Original Article

Clinical Evaluation of the Efficacy of Neodymium-Doped Yttrium Aluminium Garnet (Nd: YAG) Laser Therapy and Sensikin® in Treatment of Dentine Hypersensitivity

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Abstract:

Introduction: Dentine hypersensitivity (DH) is characterized by a short sharp pain arising from the exposed dentine, in response to a thermal, evaporative, tactile, osmotic or chemical stimulus. The aim of this study was to evaluate the efficacy of Nd:YAG laser therapy and desensitizing gel (Sensikin®, Laboratorios Kin S.A., Barcelona, Spain) in treatment of dentine hypersensitivity.
Methods: A total of 20 patients with at least 6 hypersensitive teeth were selected and divided randomly into three groups: Nd:YAG laser (10 HZ, 1W, 60 S, two times) treated group, Sensikin® treated group and a control group. Subjects were asked to apply the gel at home for the next week and 3 times a day as they were instructed. Assessment of the pain was performed by visual analyzing scale (VAS) after stimulation of the teeth by compressed air at 6 intervals: before treatment, immediately after treatment, one week, one, three and six months later. The data obtained were analyzed using the SPSS software, one way ANOVA and repeated measurement ANOVA tests.
Results: VAS scores did not show any significant differences between the three groups prior to treatment (P value>0.05), but in all groups after treatment VAS scores differed significantly in comparison to VAS scores before treatment (Pvalue<0.05). This statistically significant difference in the control group demonstrated a placebo effect. However, the efficacy between the three groups was not significantly different. An overall comparison indicated no significant differences at various time intervals.
Conclusion: Nd:YAG laser and desensitizing gel effectively reduce DH. However, we found no significant statistical differences between these two groups compared with the control group.
Keywords: dentine hypersensitivity; Nd:YAG laser; laser therapy.

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Introduction

Under normal conditions, dentine is covered by enamel or cementum and does not suffer direct stimulation. The exposure of the peripheral

terminations of dentinal tubules creates a situation of strong dentinal sensitivity, termed Dentine Hypersensitivity (DH). Cervical dentine hypersensitivity is the most frequent complaint among reported odontalgias (1). Although the reported prevalence for dentine hypersensitivity (DH) varies from 3 to 57% (2-5), the most consistent figure documented is 15% (6).

The reviews have indicated that exposure of the dentine may be a result of one of the anatomical characteristics in the region of cementoenamel junction (CEJ), removal of the enamel covering the crown of the tooth, and denudation of the root surface due to loss of cementum and overlying periodontal tissues (7-9).

Removal of enamel may be as a result of factors such as attrition, abrasion and erosion (10), chronic trauma from tooth brushing, tooth flexure due to abnormal occlusal loading forces, parafunctional habits, acute and chronic inflammatory gingival and periodontal diseases, acute trauma, periodontal surgery and acidic dietary components which are commonly cited as major causes of cervical lesions and DH (11). A number of theories have been proposed over the years to explain the pain mechanism of DH (12,13). The currently accepted hypothesis is the hydrodynamic theory, which claims that the movements of the dentinal tubule contents cause the pain and DH (14).

Grossman suggested a number of requirements for ideal treatment of DH, which are still hold true today. Therapy should be non-irritant to the pulp, relatively painless on application, easily carried out, rapid in action, effective for a long period, without staining effects and consistently effective (15).

Treatment of DH may begin with at-home methods such as desensitizing dentifrices, gels, mouthwashes and chewing gums, or with in-office treatment methods including topically applied desensitizing agents, adhesives, resins and laser (16). A wide range of commercially available products are manufactured for self treatment. Current products in marketplace include: potassium, strontium, oxalate and fluoride salts combined in toothpastes, gels and mouth rinses (17). So far, many investigators have successfully used different types of laser on dentinal hypersensitivity treatment, which effectiveness rate ranged from 5.2 to 100% depending on the laser type and parameters used (18). Various clinical studies indicated the effectiveness of different lasers in the reduction of patient's pain (18), specially the Neodymium Yttrium Aluminum Garnet (Nd:YAG) laser (19). However other studies concluded that the effect of Nd:YAG laser application on alleviating hypersensitivity is not different from placebo (20).

The purpose of the current study is to compare the effect of Nd:YAG laser and desensitizing gel (Sensikin®) in the management of DH.

Methods

The current research was a double-blind randomized controlled clinical trial study. A total of 120 teeth from 20 adult individuals (13 women and 7 men whose ages ranged from 20 to 55 years old) with a diagnosis of DH in at least 6 teeth were chosen from the patients referring to the dental school of Isfahan University of Medical Sciences. The patients had more than 1 month DH and did not use other desensitizing agents such as dentifrices and tubules sealers in the past 6 months. In our study pregnant and lactating women were not recruited due to the probable side effects of lasers. Other exclusion criteria were: teeth with pulpitis, necrotic pulps, cracked enamels, deep, extensive and defective restorations, crowns and congenital abnormalities. Abutments of partial dentures were also excluded.

Subjects read and signed the informed written consent form upon enrollment into the study, and had received oral hygiene instruction by the examiner before the study started. In the first visit, the teeth were randomly divided into three groups for each patient (two teeth in each group). For each patient an alginate impression was taken to prepare a special tray for the teeth treated with Sensikin® (Laboratorios Kin S.A., Barcelona, Spain) gel, to avoid cross-contamination. In the second visit, visual analyzing scale (VAS) was used to quantify sensitivity by the cold air syringe. VAS method consists of a 10cm long vertical line, with a numeric scale from 0 to 10. The patients were asked to rate their pain so that 0 describes "no pain" and 10 shows "severe pain" (like the pain of amputation or contraction). Group 1 teeth received Nd:YAG laser for 60 S/Cm^2 with 10 Hz and 1 Watt, two times. . The brand of laser apparatus was Fotona (Fidelis, Slovenia) with a 320 micrometer fiber.

The fiber did not have contact with the teeth and had a 3-mm distance from them. An orthodontic wire was placed and attached parallel to the fiber, so that it was 3 mm longer than it. By irradiating the laser when this wire made contact with the teeth, the 3 mm distance of fiber from the teeth was preserved and the fiber tip

was moved from mesial to distal. The amount of energy was 100 mJ and the density of energy was 141.5 J/Cm^2. The cervical parts of the sensitive teeth were irradiated and because of low distance and limited areas, irradiation was limited to the selected teeth mostly. In the second group, Sensikin® gel was applied on the teeth using a special tray for 20 minutes. In the control group, the Nd:YAG handpiece was used with the same melody, but without laser emission and no treatment was really done for this group. Patients were asked to wear the special glasses and close their eyes during the emission, so they imagined their teeth were treated by laser.Then the teeth in the three groups were again examined immediately by VAS index. All the patients who received Sensikin® gel by their special trays were asked to apply the gel three times a day for one week, each time for 20 minutes (according to the manufacturer's instruction). They were instructed to put the gel only on the teeth, which had been treated with gel, after brushing and flossing, and avoiding eating.

The pain was first assessed prior to treatment (baseline), then immediately after treatment, and 1 week, 1 month, 3 months and 6 months later. The data were analyzed using SPSS software, one way ANOVA and repeated measurement ANOVA tests. The significance level was set at 0.05%.

Results

One way ANOVA test was used to compare VAS index between the three groups before treatment which showed no statistical significant differences (P value>0.05). Repeated measurement ANOVA test indicated no significant differences before and after treatment between experimental groups over time (P value=0.062).

Table 1 shows the mean VAS values in the three groups throughout the study period and the distribution of mean VAS scores in each group at different time intervals are summarized in figure 1.

Comparison of VAS changes indicated that:

Table 1. Mean of VAS score in the three groups at different time intervals.

Evaluation group	Before treatment	Immediately after treatment	1 week after treatment	1 month after treatment	3 months after treatment	6 months after treatment
Nd:YAG group	5.93 ± 3.03	2.32 ± 3.15	3.96 ± 3.45	3.33 ± 3.29	3.45 ± 3.24	3.57 ± 3.45
Sensikin® group	4.80 ± 2.37	4.31 ± 3.24	2.03 ± 2.56	1.90 ± 2.34	1.85 ± 2.77	2.08 ± 2.94
Control group	4.70 ± 2.50	2.03 ± 2.56	3.45 ± 2.98	2.95 ± 2.76	3.06 ± 2.60	3.38 ± 2.84

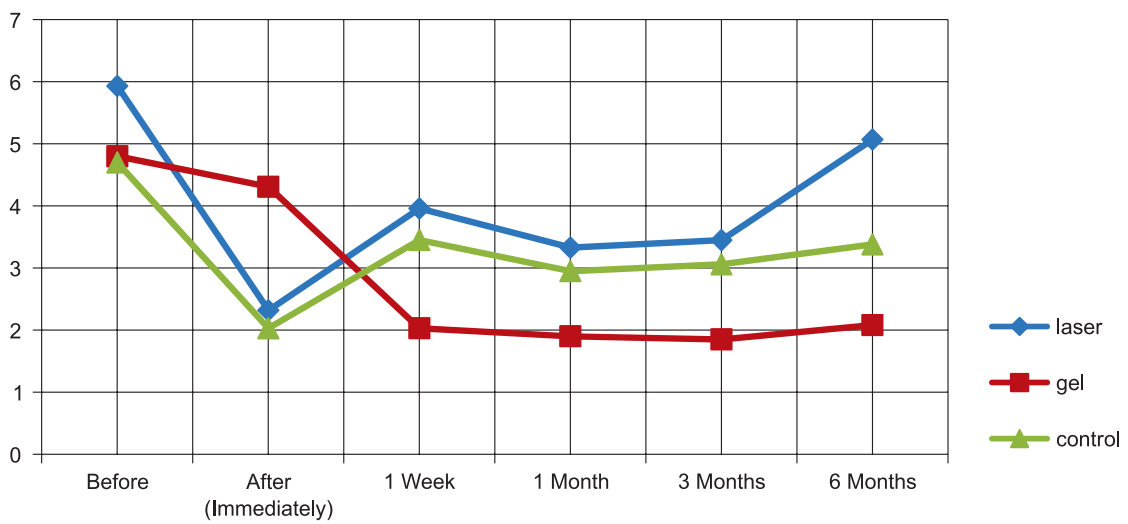

Figure 1. VAS score changes in the three groups at different evaluation times.

1- In laser treated group, the differences at all intervals compared with before treatment were statistically significant ($P<0.05$).
2- In gel treated group, except immediately after treatment, in other follow-up periods there were significant differences compared to before treatment ($P<0.05$).
3- In control group, the results were the same as the laser treated group.

Discussion

The objective of the present study was to evaluate the comparative effect of Nd:YAG laser and desensitizing gel (Sensikin®) in alleviating DH in a 6-month follow up period. DH was assessed before treatment, immediately after treatment, 1 week, 1, 3 and 6: months after the end of treatment. The amount of VAS scores prior to treatment did not indicate significant differences between the three groups, which showed a similar degree of hypersensitivity, and a random selection of the teeth. Due to the significant reduction in DH between before and after treatment in control group, a placebo effect was shown, that was also proven in Lier et al.'s study (20). As explained before, significant differences were observed in VAS index before laser treatment compared with all the follow up appointments, which is in accordance with the results of Birang et al. (19) and Matsumoto et al. (21).

The findings of the present study showed that the effect of Nd:YAG laser in decreasing the pain of DH is persistent until 6 months, which is in consistent with the results of Birang et al. (19). However there are differences between the two studies because of their different methods. In gel treated group, the amount of VAS index significantly reduced at 1 week, 1, 3 and 6 months after application compared with the baseline. Sensikin® has some active ingredients such as potassium nitrate and sodium fluoride, which's individual efficacy has been shown in several previous studies (22-26). In this group, immediately after application VAS index did not differ significantly from the baseline. This may be a cause of incomplete treatment period of gel and shows that Unlike Nd:YAG laser, Sensikin® does not have an immediate effect. Our findings also indicated that the therapeutic effect of Sensikin® lasts for at least 6 months. In previous researches on potassium nitrate and sodium fluoride, there was no 6-month evaluation period to compare with the obtained results; except in Aranha et al.'s study (27). Although they evaluated potassium oxalate and sodium fluoride, Aranha et al. explained the efficacy of potassium oxalate due to dual action mechanisms of potassium (occlusion of dentinal tubules and depolarization of neural membrane) (27).

Totally, in the comparison of treated groups with control group, we did not observe any significant differences. This condition was argued in other retrospective clinical examinations and showed a strong placebo effect that could mask the influences of laser and gel. Kienle questioned the existence of a placebo effect (28). One of the important points that should be discussed is the formation of secondary dentine in the evaluation time, which has a self-healing efficacy and protects the pulp from subsequent irritants (29). Finally in clinical positions, subjects may report lower pain due to experimental subordinations or as a cause of being polite (28). Regarding the first option, we notice to this point that different mechanisms naturally remit tooth sensitivity over time including: sclerosing of dentine or formation of secondary dentine, tertiary or reparative dentine, smear layer and calculus (30).

Lopes et al compared erbium-doped:yttrium, aluminium, and garnet (Er:YAG) laser irradiation (100 mJ/pulse; 10 Hz; 12.9 J/Cm^2) with or without conventional scaling and root planning (SRP) to SRP only for treatment of periodontal pockets. They concluded that non-surgical periodontal treatment with Er:YAG laser may be an alternative treatment for reduction and control of the proliferation of microorganism in persistent periodontitis (31). Rotundo et al. evaluated the efficacy of Er:YAG laser application in non-surgical periodontal treatment. They found that the adjunctive use of Er:YAG laser to conventional scaling and root planning (SRC) did not reveal a more effective result than SRP alone (32). Their findings showed the possible efficiency of YAG lasers in general and Er:YAG in specific for periodontal related diseases.

Yilmaz et al. in a randomized, controlled, double-blind, split mouth, clinical study concluded that both erbium, chromium-doped: yttrium,

scandium, gallium and garnet (Er,Cr:YSGG) and gallium-aluminium -arsenide (GaAlAs) lasers were effective in the treatment of DH following a single application (33-34).

In a systematic review, the effectiveness of laser therapy was compared with topical desensitizing agents in treating dentine hypersensitivity. The study indicated that laser therapy (Nd:YAG, Er:YAG, and CO_2) has a slight clinical advantage over topical medicaments (35). In an evidence based review, laser therapy for dentinal hypersensitivity was studied. Randomized controlled trial (RCT) that included patients with at least two hypersensitive teeth were selected for the study. The review suggested that laser therapy has a slight advantage over topical medicaments in treatment of dentine hypersensitivity. However larger sample size, longer time, high quality RCT's are recommended before definitive conclusion can be made (36).

In our study, the control group in each individual consisted of two sensitive teeth, so decreasing the pain in other sensitive teeth (test groups) and a sense of being treated can result in showing lower pain in control group. At last, we consider that treatment of DH is a complicated process, which is affected by placebo effect, natural desensitizing procedures, subjective nature of the patient's response and etc.

Conclusion

All in all, both laser and Sensikin® effectively reduce DH. However, we found no significant statistical differences between these two groups compared with the control group. Sensikin® is one of the at-home cares which is simple and cheap, but its influence appears at best one week after application. Nd:YAG laser is a complicated, expensive and unavailable treatment with an immediate therapeutic effect.

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