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ORIGINAL RESEARCH

Clinical evaluation of ER, CR: YSGG laser therapy used as an adjunct to non-surgical treatment of periodontitis- An original research

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ABSTRACT

Aim: Purpose of the present research was to assess the effectiveness of Er,Cr:YSGG laser in comparison or as an adjunct to non-surgical treatment for periodontitis.

Methodology: In a randomized, single-blinded, controlled trial, 27 patients were recruited. Using a split-mouth design, two quadrants were randomly allocated into either a test group or a control group. The test quadrants received Er,Cr:YSGG laser (ERL) (100 mJ/pulse;15 Hz to hard tissue and 50 mJ/pulse; 30 Hz to soft tissue) plus SRP treatment, while the control quadrants received SRP only. We evaluated periodontal indexes, including probing depth (PD), clinical attachment level (CAL), bleeding index (BI), and plaque index (PLI) at baseline, 3 months, and 6 months.

Results: The PD and CAL means in the ERL+SRP group were significantly lower than those in the SRP group at 3-month follow-up (PD: 2.98±0.38 mm vs. 3.09±0.35 mm; CAL: 4.51±0.69 mm vs. 4.72±0.67 mm) and 6-month follow-up (PD: 2.91±0.31 mm vs. 3.02±0.30 mm; CAL: 4.52±0.65 mm vs. 4.72±0.66 mm) (p=0.03 for both PD and CAL). There were no significant differences in BI and PLI between two groups.

Conclusion: The Er,Cr:YSGG laser treatment combined with conventional SRP significantly improved PD and CAL compared to SRP therapy alone; however, these differences were very small and, as a result, the adjunctive effect of Er,Cr:YSGG laser is likely to be minimal clinically important.

Keywords Er,Cr:YSGG laser, periodontitis, minimally invasive, attachment level.

INTRODUCTION

Periodontal treatment aims to reduce and remove periodontal diseases with a variety of techniques such as scaling and root plaining and flap procedures.[1] Mechanical therapy of periodontal diseases have been applied securely with high success rates for years. The improvement in bacterial reduction in periodontal pocket and clinical healing appeared to be better in patients with conventional periodontal therapy assisted with adjunctive therapy than in patients with conventional periodontal therapy alone.[2] Lately, there have been several improvements in the treatment of periodontal disease, such as the usage of hard and soft lasers as an adjunctive to conventional periodontal therapy for the effective reduction and eliminationof pathogenic microorganisms in the periodontal pocket, thus, leading to a more effective and pain free treatment.[3,4] As a member of the erbium laser family, Er,Cr:YSGG lasers demonstrate a very shallow penetration in tissue with a wavelength of 2.78 μm posing minimal thermal risk to the deeper tissues when compared with other lasers and provide a better surface for the attachment of blood derived components on roots.[5,6] It is also reported that ER,Cr,YSGG laser enhances cell attachment and migration on the root surfaces.[7] The morphological surface alterations promoted by Er,Cr:YSGG have been related to its high absorption in water.[8] The utilization of Er,Cr:YSGG laser adjunctive to conventional periodontal therapy is reported to be more effective in bacterial reduction compared to conventional periodontal therapy. In addition to the bacterial reduction, Er,Cr:YSGG lasers are also successful in coagulating the opened blood vessels and de-epithelizing the gingival pocket.[9] The laser assisted treatment is a better treatment modality compared to the conventional non-surgical periodontal treatment according to several studies.[10] Taken together, the evidence suggests that Er,Cr:YSGG laser has excellent capability foreffectively ablating hard tissue, removing calculus and plaque, providing a smooth andhomogeneous root surface with good biocompatibility for soft tissue attachment.However, the clinical effectiveness of the Er,Cr:YSGG laser on periodontitis remainscontroversial. We hypothesized that Er,Cr:YSGG laser combined with conventional SRP provides more effective treatment than SRP alone. The purpose of this study, therefore, was to compare the use of Er,Cr:YSGG laser with mechanical scaling and root planning in the non-surgical treatment of periodontitis

AIM OF THE PRESENT STUDY

Purpose of the present research was to assess the effectiveness of Er,Cr:YSGG laser in comparison or as an adjunct to non-surgical treatment for periodontitis.

METHODOLOGY

This study was a randomized, single-blinded, controlled trial. In this split-mouth design, each patient served as his or her own control. The patient population consisted of 27 systemically healthy periodontitis patients between 35 and 70 years of age from March 2022- September 2022. The study protocol was approved by the ethics committee. Participants were eligible if they met the following inclusion criteria: 1) a minimum of 16 teeth (four per quadrant); 2) at least two teeth with at least one site with probing depths (PD) ≥4mm in each quadrant with bleeding on probing; 3) 35-70 years old, in good general health; and 4) non smoker. For each patient, the two treatments were randomly assigned to either the right or the left side. One half of random number sequences were defined as group A: left side with Er,Cr:YSGG laser+SRP and right side with SRP alone; and another half of random number sequences were defined as group B: left side with SRP alone and right side with Er,Cr:YSGG laser+SRP. During clinical visits at baseline (0), 3, and 6 months, periodontal examinations

were taken by the same blinded examiner. Clinical examination included measurement of pocket depth (PD), location of the cemento-enamel junction (CEJ) to calculate clinical attachment level (CAL), bleeding index (BI), and assessing of plaque index (PLI). Laser parameters were set at an energy level of 100 mJ/pulse and a repetition rate of 15 Hz (Hard Tissue / Calculus removal mode). Primary outcomes were changes in PD and CAL after periodontal treatment. Secondary outcomes were changes in BI and PLI after periodontal treatment. The distributions of all outcome values were examined using the Kolmogorov-Smirnov normality test. Since they were all normally distributed, baseline characteristics between two treatment groups were compared using paired- *t* test. $\chi 2$ test were used to compare the proportions of sites showing ≥2mm change in PD and CAL. The level of significance was set at $p<0.05$.

RESULTS

All 27 patients returned for the 3- month visit and only two did not return for the 6-month visit. The mean age of the patients was 49.0±9.6 years, and 16 out of 27 were women. All 27 patients were non- smokers. 19 patients (70.4%) were periodontitis of Stage III and 8 patients (29.6%) were periodontitis of Stage II. Within the groups, compared with baseline measurements, both therapies (ERL+SRP or SRP) produced significant reductions in the means of PD, CAL, BI, and PLI at 3-month and 6-month follow-up (all $p<0.05$). The differences between 3-month and 6-month follow-up were not statistically significant. ERL+SRP quadrants also had lower CAL means at 3-month follow-up (4.51±0.69 vs. 4.72±0.67 mm) and at 6-month follow-up (4.52±0.65 vs. 4.72±0.66 mm) than the control quadrants ($p=0.03$). (Table 1)

Table 1- Percentage of sites showing ≥2mm change in PD between baseline and follow-up periods at 3 months and 6 months [n (%)]

	ERL+SRP group	**SRP group**				
	n	**improved**	**worsened**	**n**	**improved**	**worsened**
Initial PD (5-6mm)						
3 months	352	170(48.3)	2(0.6)	296	136(45.9)	4(1.4)
6 months	326	175(53.7)	3(0.9)	274	138(50.4)	6(2.2)
Initial PD (≥7mm)						
3 months	62	46(74.2)	0(0)	68	48(70.6)	0(0)
6 months	57	44(77.3)	1(1.8)	63	46(73.0)	1(1.5)

***ERL: Er,Cr:YSGG laser; SRP: scaling and root planning; PD: probing depth*

In the ERL+SRP group, the percentages of sites showing ≥2mm improved in PD tended to be higher than those in the SRP group from baseline to 3 and 6 months. In the ERL+SRP group, the percentages of sites showing ‘‘pocket closure’’ appeared to be higher than those in the SRP group at two examination intervals but the differences were not statistically significant for pockets initially 5-6mm deep (72.4% vs. 68.9% at 3 months; 77.6% vs. 73.4% at 6 months) and those initially ≥7mm deep (35.5% vs. 29.4% at 3 months; 47.7% vs. 42.9% at 6 months) (all $p>0.05$).(Table 2)

Table 2- Percentage of sites showing ≥2mm gain or loss of CAL between baseline and follow-up periods at 3 months and 6 months [n (%)]

	ERL+SRP group			**SRP group**		
	n	**gain**	**loss**	**n**	**gain**	**loss**
Initial PD (5-6mm)						
3 months	352	192(54.5)	5(1.4)	296	124(41.9)	5(2.1)

6 months	326	197(60.4)	9(2.8)	274	143(52.2)	10(3.6)
Initial PD (≥7mm)						
3 months	62	44(71.0)	1(1.6)	68	35(51.5)	1(1.5)
6 months	57	39(68.4)	1(1.8)	63	40(63.5)	2(3.2)

*****ERL: Er,Cr:YSGG laser; SRP: scaling and root planing; PD: probing depth; CAL: clinical attachment level*

DISCUSSION

In this split-mouth randomized controlled study of 27 patients with periodontitis (stage III or stage II), quadrants treated with a combination of Er,Cr:YSGG laser and mechanical SRP (ERL + SRP) had lower measurements of PD and CAL than the control quadrants at 3-month and 6-month follow-up. In recent years, there have been many clinical studies of dental lasers for nonsurgical treatment of periodontal disease. However, their results are inconclusive regardingwhether laser therapy has additional benefits over conventional SRP. [11]Even when the type of laser used was limited to Er,Cr:YSGG, findings were inconsistent. A recent meta-analysis including 11 RCTs and 1 quasi-RCT by Cheng et al. suggested that adjunctive laser therapy significantly reduced PD at 3 months.[12] In addition, our data also support the findings of Yilmaz et al., who observed that positive changes in clinical parameters such as attachment gain and PD reduction were significantly greater in the ERL+SRP group than the SRP group. Several mechanisms have been proposed as underlying the possible beneficial effect of Er,Cr:YSGG laser in non-surgical periodontal treatment. First, Er,Cr:YSGG lasers are well absorbed in water. As dental calculus has a moderate water content, Er,Cr:YSGG lasers are indicated for its removal. Unlike Nd:YAG lasers used for soft tissues only, Er,Cr:YSGG lasers can be used for both hard and soft tissues. Second, Er,Cr:YSGG lasers can safely and effectively remove granulation tissue, even from bone defects, which are difficult to access without harming the osseous tissue.[13] Third, Er,Cr:YSGG lasers can also remove bacterial endotoxins from the root surface.[14] Finally, these wavelengths, when used in nonsurgical therapy,[15] can improve fibroblast and periodontal ligament fibroblast attachment to root surfaces and support the formation of new connective tissue attachment.

CONCLUSION

Our split-mouth randomized controlled trial suggests that Er,Cr:YSGG laser, as an adjunctive treatment to SRP, generated better results than SRP alone in terms of significant PD reduction and clinical attachment gain at 3 months and 6 months.

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