 1**

| buccal | baseline | 12 mnts | 24 mnts | 60 mnts |
|---|---|---|---|---|
| PPD | 7 mm | 2 mm | 2 mm | 2 mm |
| REC | 3 mm | 2 mm | 2 mm | 2 mm |
| CAL | 10 mm | 4 mm | 4 mm | 4 mm |

**Tab. 2**

line. Second grade mobility, probably due to occlusal trauma was evident. Periodontal pocket probing depths were buccal 7 mm (Fig. 2), distal 9 mm (Fig. 3), mesial 3 mm and lingual 3 mm.

The plaque index (PI) and bleeding on probing (BOP) < 15 % and the patient demonstrated high standards of oral hygiene. Radiographic exams (Fig. 4) showed a vital tooth with a normal root length. A wide angled non supportive bone defect was present at the distal side of the root.

Follow up was monitored with radiographs, with BOP- and PI-indexes and PPD, REC, CAL were registered. The occlusion was corrected by elimination of the pre-contact, no splint was placed.

After infiltration anaesthetics, the soft tissue incisions are made with a by Takei in 1995 proposed papilla preserve technique reflecting the lingual papilla to the buccal. The laser's angled handpiece mounts a chisel shaped tip, with which in contact mode the flapdesign is made. Laser power settings on 2.0 Watt, 30 % Air, 10 % Water, and 30 Hz.



Fig. 13



Fig. 14

Granulation tissues were removed (Fig. 5) with laser power settings on 2,5 Watt, 40 % Air, 20 % Water, and 25 Hz. Root-conditioning (Fig. 6) is performed holding the tip in a 1,5–2 mm distance from the root, in overlapping vertical and horizontal strokes, until the root-surface has a whitish etched aspect, with laser settings 1,5 Watt, 30 % Air, 20 % Water, and 20 Hz. The wide non-sustaining defect (Fig.7) was filled with the demineralised bovine bone mineral (Fig.8) to avoid collapse of the soft tissue into the defect. The bone substitute (Bio-Oss, Geistlich Biomaterials) was then covered with a resorbable collagen membrane (Bio-Gide, Geistlich Biomaterials) to avoid fibroblast in-growth. After releasing the buccal flap, the papilla is repositioned and sutures are placed and the wound is perfectly closed without tension. Patient received post-operative instructions.

## _Results

Initial healing was uneventful although the tooth demonstrated I-grade mobility, which diminished in the first three months to zero. After two weeks sutures were removed and oral hygiene was resumed with brushing carefully the operated site. At six months remineralisation of the defect was evident on radiographic exam (Fig. 9). At one year significant CAL gains have been found, both on the buccal as on the distal. To further close the black triangle a composite filling was made on the mesial side of tooth 22 (Fig.10). The PPD on the buccal went from 7 mm at baseline to 2 mm and had a CAL-gain of 6 mm which remained stable (Fig.11). The PPD on the distal went from 9 mm to 4 mm in the first 12 months (Fig.12). and measured at 60 months 3 mm (Fig.13), with a final CAL-gain of 9 mm Radiographic follow-up showed regular alveolar bone outline with lamina dura at 60 months (Fig.14).

## _Discussion

According to evidence based therapy, a combination of barrier membranes and bone substitutes, is a standardized approach to treat wide non supportive bone defects (Camelo M. 1998). To be able to introduce the laser treatment in regenerative periodontal surgery, for debriding and decontaminating the bone defect , it needs to be taken in consideration that much knowledge in laser-dentistry is still experience based and widely discussed. Especially because there are many kinds of wavelengths, as well as very little evidence based research (Ishikawa I. 2008). In periodontal regenerative surgery the conditioning of rootsurfaces appropriately, is likely to be important for enhancing predictability of regenerative therapies (AAP, 2005). The introduction of the Er,Cr laser to debride the defect and decontaminate

the root is based on several findings. It is reported that this laser is suitable for the disinfection of even the deeper layers of dentin, because of its bactericidal effect (Schoop U. 2004). With the appropriate settings, an Er,Cr:YSGG laser is capable of performing scaling and root planing to remove calculus, and because of its short pulse, it may be especially suitable for the micro-morphology of the root surface (Hakki SS. 2010). Due to high absorption in water of laser energy, an effective ablation with a very thin surface interaction occurs on the irradiated tissues, and without any major thermal damage to the irradiated and surrounding tissues (Straßl M. 2004, Wang X. 2005). To avoid smearlayer caused by hand-instruments or detrimental effects of chemical root-conditioning (Blomlof J. & Lindskog S.1995), the Er,Cr laser is used to clean and etch the exposed rootsurface. Furthermore the Er-wavelength seems to give comparable results to ultra sonic devices (Crespi R. 2007), without leaving a smearlayer however.

The AAP consensus statement declared, that research should be focused on identifying factors that can detoxify roots and also influence appropriate cell attachment (AAP 2005). Regeneration of periodontal tissues is reported in studies, where laser's decontaminative capacity created right circumstances for fibroblast attachment on root-surfaces (Feist IS. 2003), and in case reports this might have induced to clinical improvements in periodontal healing (Schwarz F. 2003). Er-laserwavelenght is capable to ablate periodontopathic bacteria with thermal vaporization, and its bacteriacidal effect on the diseased root surfaces appears to be superior to that of the ultrasonic scaler (Akiyama F. 2010). Furtheremore, the Er,Cr laser irradiation to perforate the alveolar bone of the defect to release blood, containing growth factors, could be advantageous for wound healing of bone tissues as comparative studies on bone healing suggested (Pourzarandian A. 2004). The application of Er-wavelenght seem to be slightly more effective when plateled derived growth factors are involved for regeneration purposes and therefore a promising treatment alternative (Belal M.H. 2007).

## _Clinical relevance statement & conclusions

The application of an Er,Cr:YSGG laser with 2,780 nm wavelength, which substitutes the scalpel blade, root conditioning agents and hand- or ultrasonic instruments, demonstrate the possibility to integrate laser treatment successfully in various stages of advanced periodontal therapy. Clinically the Er,Cr:YSGG laser seems to contribute with its decontaminative capacities to create ideal circumstances for regenerative procedures which resulted in significant CAL-gain in this case report.

| distal | baseline | 12 mnts | 24 mnts | 60 mnts |
|---|---|---|---|---|
| PPD | 9 mm | 4 mm | 3 mm | 3 mm |
| REC | 4 mm | 2 mm | 2 mm | 1 mm |
| CAL | 13 mm | 6 mm | 5 mm | 4 mm |

**Tab. 3**

| mesial | baseline | 12 mnts | 24 mnts | 60 mnts |
|---|---|---|---|---|
| PPD | 5 mm | 2 mm | 2 mm | 2 mm |
| REC | 2 mm | 3 mm | 3 mm | 3 mm |
| CAL | 7 mm | 5 mm | 5 mm | 5 mm |

**Tab. 4**

Randomized controlled clinical trials and more basic studies have to be encouraged and performed to confirm the status of Er,Cr:YSGG laser treatment as an adjunct in traditional periodontal surgical therapy.

## _About the author

Dr Elena Speranza Moll graduated in Dentistry at the University of Amsterdam, The Netherlands. She established herself opening her office in the outskirts of Florence in Italy. She specialized mainly in Periodontology and Implantology. In 2003 she completed the post-graduate course on Laser Dentistry at the University of Florence. In 2004 on Laser Oral Surgery held by the L'Istituto Nazionale Tumori in Milan. She is since 1995 member of the SIdP, Italian Society of Periodontology and since 2003 of the International Society for Oral Laser Applications. She has participated to mod I and II of the Academy of Oral Laser Applications based in Vienna. She has lectured in national and international congresses and has given courses on the integration of laser techniques in evidence based treatment approaches in advanced periodontal and basic implantology treatments._

*Editorial note: The literature list can be requested from the editorial office.*

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