

# A pilot study of Er,Cr:YSGG laser therapy used as an adjunct to scaling and root planing in patients with early and moderate periodontitis

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## SUMMARY

**Objectives:** The study aim was to compare the results of an Er,Cr:YSGG laser therapy used in adjunct to scaling and root planing (SRP), and of SRP alone, in a small group of patients with early to moderate periodontitis. **Materials and methods:** ten adult patients with periodontitis were treated according to split-mouth design, using Protocol A (SRP alone) or, Protocol B (Er,Cr:YSGG laser therapy combined with SRP). At baseline, and 3 months after the treatment the following periodontal parameters were evaluated: bleeding on probing (BOP), probing depth (PD), plaque index (PI). **Results:** no statistically significant difference in plaque levels was noted before and after the treatment between the treated quadrants, however a tendency of a more pronounced decrease in plaque levels was noted in the group of laser-SRP treated teeth. After three months, 60-68% decrease of BOP-positive teeth compared to baseline status was noted in all treated quadrants, without significant difference between the treatment modes. The decrease of mean PD values was measured after three months compared to baseline: on the lingual surfaces in 'SRP' group the mean PD improvement value was  $0,94 \pm 12$ , and in the laser-SRP group it was  $1,96 \pm 11$ , ( $p < 0,001$ ); on the vestibular surfaces the mean improvement values were  $0,99 \pm 0,14$  and  $2,03 \pm 0,11$ , respectively ( $p < 0,001$ ). **Conclusions:** Non-surgical periodontal therapy using both an Er,Cr:YSGG laser + SRP and SRP alone, lead to significant improvements in all the investigated clinical parameters. The combined treatment using laser as an adjunct to root scaling and planing seemed to be advantageous when compared to SRP alone, due to more efficient attachment level restoration.

**Key words:** laser therapy, periodontal attachment, periodontitis, root planing, scaling.

## INTRODUCTION

A primary goal in the treatment of periodontitis can be defined as thorough removal of bacterial deposits from the surfaces of teeth, and further control of the disease progression [1]. This goal is traditionally accomplished by means of hand instruments and sonic or ultrasonic scalers [2]. However, the most important outcome factor in periodontal therapy is restoration of the attachment level. Recently, the use of laser radiation has been suggested

as an alternative to the conventional mechanical treatment. It was proposed that laser-based root surface treatment might lead to improved periodontal therapy due to relatively conservative removal of tooth substance as well as to the bactericidal effect towards periopathogenic bacteria [3,4,5]. Also, it has been annotated in the literature that application of laser in periodontal treatment provides a more comfortable patient experience with less trauma and post-operative complications as well as a decreased healing time [6].

The newly developed Er: YAG (erbium:yttrium, aluminum, and garnet) laser emitting at a wavelength of 2,94 nanometers, has been demonstrated to be very useful for hard tissue as well as soft tissue applications [7]. Series of advantages of this laser have been demonstrated in periodontal therapy, such

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as calculus removal [8], high bactericidal capacity, root conditioning [9] and detoxification effect of the diseased root surface [10].

Many techniques have been used to retard epithelial proliferation apically along the healing root surface and to enhance periodontal tissue regeneration [11, 12]. Removal of the outer epithelium is called laser de-epithelization. This procedure helps to block the growth of the epithelium into the healing periodontal pocket after intervention and therefore prevents formation of a long junctional epithelial attachment [13].

Er, Cr: YSGG laser is the latest version developed in dentistry, and it seems to be a promising tool to achieve better periodontal tissue regeneration than using conventional non-surgical treatment. The wavelength delivered from this laser is 2,780 nanometers. The investigations showed that the effect of this laser on root surface might be comparable to those of the Er: YAG [9], but there is no data yet evaluating the clinical effect of the combination of an Er, Cr: YSGG laser and conventional scaling and root planning for non-surgical periodontal treatment.

Therefore, a large study testing various clinical parameters of periodontitis when using an Er,Cr: YSGG laser for treatment of periodontal patients has been planned at Clinic of Dental and Oral Pathology, Kaunas University of Medicine.

The purpose of this study was to evaluate the effect of an Er,Cr: YSGG laser therapy used in adjunct to conventional scaling and root planning (SRP) compared to SRP alone, on selected clinical parameters of early to moderate periodontitis, in a small group of adult patients.

## MATERIAL AND METHODS

### Study subjects and design

A total of 10 patients with early to moderate periodontitis, aged between 30 and 60 years were selected from those applying for treatment at Kaunas University Dental Clinic (Lithuania) during the period from March 2006 to September 2006 and were invited to participate in the study. Subjects' participation was based on the signed informed consent forms. The patient selection criteria were as follows:

- No periodontal treatment received within the last 12 months
- No systemic diseases, which could influence the outcome of the therapy
- No use of systemic antibiotics within the last 6 months

- Non-smokers

A total of 130 teeth were examined. The criteria for teeth selection: every tooth had to exhibit gingival inflammation with a positive BOP (bleeding on probing), subgingival calculus and a PD (probing depth) of 4 mm on at least one aspect of the tooth.

The study was performed according to a split-mouth design. Thus, every mouth was split in four quadrants, and consequently, every patient received treatment for at least, two quadrants using test and control treatment methods.

Two treatment modes were performed for the patients:

- 1) Protocol A (control method): conventional scaling and root planing (SRP)
- 2) Protocol B (test method): SRP plus Er, Cr: YSGG laser therapy.

At least two quadrants were treated using the control method. One quadrant received laser treatment in addition to SRP.

Random selection of the mouth quadrants to be treated alternatively with the control or, test treatment mode, was performed. Thus, a total of ten cards, five marking Protocol A and the other five marking Protocol B were provided in the envelope. Prior to treatment, the clinician randomly pulled a card from the envelope. The selected card determined the side of the mouth to be treated with the control, or test method, alternatively. Furthermore, the selected protocols were coded in the patients' case descriptions, in order to prevent biased measurements of the treatment outcomes.

### Treatment procedures

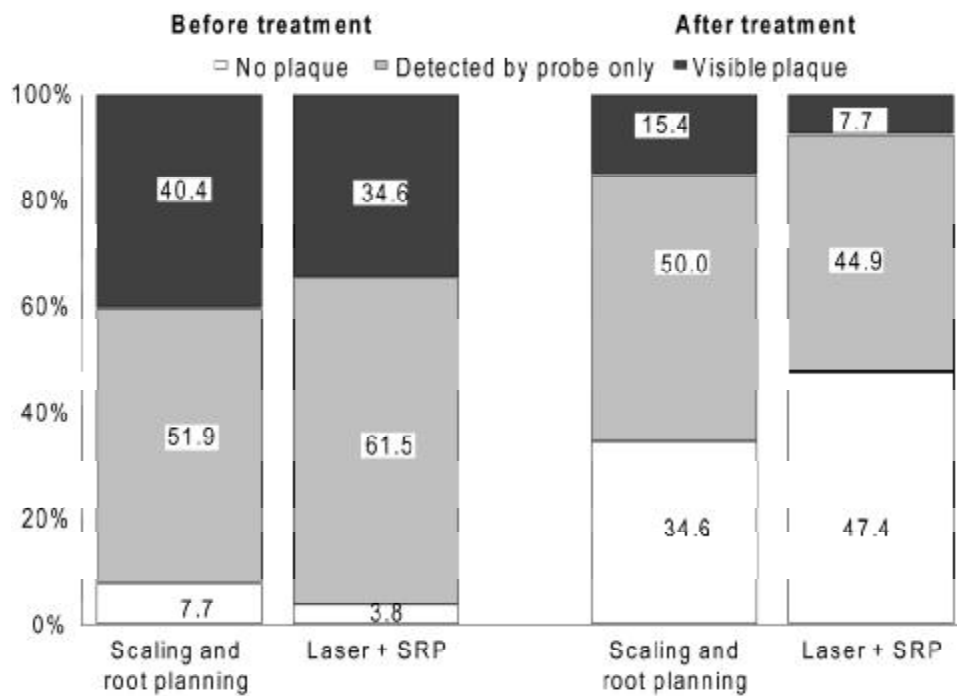
The treatment procedures were performed at the University Dental Clinic (Kaunas, Lithuania), in the dental chair, by the same operator (SK). Clinical parameters of periodontal status were measured at baseline, and three months after treatment. All measurements were performed by the same researcher, however, the final examinations were performed blind, without knowing which treatment mode had been applied.

#### *Scaling and root canal planning (SRP)*

The mechanical subgingival instrumentation was performed using Gracey curettes (American Eagle, USA). The instrumentation was accomplished until the operator felt that the root surfaces were adequately scaled and planed.

#### *Er, Cr: YSGG laser therapy and SRP (laser+ SRP)*

Laser (erbium, chromium : yttrium, scandium, gallium, garnet laser, Biolase, USA) was used to re-



**Fig. 1.** Dental plaque levels before and after periodontal treatment

move the inner epithelial lining (epithelium, which is inside the periodontal pocket) to the depth of the pocket and the outer epithelium (oral epithelium, which is near the free gingival margin) to the depth of 5mm. A 9 mm Z-6 tip marked to the depth of the pocket was used at a setting of 1 watt, 10% air and 15% water. To condition the root the laser tip was angled 5-15 degrees toward the root and moved up and down. Finally, the roots were smoothed with a curette. The same procedure was performed once a week for 3-4 weeks for each mm of pocket reduction. At subsequent visits inner epithelium to the depth of the pocket (usually 1mm less than previous appointment) and 5mm of the outer epithelium was removed. In the control quadrants only polishing was done at the follow-up visits during the three-month period.

#### Clinical measurements

Several clinical parameters were recorded before treatment, and 3 months after the last treatment. The following parameters were evaluated: plaque index, probing depth (PD), and bleeding on probing (BOP). Plaque index was assessed for every tooth examined using the following scale modified from Silness & Loe [14]: 0 – no plaque; 1 – plaque detected by probe only; 2 – visible, average amount of plaque 3 – a lot of visible plaque near the gingival margin and into the pocket. Bleeding on probing was assessed simultaneously to the pocket

measurements, and the presence or absence of bleeding up to 30 s after probing was recorded.

The PD and BOP measurements were made at six aspects per tooth: mesio-vestibular (mv), mid-vestibular (v), disto-vestibular (dv), mesio-lingual (ml), mid-lingual (l), disto-lingual (dl).

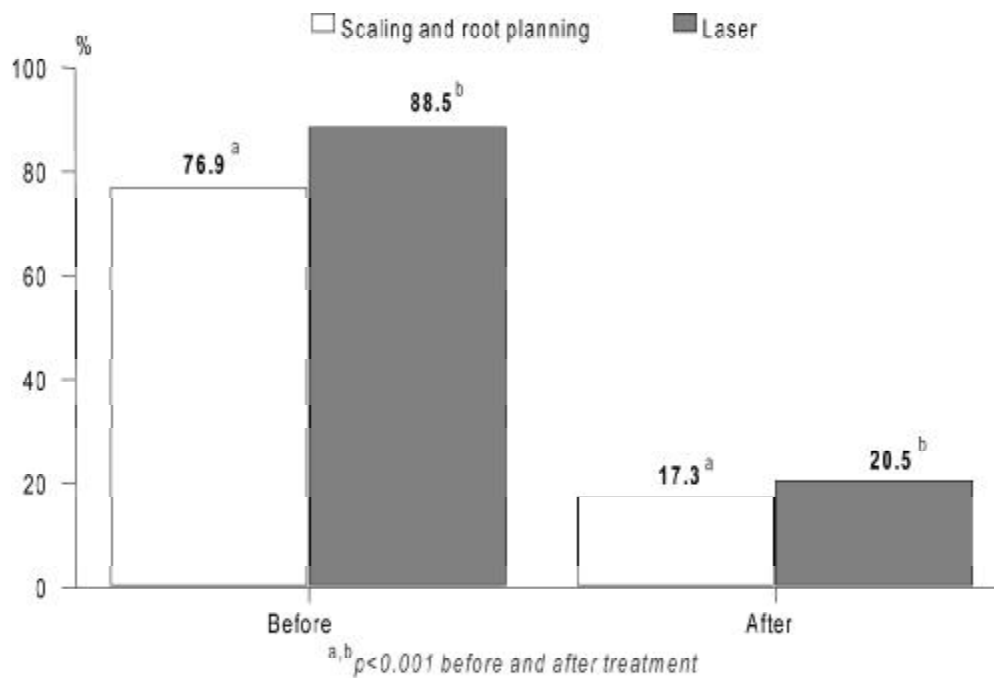
#### Statistical analysis

The data were analyzed using descriptive and analytical methods for analysis. Statistical significance of differences in proportion was tested by Pearson  $\chi^2$  test. The evaluation of mean values was performed using Student's t test. The difference with significance level below 0.05 was evaluated as significant. The power of the study, given PD of 1 mm as a significant difference between groups, was calculated to be 0.99 which justified the sample size of 10 patients.

Plaque distribution was evaluated at a tooth level, and was determined by percentages of teeth with different scores recorded.

For evaluation of periodontal depth (PD), lingual and vestibular surfaces of teeth were assessed, and for every surface the mean values of three corresponding measurements were calculated: ml, l, dl for lingual surfaces; and mv, v, dv, for vestibular surfaces, respectively.

BOP was assessed on a tooth level using score 'present' or 'absent', without differentiation of whether one or more aspects of the tooth exhibited bleeding.



**Fig. 2.** Bleeding on probing before and after treatment

### Ethics

This protocol is part of a large clinical study that has received approval from Ethical Committee of Kaunas University of Medicine, Kaunas, Lithuania.

### RESULTS

The postoperative healing was uneventful in all cases. No treatment complications were observed throughout the study period. At baseline, no plaque was observed in 3,8% of laser+SRP treated teeth ( $n=78$ ), and in 7,7% of SRP treated teeth ( $n=52$ ), respectively (Fig.1). After 3 months, the percentages of plaque-free surfaces increased to 47,4%, and to 34,6% in the 'laser+SRP' quadrants and in 'SRP' quadrants, respectively (Fig 1). There was no statistically significant difference in plaque lev-

els neither before nor after the treatment between the treated quadrants, however a clear tendency of a more pronounced decrease in plaque levels was noted in the group of laser-SRP treated teeth.

At baseline, 88,5% of the teeth examined in "laser+SRP" group and 76,9% in the 'SRP' group demonstrated bleeding on probing (Fig.2). After 3 months, marked reduction of the bleeding scores took place in both groups such as 20,5% of teeth in the 'laser+SRP' group and 17% of teeth in SRP were recorded with positive BOP score (Fig.2).

Reduction of periodontal depth (PD) occurred in both groups, however, it was significantly more pronounced in "Laser+SRP" group (Table). Thus, in the control group the mean improvement value of PD on the lingual surfaces was  $0,94 \pm 0,12$ , and in the test group it was  $1,96 \pm 0,11$ , respectively ( $p < 0,001$ ). Accordingly, on the vestibular surfaces the mean im-

**Table.** Periodontal depth on vestibular and lingual surfaces of treated teeth before and after treatment

	Scaling and root planning (mean $\pm$ SE)	Laser+SRP (mean $\pm$ SE)
<b>Vestibular surfaces</b>		
Before	3.44 $\pm$ 0.12	4.13 $\pm$ 0.13
After	2.45 $\pm$ 0.09	2.09 $\pm$ 0.08
Improvement	0.99 $\pm$ 0.14*	2.03 $\pm$ 0.11*
<b>Lingual surfaces</b>		
Before	3.62 $\pm$ 0.15	4.40 $\pm$ 0.13
After	2.69 $\pm$ 0.13	2.44 $\pm$ 0.12
Improvement	0.94 $\pm$ 0.12*	1.96 $\pm$ 0.11*

\* $p < 0.001$

provement values were  $0,99 \pm 0,14$  and  $2,03 \pm 0,11$  in the control and test groups, respectively ( $p < 0,001$ ).

## DISCUSSION

The results of the present study have first of all, demonstrated that non-surgical periodontal treatment either with or without laser therapy, lead to clinically significant improvements in all investigated parameters (plaque level, bleeding on probing, and periodontal depth) at a 3-month interval after the treatment. The observation that in all cases there were no post-operative complications indicates good tolerance of all conservative treatment procedures received.

Application of Er;Cr:YSGG laser in addition to conventional root planning and scaling procedure resulted in significantly lower values of periodontal depth measurements after 3-months follow up, when compared to the results of SRP alone. It is well known that restoration of periodontal attachment level is one of the most important determinants of successful periodontal treatment. Of course, the results of the present study do not allow us to draw firm conclusions about a long-term clinical effect of the laser therapy. Management of the disease and inflammation stability is usually influenced by many different factors, particularly oral hygiene control [15].

The results obtained in our clinical study are in agreement with previous reports on laser therapy [16]. Thus, one of the studies comparing the effectiveness of the Er:YAG laser with conventional SRP suggested that the Er:YAG laser could be considered as a meaningful alternative to hand instruments in the treatment of periodontitis [5]. Further, Blomlof and co-authors [17], showed that ultrasonic debridement resulted in a smooth surface covered by the smear layer containing remnants of dental debris contaminated root cementum, bacterial endotoxin, and subgingival plaque whereas Er:YAG laser irradiation induced glazed microstructures presenting a rough aspect to root surface. Such morphological roughness of lased surfaces enhances adhesion and

proliferation of fibroblasts [19]. This phenomenon could serve as potential explanation for greater periodontal re-attachment.

Several literature reports indicated that laser irradiation is capable to exhibit high bactericidal properties [4,20]. Comparatively, mechanical periodontal treatment alone improves clinical conditions however; it is not effective in eliminating all types of bacteria. Furthermore, it has been shown that laser irradiation helps to remove epithelium lining and granulation tissue of the gingival wall within periodontal pockets. When compared the removal of pocket epithelium by the CO<sub>2</sub> laser technique with conventional methods, laser therapy appeared to be more effective. According to the authors, laser de-epithelization blocks the down-growth of epithelium into the healing periodontal pocket and so enhances periodontal reattachment [21].

In addition to the above mentioned advantages of laser therapy, other factors such as easy handling, short treatment time, minimal tissue damage, seem to encourage a more extensive application of lasers in oral treatment. However, despite the successful experimental results, there is still insufficient scientific evidence of a superior clinical efficacy of lasers, particularly on a long-term basis, before it can be widely recommended for daily practice. Further clinical and basic studies are needed to establish the most optimal parameters of laser application in periodontology.

## CONCLUSIONS

Based on the present study conditions, we conclude that:

1. Non-surgical periodontal therapy using both an Er;Cr:YSGG laser + SRP and SRP alone, lead to significant short-term improvements in all clinical parameters investigated.
2. The combined treatment using laser as an adjunct to root planing and scaling seemed to be advantageous when compared to SRP alone, due to more efficient attachment level restoration.

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