International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Comparison of Nd:YAG, Er,Cr:YSGG and Diode Lasers in Nonsurgical Periodontal Treatment

Mariya Miteva

Department of Periodontology and Implant Dentistry, Faculty of Dental medicine, Medical University - Varna, Bulgaria

Abstract: ***Purpose: The aim of the study was to evaluate and compare the clinical efficacy of Nd: YAG, Er, Cr: YSGG and Diode lasers as an additional tool for non-surgical periodontal therapy. Methods: The study included 60 male and female patients with chronic generalized periodontitis who were divided into the following groups: 1-SRP + Nd: YAG, 2-SRP + Er, Cr:YSGG, 3-SRP + Diode, 4-SRP (control group). A hygienic phase of periodontal treatment was performed for all patients. Probing pocket depth, gingival margin and clinical attachment level were registered for the patient prior to the treatment initiation as well as at 1,5 and 3 months after it. In groups 1, 2 and 3 the periodontal pockets were treated with the corresponding laser after SRP, whereas the control group was not treated with a laser as an additional tool. Results: At three months after treatment, there was no statistically significant difference in the measured clinical parameters between the SRP group and the groups for which high-energy lasers had been used. Conclusion: The results of the study and their statistical processing showed similar results between all study groups and it was proved that the application of SRP + high-energy laser did not lead to better clinical results. The experimental-statistical study requires to be traced for longer period of time in order to adequately evaluate the presence and frequency of recurrences after the administered treatment methods.***

Keywords: lasers, periodontology, non-surgical

1. Background

Different lasers penetrate to different tissue depths, depending on their wavelength and the type of tissue they are directed at. For instance, when applied to soft tissues, Nd: YAG lasers (1064 nm) have a penetration depth of approximately 2–3 mm, compared to CO_2 lasers (10,600 nm), which affect the tissue only superficially (0.1–0.3 mm). In addition, CO_2 lasers have a high absorption rate of water.

Lasers can be used in a focused beam (for excisions and incisions) and in an unfocused beam (for ablation and coagulation). Some evidences suggest that lasers used as an adjunct to scaling and root planing (SRP) may provide additional benefits.[1] Lasers and piezosurgical devices can also be used in implant surgery [2, 3]. The heat generation during the implant site preparation is commonly measured using infrared thermal camera.[4]

Lasers in periodontal therapy have been demonstrated to be beneficial for control of bacteremia,[5] better removal of the pocket epithelium in the pockets,[6, 7] bacteria reduction,[8, 9, 10, 11] efficient subgingival calculus removal (using Er: YAG lasers) [12] and improvement of periodontal regeneration in animals and humans without damaging the surrounding bone and pulp tissues.[13, 14].

Objective

The aim of the study was to evaluate and compare the clinical efficacy of Nd: YAG, Er, Cr: YSGG and Diode lasers as an additional tool for non-surgical periodontal therapy

Methods

The study included 60 male and female patients with chronic generalized periodontitis who were divided into the following groups: 1-SRP + Nd: YAG, 2-SRP + Er,Cr:YSGG, 3-SRP + Diode, 4-SRP (control group). A hygienic phase of periodontal treatment was performed for all patients. Probing pocket depth (PPD), gingival margin and clinical attachment level were registered for the patients prior to the treatment initiation as well as at 1,5 and 3 months after it. In groups 1, 2 and 3 the periodontal pockets were treated with the corresponding laser after SRP, whereas the control group was not treated with a laser as an additional tool.

2. Results and discussion

After treatment in the four study groups, a statistically significant reduction of the pocket depth (PD) was obtained at a month and a half and at the third month after treatment.(Fig.1)

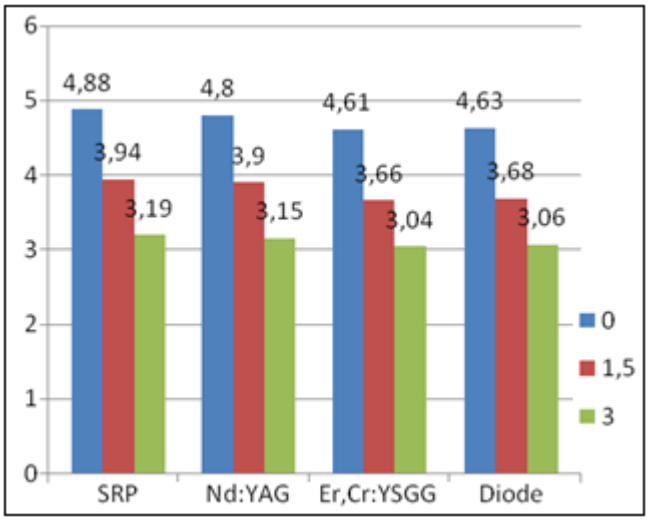

Figure 1: Probing depths by periods and treatments

The decrease in pocket depths indicates the success of the non-surgical periodontal therapy, which is confirmed by a number of authors - Swierkot, Cobb and others. [15, 16, 17].

There was no statistically significant difference between the SRP group and the groups using high energy lasers. These results are confirmed by other authors [18, 19, 20], but are in contradiction with some studies that demonstrate a statistically significant difference [21, 22, 23].

For each of the studied groups, periodontal pockets were recorded as follows - Fig.2

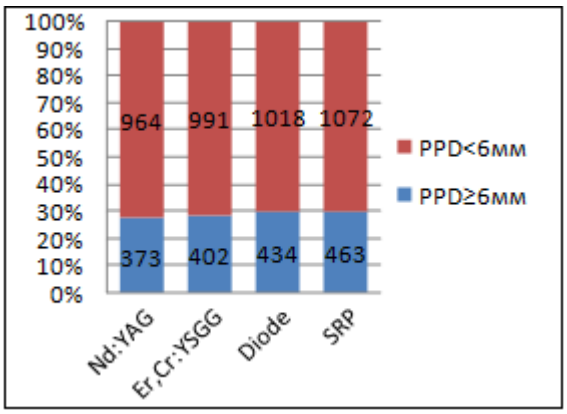

Figure 2: Distribution of periodontal pockets according to pocket depth - prior to initiation of a treatment

Figure 2 shows that almost 1/3 of the registered periodontal pockets before treatment have pocket depth ≥ 6mm, in the other cases the pocket depth is 4-5 mm.

A month and a half after treatment, a reduction in the pocket depth and a reduction in pockets of ≥ 6 mm was observed - Fig.3

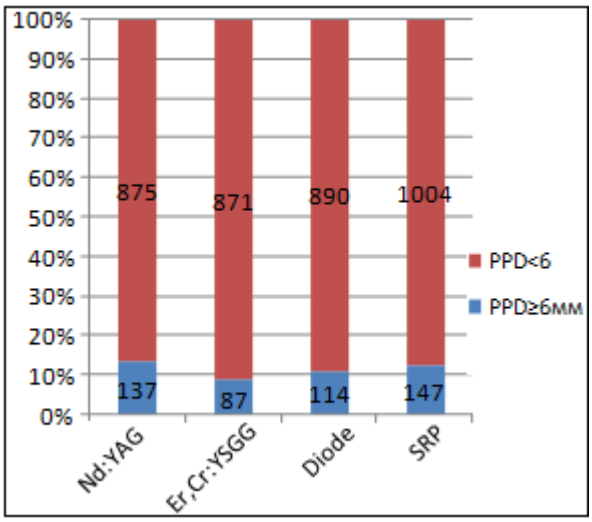

Figure 3: Distribution of periodontal pockets according to pocket depth at 1.5 months after treatment

373 periodontal pockets with PPD ≥ 6mm were observed. After 1.5 months, their number decreased to 137 for the Nd: YAG group. The decrease was from 402 to 87 periodontal pockets for the Er, Cr: YSGG group; from 434 to 114 pockets for the diode group and from 463 to 147 pockets for the SRP group. Although the Er, Cr: YSGG group had the smallest number of periodontal pockets with PPD ≥ 6mm, the relative share remained the same (about 10%) in all types of therapies without significant expression between the groups. Reducing PD on periodontal pockets from ≥ 6 mm to 4-5 mm confirms that debridement has become a "gold standard" in the non-surgical treatment of periodontal diseases.

At the third month post-treatment, it was found that the reduction in PPD continued and the number of periodontal pockets ≥ 6 mm was minimal. (Fig.4)

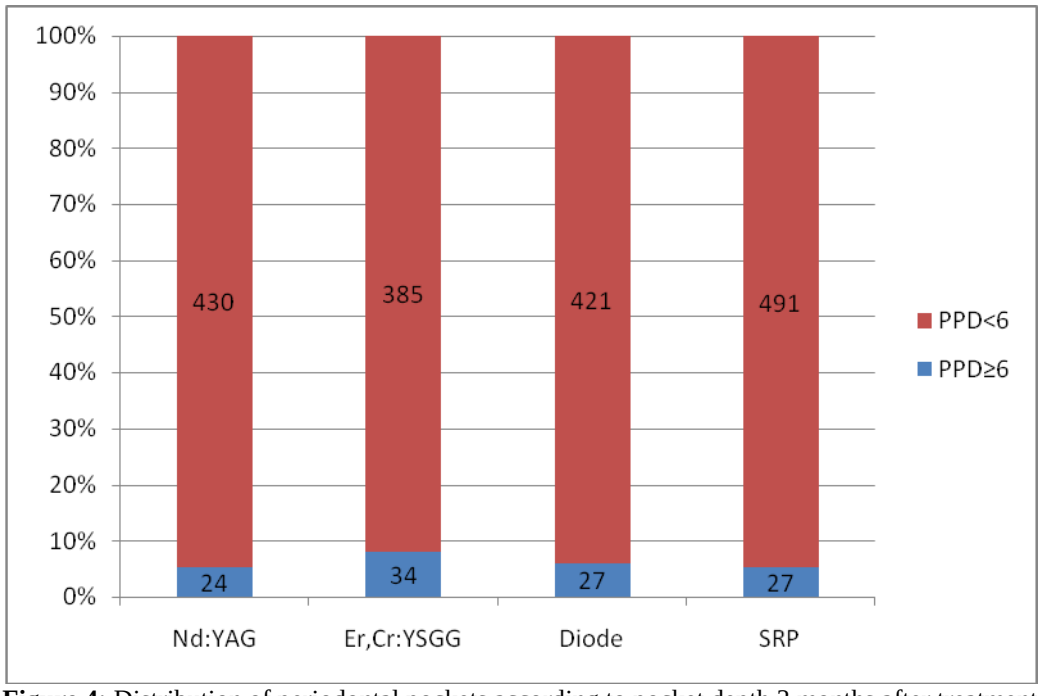

Figure 4: Distribution of periodontal pockets according to pocket depth 3 months after treatment

The presence of a pocket depth of 4-5 mm is due to the reduction of deeper periodontal pockets, for which no complete elimination is expected with non-surgical therapy. The absence of bleeding in more than 50% of the remaining pocket depths of 4-5mm indicates the inactivity of the periodontal pockets, i.e no future clinical attachment loss is expected in compliance with the maintenance visits deadlines.

From 373 periodontal pockets with PD ≥ 6mm after 3 months, their number decreased to 24 for the Nd: YAG group; from 402 to 34 pockets for the Er, Cr: YSGG group; from 434 to 27 pockets for the diode group and from 463 to 27 pockets for the SRP group. Although in the Er, Cr: YSGG group there were the highest number of periodontal pockets with PD ≥ 6mm, the relative share remained the same (about 5%) in all types of therapies without significant expression between the groups.

The fact that the PPD continues to decline by the third month shows that treatment has good short-term efficacy.

A month and a half and three months post-treatment, a marked increase in gingival recession or a decrease in gingival margin were reported for all study groups and periods. The resulting reduction in gingival margin is most pronounced in the SRP group, indicating that this type of treatment produces the largest post-therapeutic gingival recession. The smallest gingival recession occurs in the diode laser treated group. It is established that the largest increase in recession is in the first 1.5 months, due to reduction in inflammation and contraction of gingival tissues in the initial stages of the healing process.

The reduction in pocket depth along with reduced gingival margin showed that the reduced depth was due to the greatest extent to gingival recession and, to a lesser extent, to clinical attachement gain.

Based on the overall reduction in gingival margin in the 3-month period compared to the pre-treatment period, the therapies are ranked in the following order:
1) SRP therapy - 1.25 mm reduction;
2) Nd: YAG Laser - 1.22 mm reduction;
3) Er, Cr: YSGG - 1.04 mm reduction;
4) diode laser - 0.99 mm reduction;

All clinical groups and periods tested were found to have a significant clinical attachement gain, as it was less pronounced in the Nd: YAG and SRP groups, and more strongly pronounced in the Er, Cr: YSGG and diode groups. The reduction of this clinical parameter is an expression of good therapeutic effect.

Based on the total clinical attachment gain in the 3-month period related to the pre-treatment period, the therapies were ranked in the following order:
1) diode laser - 0.58mm gain;
2) Er, Cr: YSGG - 0.52mm gain;
3) SRP therapy - 0.45mm gain;
4) Nd: YAG laser - 0.41mm gain;

3. Conclusion

At the third month post-treatment, there was no statistically significant difference in the studied clinical parameters between the SRP group and the high energy laser use groups.

The results of the study and their statistical processing showed similar results between all study groups and it was proved that the application of SRP + high-energy laser did not lead to better clinical results. The experimental-statistical study requires to be traced for a longer period of time in order to adequately evaluate the presence and frequency of recurrences after the administered treatment methods.

References

[1] Cobb CM. Lasers in periodontics: A review of the literature. J Periodontol. 2006;77:545–64.
[2] Sabeva E. Factors Affecting Bone Temperature Increase During Implant Surgery – Review. Scripta Scientifica Medicinae Dentalis, [S.I.], v. 5, n. 1, p. 7-15, aug. 2019. ISSN 2367-7244. doi:http//dx.doi.org/10.14748/ssmd.v5i1.5950.
[3] Peev S., Gusiyska A., Sabeva E. Longitudinal Ridge Split Osteotomy and Simultaneous Implant Placement. Int J Sci and Res (IJSR). 2016;5(2), 1024-26.
[4] Peev S, Sabeva E. Assessment of the heat generation at the marginal bone area during the implant insertion using infrared thermography (experimental study). Int J Sci Res (IJSR). 2016;5(9):822-5.
[5] Pinero J. Nd: YAG-assisted periodontal curettage to prevent bacteria before cardiovascular surgery. Dent Today. 1998;17:84–7
[6] Gold SI, Vilardi MA. Pulsed laser beam effects on gingiva. J Clin Periodontol. 1994;21:391–6.
[7] Romanos GE. Clinical applications of the Nd: YAG laser in oral soft tissue surgery and periodontology. J Clin Laser Med Surg. 1994;12:103–8
[8] Ben Hatit Y, Blum R, Severin C, Maquin M, Jabro MH. The effects of a pulsed Nd: YAG laser on subgingival bacterial flora and on cementum: An *in vivo* study. J Clin Laser Med Surg. 1996;14:137–43.
[9] Moritz A, Schoop U, Goharkhay K, Schauer P, Doertbudak O, Wernisch J, et al. Treatment of periodontal pockets with a diode laser. Lasers Surg Med. 1998;22:302–11.
[10] Schwarz F, Sculean A, Georg T, Reich E. Periodontal treatment with an Er: YAG laser compared to scaling and root planing. A controlled clinical study. J Periodontol. 2001;72:361–7.
[11] Yaneva B, Firkova E, Karaslavova E, Romanos GE. Bactericidal effects of using a fiber-less Er: YAG laser system for treatment of moderate chronic periodontitis: Preliminary results. Quintessence Int. 2014;45:489–97.
[12] Eberhard J, Ehlers H, Falk W, Açil Y, Albers HK, Jepsen S. Efficacy of subgingival calculus removal with Er: YAG laser compared to mechanical debridement: An *in situ* study. J Clin Periodontol. 2003;30:511–8.
[13] Israel M, Rossmann JA, Froum SJ. Use of the carbon dioxide laser in retarding epithelial migration: A pilot histological human study utilizing case reports. J Periodontol. 1995;66:197–204

[14] Mizutani K, Aoki A, Takasaki AA, Kinoshita A, Hayashi C, Oda S, et al. Periodontal tissue healing following flap surgery using an Er: YAG laser in dogs. Lasers Surg Med. 2006;38:314–24.
[15] Axelsson P, Lindhe J. Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. J Clin Periodontol. 1978 May;5(2):133-51.
[16] Badersten A, Niveus R, Egelberg J. 4-year observations of basic periodontal therapy. J Clin Periodontol. 1987 Sep;14(8):438-44.
[17] Swierkot K, Nonnenmacher CI, Mutters R, Flores-de-Jacoby L, Mengel R. One-stage full-mouth disinfection versus quadrant and full-mouth root planing. J Clin Periodontol. 2009 Mar;36(3):240-9.
[18] Miyazaki A, Yamaguchi T, Nishikata J, Okuda K, Suda S, Orima K, Kobayashi T, Yamazaki K, Yoshikawa E, Yoshie H. Effects of Nd:YAG and CO2 laser treatment and ultrasonic scaling on periodontal pockets of chronic periodontitis patients. J Periodontol. 2003 Feb;74(2):175-80.
[19] Ratka-Krüger P, Mahl D, Deimling D, Mönting JS, Jachmann I, Al-Machot E, Sculean A, Berakdar M, Jervøe-Storm PM, Braun A. Er:YAG laser treatment in supportive periodontal therapy. J Clin Periodontol. 2012 May;39(5):483-9.
[20] Slot DE, Timmerman MF, Versteeg PA, van der Velden U, van der Weijden FA. Adjunctive clinical effect of a water-cooled Nd:YAG laser in a periodontal maintenance care programme: a randomized controlled trial. J Clin Periodontol. 2012 Dec;39(12):1159-65.
[21] Kelbauskiene S, Maciulskiene V. 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. Stomatologija. 2007;9(1):21-6.
[22] Qadri T, Javed F, Poddani P, Tunér J, Gustafsson A. Long-term effects of a single application of a water-cooled pulsed Nd:YAG laser in supplement to scaling and root planing in patients with periodontal inflammation. Lasers Med Sci. 2011 Nov;26(6):763-6.
[23] Schwarz F, Pütz N, Georg T, Reich E. Effect of an Er:YAG laser on periodontally involved root surfaces: an in vivo and in vitro SEM comparison. Lasers Surg Med. 2001;29(4):328-35.