Comparative Evaluation of the Effect of Nd:YAG Laser and Chlorhexidine Gel

A Randomized Clinical Study

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_Abstract

Many studies have shown the inability of conventional periodontal treatments when used alone to completely eliminate pathogens existing in periodontal pockets. These studies have pointed out that adjunctive treatments such as laser or antimicrobial therapies may be effective in the complete elimination of such agents. The objective of the present study is to investigate the effects of SRP assisted by the two clinical treatment methods of laser or chlorine hexedine applications in comparison with SRP alone.

Materials and Methods: Six patients with average to severe chronic periodontitis were selected for this study. Each of the subjects had at least three pockets 4–7 mm deep. 28 randomly selected pockets were subjected to treatment by SRP, 40 pockets to Nd:YAG laser (100 mJ/Pulse 2Hz) 2W min, and 40 pockets were treated by chlorhexidine gel with a xathan base. The clinical indices (PI, BoP, CAL, and PPD) before and three months after treatment were measured and evaluated.

Results: The results revealed that SRP assisted by chlorhexidine gel and Nd:YAG laser therapies exhibits better results than SRP alone in reducing the probing pocket depth (PPD), in improving clinical attachment level (CAL), and in reducing bleeding on probing (BoP) ($P \leq 0.05$); no significant differences, however, were observed between the two laser and gel treatment methods ($P \geq 0.05$).

Results and Conclusion: The results from the present study revealed that in the treatment of periodontal pockets, SRP assisted by Nd:YAG laser and chlorhexidine gel has better effects on improving clinical indices than SRP alone. This can be due to the bactericidal effects of these two methods compared with the mechanical therapy.

_Introduction

An essential measure in the treatment of periodontal diseases is the complete elimination of the pathogenic agents, which is typically achieved by mechanical debridement of the microbial plaque.[1] However, the limitations of the application and effectiveness of this method warrants a set of adjunctive methods to be employed along with the more conventional treatment methods in order to maximize therapeutic effects. A number of antimicrobial agents and certain types of lasers have nowadays been proposed as Adjunctive methods in periodontal pocket therapies. The antimicrobial agents have a siecal deliverymenthods found wider applications since they create higher concentrations of the effective agent within the pocket and also because they are associated with fewer side effects compared with antibiotics. From among these, chlorhexidine has become the more common antiseptic agent used in combating microbial plaques and with a long history of utilization as mouthwash.[2] It has more recently come to be used in small chips and in gel form for the treatment of periodontal pockets, which owes its therapeutic effect in improving periodontal indices to its sustained release inside the pockets.[3-7] Vinholis et al[3] studied the effect of Chlorhexidine gel 1 % in periodontal therapy. They reported that the gel could be used as an Adjunctive material and that it is of value not only in the maintenance phase but even during treatment phase of periodontal therapy. Stratual et al.[4], Dinca et al.[5]

compared a Novel type of chlorhexidine–xanthan based called Chlosite combined with the Plakout chlorhexidine which lacks the xanthan base in the non-surgical therapy of periodontal pockets. They reported the sub-gingival application of Chlosite gel to be effective in improving periodontal indices, leading to reduced probing pocket depth (PPD) and increasing clinical attachment level (CAL).[4,5]

Numerous studies have also reported on the success rate of laser applications such as CO_2, Diode laser, Nd:YAG, and Er:YAG in the treatment of periodontal pockets.[8-14] Among these, Nd:YAG has been found to be one of the most desirable lasers as an adjunctive therapy to the conventional mechanical debridement due to its associated ease of energy transfer via a flexible optical fiber into the pocket and its disinfection and detoxication effects within the periodontal pocket.[15]

Horrton and Line[16] reported that Nd:YAG laser irradiation into the periodontal pockets was more effective that SRP in reducing specific bacteria and in controlling their recolonization Neil & Melloning[17] and Gutknecht et al[18] reported that Nd:NAG laser as an adjunctive method to SRP could play a significant role in reducing microorganisms inside pockets and in improving clinical parameters. However, Radvar et al[19] reported no advantage for Nd:YAG laser over SRP alone in improving microbiological and clinical parameters.

The objective of the present study was to investigate the effects of the two Nd:YAG and chlorhexidine gel-xanthan based on the clinical parameters of periodontal diseases in comparison with those of the SRP alone.

_Methods

Six patients of moderate to severe chronic periodontitis, each with at least three pockets 4–7mm deep were selected for the purposes of this study. Over 112 pockets were studied and 28 pockets (control) were randomly selected for treatment with SRP alone, 40 with SRP assisted by Nd:YAG laser therapy, and 44 pockets were subjected to SRP assisted by gel therapy. Single root teeth were used in this study. The criteria used to reject patients from this study included suffering from systemic diseases, taking such drugs as antibiotics over the three months prior to the study period, failing to cooperate appropriately, smoking, or having received periodontal treatments in the three months prior to the study period.

A record file was set up for each subject in which measurements of the clinical indices CAL, PPD, BOP, and PI were recorded. Following the measurements, scaling and root planing were accomplished using the ultrasonic dental unit (Mectron, Carasco, GE, Italy). Using curettes (Hu-Friedy, Chicago, IL, USA), root planing was also performed in zones where pocket depth was less than 5 mm. Then, scalers were used to detect the presence of any residual calculus. After the first SRP session, all patients received special training on brushing their teeth every night for two minutes using the modified Bass technique, flossing, and using chlorhexidine 0.2 % to be applied twice daily. A week later, patients would be checked again for any remaining calculus to undergo another SRP session if necessary. In a following session a week later, the patients would then be subjected to Nd:YAG laser therapy (Fidelis Plus, Fotona; Ljubljana, Slovenia, 300 fiber; 2 W/100, 20 Hz, 2 min) as well as gel therapy. In this way, some pockets would be randomly selected for laser therapy and some for gel Chlosite (GHIMAS, s.p.a Bologna, Italy) therapy while leaving some pockets without either of the adjunctive therapies to be used as control. In teeth with pockets at several levels around, efforts were made to avoid the combined application laser and gel in order to prevent confused and interfering effects. Health care instructions would be given again after this round of treatment but

PPD reduction	After treatment	Before treatment	Group
3.2 ± 1.4	2.3 ± 1	5.4 ± 1.2	Laser
2.7 ± 1	2.3 ± 1	5 ± 1	Gel
1.4 ± 1	3.3 ± 0.7	4.7 ± 1	Control

Table 1_Mean & standard deviation of PPD before and after treatment.

PPD reduction	After treatment	Before treatment	Group
2.2 ± 1.6	2.3 ± 1.7	4.5 ± 1.9	Laser
2.8 ± 1.8	2.4 ± 1.5	5.3 ± 2.1	Gel
0.6 ± 1.2	3.7 ± 1.4	4.3 ± 1.8	Control

Table 2_Mean & standard deviation of CAL before and after treatment.

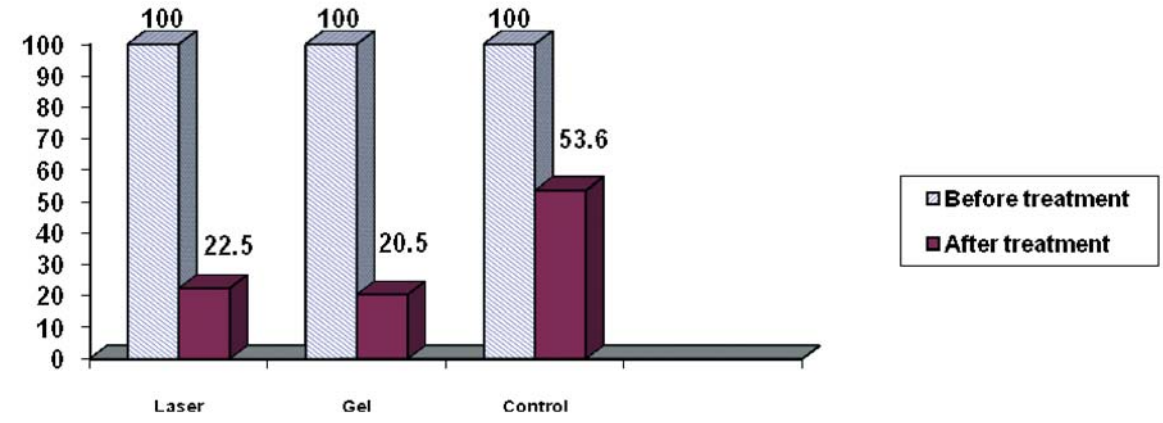

Fig. 1

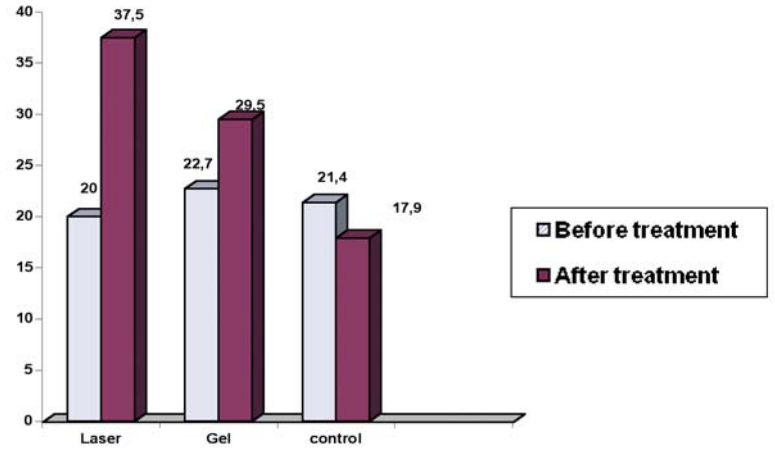

Fig. 2

Figure 1_Prevalence of BoP before and after treatment.
Figure 2_Prevalence of plaque-free zones before and after treatment.

chlorhexidine washmouth would be stopped. A week later again, laser therapy would be repeated. In the following and last session, laser or gel therapy would be administered for each of the experimental groups according to their treatment plan. This resulted in two gel therapies and three laser therapies for each patient. Patients were called back again three months after the first treatment session for clinical measurements. The data thus obtained were finally subjected to paired T-test, one-way ANOVA, Tukey's HSD Test, Kruskal-Wallis test, and Chi-square test, the results of which were then analyzed using the SPSS software ($P < 0.05$).

_Results

In this study, 112 cases were studied of which 40 cases (35.7 %) were included in the laser therapy group, 44 cases (39.3 %) in the gel therapy group, and 28 cases (25 %) in the control group.

Average values (expressed in mm) of probing pocket depth (PPD) and clinical attachment level (CAL) before and after treatments in the three groups of laser therapy, gel therapy, and control are reported in Tables 1 and 2.

Paired T-test revealed that treatment in all three groups significantly improved PPD and CAL compared to pretreatment conditions ($P > 0.001$). The One-way ANOVA showed that improvements in PPD and CAL in the three groups had significant differences ($P > 0.001$). Tukey's test also showed that PPD reduction ($P = 0.168$) and enhanced CAL ($P = 0.198$) in the two gel and laser therapy groups had no significant differences after treatment. However, these changes in the control were significantly less than those in the experimental groups ($P > 0.001$). Figure 1 below shows the distribution of prevailing BoP zones before and after treatment in the three laser, gel, and control groups.

The Chi-square test revealed that the percentage of BoP regions in the gel therapy and laser therapy groups was significantly less than that in the control ($P < 0.5$), while the two experimental groups did not show significant differences in this respect ($P = 0.820$).

Kruskal-Wallis test showed no significant differences between plaque-free zones in both groups before treatment ($P = 0.482$) and after treatment ($P = 0.186$). Figure 2 shows the distribution of plaque-free zones in the three groups.

_Discussion

Pathogenesis and treatment of periodontal diseases have undergone essential changes over the past three decades.[20] For instance, the initial non-surgical treatment of periodontal diseases which plays an important role in removing pathogenic bacterial plaque and, thus, in curing it no longer depends solely on the conventional me-

chanical debridement (SRP). Rather, local delivery of antimicrobials, host modulators, and laser application are used nowadays for reducing gingival sulcus bacteria and coagulation in the treatment zone.[2] However, no definitive answers can yet be given as to the effectiveness and application method of each of these agents in treating periodontal pockets.[15] In this study, therefore, efforts were made to compare the efficiency and effectiveness of two adjunctive methods including therapies using Nd:YAG laser and chlorhexidine gel with a xathan base following a conventional SRP treatment. The results revealed that Nd:YAG laser irradiation inside periodontal pockets with average depths of 4 to 7 mm following SRP had better therapeutic effects than the SRP alone, giving rise to higher PPD and BoP reductions and enhanced CAL (Tables 1 & 2, and Fig. 1).

Our findings are in agreement with those obtained by Neil and Melloning,[17] Gutknecht et al.[18], and Miyazaki et al.[8] despite slight differences in the application of Nd:YAG laser and the parameters used in the present study and those cited. In Miyazaki et al, Nd:YAG laser was used alone and compared with SRP while CO_2 laser was administered in three independent experimental groups, not as an adjunctive technique. Although in their study, Nd:YAG laser improved clinical parameters and the subgingival microflora after treatment, no significant differences were reported between the three groups. In our study, however, like those of Gutknecht et al. and Neil and Melloning, Nd:YAG laser was used as an adjunctive treatment to SRP, which showed enhanced improvements in clinical parameters compared to the SRP alone. The use of Nd:YAG laser in Gutknecht et al additionally led to a higher reduction of periopathogenic microorganisms. In contrast, the findings of our study do not match those of Radvar et al.[19] and those of Liu et al.[22] Liu et al. reported that the secondary application of Nd:YAg laser after SRP was associated with no advantages over SRP alone.

The parameters used for Nd:YAG laser beam were also different. Various combinations of the laser beam clinically used[24] for the treatment of periodontal pockets have been reported in different studies. Whit[23] and Coluzzi used it for different purposes such as coagulation and curettage of the pocket soft wall, bacterial reduction, and reduced hemostasis after mechanical debridement. This is while Gutknecht et al.[25] suggested Nd:YAG laser application with similar parameters (100 mJ/Pulse 2 Hz (2W)) for curettage before mechanical debridement in an attempt to reduce bacterium risks associated with SRP. Generally speaking, no consensus exists as to the application of Nd:YAG laser in the treatment of periodontal pockets. However, previous In vitro and In vivo studies have emphasized that Nd:YAg laser which is a soft tissue laser must only be used as an adjunctive method to conventional mechanical treatment methods rather than as a primary treatment of periodontal pockets.[15] The findings from our study also indicate that application of Chlorhexidine gel with a xathan base to periodontal pockets leads to significantly improved clinical parameters such as BoP, PPD, and CAL compared to the control ($P < 0.001$) (Table 1 & 2 and Fig. 1). These findings match those of Vinholis et al., Rusu et al., Cheng et al.[26], and Coysn et al.[27]

Comparison of the effects of Nd:YAG laser and chlorhexidine gel therapies on clinical parameters in the present study shows that the values of pocket reduction ($P = 0.168$) and CAL enhancement ($P = 0.198$) after treatment in the two experimental groups exhibit no significant differences. The same findings also show that percentage of bleeding zones (BoP) in the two gel and laser therapy groups is significantly lower than that in the control group ($P < 0.5$), but with no significant differences between the experimental groups in this parameter ($P = 0.820$).

It was also found that chlorhexidine gel with a xathan base and Nd:YAG laser as adjunctive therapies to SRP had similar effects, which may be due to their antimicrobial effects. Due to its mucoadhesive property and long retention time within the pocket, Xathan gel causes a delayed release of chlorhexidine, retaining it over two weeks and, thus, inhibiting bacterial recolonization.[4,5]

_Conclusion

Based on our findings, it may be concluded that application of Nd:YAG laser or chlorhexidine gel as adjunctive therapies to SRP may improve periodontal clinical indices to a far greater extent than would conventional periodontal mechanical treatments (SRP alone).

The Literature list can be requested from the editorial office.

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