Acta Odontologica Scandinavica, 2013; 70: 1469–1474

informa
healthcare

ORIGINAL ARTICLE

Clinical evaluation of two desensitizing treatments in southern Brazil: A 3-month follow-up

RAFAEL GUERRA LUND[1], ADRIANA FERNANDES DA SILVA[1], EVANDRO PIVA[1], WELLINGTON LUIZ DE OLIVEIRA DA ROSA[2], SANI SILVA HECKMANN[2] & FLÁVIO FERNANDO DEMARCO[1]

[1]*Department of Restorative Dentistry, Postgraduate Program in Dentistry, Faculty of Dentistry, and* [2]*Faculty of Dentistry, Federal University of Pelotas, RS, Pelotas, Brazil*

Abstract

Objective. This study aimed to evaluate and compare the effectiveness of two treatments for dentin hypersensitivity *in vivo* during 90 days of follow-up. ***Materials and methods.*** The sample consisted of 117 teeth (13 patients) that were divided into three groups: control with carbomer 940 gel ($n = 32$) (placebo treatment), 2% sodium fluoride gel ($n = 31$) and low-level infrared diode laser ($n = 54$). Prior to the desensitizing treatment, the dentin hypersensitivity status of each tooth was assessed by an evaporative stimulus; the patient's response was evaluated using the Visual Analogue Scale (VAS) and by counting the Exposure Time to Air Blast (ETAB) with a dental air syringe. Re-evaluations of the treatments occurred after 5 min, 7, 15, 30 and 90 days. The statistical analysis was performed using the Kruskal-Wallis test, Friedman test, one-way ANOVA, Tukey's test and Spearman's rank correlation ($\alpha = 5\%$). ***Results.*** No significant differences were observed among the low-level laser, 2% topical fluoride and carbomer 940 gel applications. When the methods of evaluation (VAS and ETAB) were compared, there was no difference among the groups with respect to the values for every period of evaluation ($p < 0.001$), verifying that the scores obtained with the VAS decreased at the same proportion as the remaining time of ETAB increased. ***Conclusions.*** This study showed that both tested therapies were efficacious in controlling painful symptoms associated with dentin hypersensitivity over the entire 90-day follow-up period. The treatments were able to reduce the painful symptoms caused by dentin hypersensitivity, including placebo.

Key Words: *clinical trial, dentin desensitizing agents, dentin sensitivity, fluorides, low-level laser therapy*

Introduction

The main characteristic of dentin hypersensitivity is a specific, sharp and short-lasting pain that can be caused by several different stimuli. Mechanical, thermal, tactile, osmotic and chemical agents may be involved in the etiology of this event [1–3]. The amount of pain experienced ranges significantly from one person to another and the condition generally involves the vestibular tooth surfaces near the cervical regions; as such, dentin hypersensitivity is very commonly felt in premolars and canines [4]. The most common reasons for dentin exposure and tooth sensitivity include improper brushing habits that are associated with abrasive toothpastes, occlusal stress (abfraction), ingestion of acidic foods or beverages (erosion), periodontal diseases, failures in co-adaptation between cement and enamel and systemic diseases such as bulimia and anorexia nervosa [5–8].

The most widely accepted theory that explains dentin hypersensitivity is Brannstrom's hydrodynamic theory, based on fluid movement within the dentinal tubules, which in turn stimulate the odontoblast processes and cause a sensitive response [1,2,9].

Several different approaches have been proposed to treat dentin hypersensitivity, which aim to reduce or eliminate the pain symptomatology [10–12] and may be either invasive or non-invasive [4,13]. The most inexpensive, efficacious and widely used first line of treatment for most patients is a dentifrice that contains a desensitizing active ingredient such as potassium

Correspondence: R. G. Lund, Faculty of Dentistry, Postgraduate Program in Dentistry, Federal University of Pelotas, Gonçalves Chaves St, 457/504, Centro, Zip Code: 96015-560, Pelotas, Brazil. Tel: +55 53 91257668. Fax: +55 53 3222 6690. E-mail: rafael.lund@gmail.com

(Received 20 August 2012; accepted 24 January 2013)

ISSN 0001-6357 print/ISSN 1502-3850 online
DOI: 10.3109/00016357.2013.770919

nitrate and/or stannous fluoride [14–16]. Fluoride application using different agents is another treatment option and its efficacy usually relies on tubule occlusion and the prevention of acidic erosion. Clinical trials have demonstrated that fluoride varnish with high concentrations of fluoride ions can be an excellent alternative in reducing dentin hypersensitivity [1,17]. Dentin hybridization is another desensitizing alternative, which involves the application of adhesive systems coupled with restorative treatment. This alternative is indicated in cases focused on esthetic factors.

Today, lasers are employed as an optional treatment for dentin hypersensitivity [18]. The low-level lasers that are commonly used in this therapy have wavelengths ranging from 635–850 nm, GaA1A diode lasers being the outstanding option between available lasers in the market. They induce an analgesic, anti-inflammatory and biostimulative effect over dental nerve endings, consequently inducing the formation of secondary dentin by the stimulation of odontoblasts [19–23]. Such treatment is relatively new, and researchers like Corona et al. [19] have highlighted the necessity for *in vivo* controlled studies with an emphasis on the effectiveness of laser therapies in the treatment of dentin hypersensitivity. Moreover, it is important to compare the efficacy of laser-based treatments with those involving commonly used desensitizing agents [19,24].

One must take into consideration that symptoms of dentin hypersensitivity, which can occur due to alterations in tooth morphology, are related to psychological and neurophysiologic factors. Therefore, sometimes it may be difficult to differentiate normal sensitivity to dentin hypersensitivity [2,4–6]. However, it is of crucial importance to perform a detailed medical evaluation of the patient along with physical and radiographic exams, all of which enable correct diagnostic outcomes. Dentin hypersensitivity can simultaneously be present with other dental alterations, such as caries and post-operatory sensitivity [5]. Such clinical manifestations are physiologically normal, because, when stimuli like air blasting or periodontal probes are applied over affected areas, patients experience painful responses that promptly disappear after the removal of the causative agent. Therefore, therapeutic measures can be implemented only after the identification and removal of the causative factors.

However, the greater challenge regarding dentin hypersensitivity treatment is associated with the maintenance of treatment effectiveness for longer durations of time. Although there are several desensitizing methods utilizing various action mechanisms, the recurrence of symptoms associated with dentin hypersensitivity is a constant worry on the part of dentists and patients alike. Therefore, the purpose of this study was to perform a clinical evaluation of two different types of therapies for dentin hypersensitivity.

Materials and methods

The patient selection involved the following criteria: aged between 18–60 years, good health conditions, symptoms elicited by cold air, no periodontal surgery in the last 6 months, no use of desensitizing agents in the last 6 months, no use of analgesics and/or anti-inflammatory medicines, no orthodontic treatment, absence of excessive gingival inflammation and the presence of, at a minimum, two teeth with dentin hypersensitivity. Detailed medical histories were obtained to assess the general health status of all patients and intra-oral clinical exams were conducted to eliminate any other possible causes of sensitivity such as pulpitis, failed restorations, premature contacts, attrition, abrasion, occlusal stress or periodontal disease. Pulp vitality tests were performed to detect any pulp damage, while radiographs were taken to evaluate resulting alterations in dental and periradicular regions. Patients that met all of the inclusion criteria signed consent forms before entering the trial. This study was approved by the Ethics Committee of the Dental College at Federal University of Pelotas, RS, Brazil (Reference #046/2003).

Subsequently, patients were provided with occlusal adjustments, diet orientation, 10 cm Visual Analogue Scale (VAS) training for patient standardization and brushing and flossing instructions (provided by professionals). The initial level of dentin hypersensitivity (baseline) was acquired from each tooth and levels were recorded again after assessments using an evaporative stimulus (with a dental air syringe) that was applied 2 cm distant from the hypersensitive area for 60 s, with a right angle to the buccal site of the assigned teeth, whilst adjacent teeth were isolated with cotton rolls, until the patient raised his or her hand to indicate the occurrence of sensitivity. Soon after pain was detected, the stimulus was interrupted and the Exposure Time to Air Blast (ETAB) was noted. The level of sensitivity was also measured with a Visual Analogue Scale (VAS) resembling a ruler with scores ranging from 0–10 cm, where 0 cm indicated the absence of pain and 10 cm represented intolerable pain. Each patient recorded the intensity of his or her painful symptoms. VAS and ETAB are the main tests used in clinical trials related to dentin desensitizing agents with the purpose of evaluating the reduction of pain over time [8,15,25,26]. All clinical procedures were performed by only one trained operator and all stimuli were given in the same dental chair equipment yielding similar air pressure (55–60 psi) and air temperature (20–25°C) during recalls.

The baseline level was recorded to make comparisons between the post-treatment evaluation periods (e.g. 5 min after the execution of the last session of treatment and after 7, 15, 30 and 90 days). After the initial hypersensitivity scores were recorded (baseline), the teeth were randomly divided into one of three

Table I. Description of the variables for each patient.

Variable	*N*	Frequency
Gender of the patient		
Male	6	46.2%
Female	7	53.8%
Total	13	100%
Age		
18–25 years	6	46.2%
26–45 years	3	23.1%
> 46 years	4	30.7%
Total	13	100%
Location		
Mandible	63	53.8%
Maxilla	54	46.2%
Total	117	100%
Teeth group		
Incisors	24	20.5%
Canine	16	13.7%
Premolars	43	36.7%
Molars	34	29.1%
Total	117	100%

treatment groups. In this split-mouth study, for each patient, selected teeth were assigned to the Diode low-level laser group, the 2% sodium fluoride gel group and the control group (carbomer 940 gel). Up to two desensitizing treatments were used in the same patient in a split-mouth model similar to previously described methodology [27] and the control group received placebo treatment. In all, 117 teeth from 13 volunteers that showed sensitivities in the cervical regions were treated. A diode low-level laser was used in 54 teeth, 2% sodium fluoride gel was used in 31 teeth and carbomer 940 gel was used in 32 teeth (control).

The desensitizing treatment was preceded by dental surface cleanings using moistened cotton, slight drying and relative isolation with cotton and polyester strips. Topical treatment with sodium fluoride or carbomer 940 gel consisted of a weekly application over the exposed dentin surface for a duration of 1 min for 4 consecutive weeks. In addition, the patients were advised not to ingest food or drink for 30 min after each treatment. Infrared diode low-level laser treatment (Bio wave Dual – Kondortech, class IV = 780 nm) consisted of three sessions of application on the teeth, at intervals of 72 h. The protocol was followed by four punctual applications of 10 s each, three at the cervical zone (mesiobuccal, the buccolingual mid-point and distobuccal) and one at the root apex with an applied dosage of 5 J/cm^2, which represented the effective optic potency of 20 mW at the entry of the laser equipment.

At the end of the evaluation period, hypersensitivity scores were submitted to the Kruskal-Wallis test for comparisons between groups for each evaluation period. The Friedman, one-way ANOVA and Tukey's test were used for the paired analysis of the intra-group results obtained to evaluate the performance of the desensitizing agents over the periods of evaluation. Spearman's rank correlations were calculated to measure concordances between the methods used for pain measurement (VAS X ETAB). In all of the statistical testing, a 5% significance level was used.

Results

The sample consisted of 13 patients with dentin hypersensitivity at the buccal surfaces. The patients were 38% ($n = 5$) male and 62% ($n = 8$) female; their ages ranged from 19–58 years, with an average age of 35.75 years and a standard deviation of 15.05 years.

The teeth selected for the evaluation of the desensitizing therapies had the following distribution: upper incisors 7% ($n = 8$), lower incisors 14% ($n = 16$), upper canines 6% ($n = 7$), lower canines 8% ($n = 9$), upper premolars 21% ($n = 26$), lower premolars 15% ($n = 17$), upper molars 18% ($n = 21$) and lower molars 11% ($n = 13$) (Table I).

Table II. Means and statistical comparisons.

	VAS			ETAB		
Time	Fluoride	Laser	Placebo	Fluoride	Laser	Placebo
Initial	6.1^{a}	4.8^{a}	4.4^{a}	4.0^{a}	6.3^{a}	7.6^{a}
5 min	4.1^{b}	3.2^{b}	3.5^{b}	9.0^{a}	9.3^{ab}	9.4^{ab}
1 week	3.8^{b}	2.7^{bc}	3.1^{b}	12.0^{a}	14.0^{b}	13.8^{abc}
2 weeks	3.8^{b}	2.7^{bc}	3.4^{b}	10.2^{a}	13.2^{b}	15.2^{bc}
1 month	3.8^{b}	2.6^{c}	3.3^{b}	13.6^{a}	14.9^{b}	16.5^{c}
3 months*	3.7^{b}	3.2^{c}	2.9^{b}	15.2^{a}	12.8^{b}	16.1^{bc}

Different letters in columns indicate statistically significant differences between times of evaluation ($p < 0.05$).
*Comparisons between treatments after 3 months were performed using Kruskal-Wallis one way analysis of variance on ranks and there were no statistical differences between the treatments.

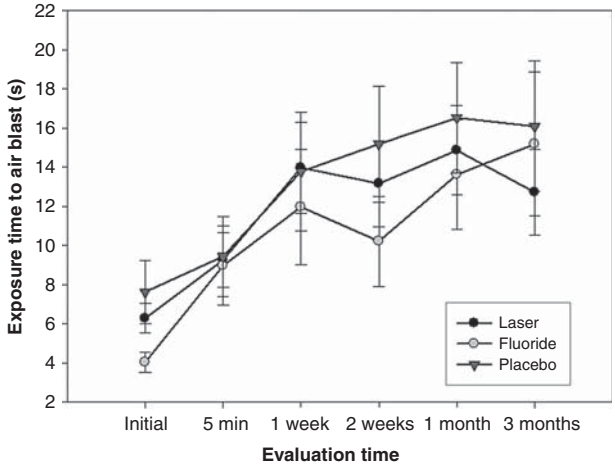

Figure 1. Comparison of the averages for each treatment with respect to the tolerable exposure time to air blast.

Table II and Figures 1 and 2 illustrate the post-treatment evaluation periods for the tested treatments (5 min after the execution of the last session of treatment and after 7, 15, 30 and 90 days). In relation to tolerance ETAB, significant differences were observed between baseline and the other three groups, including the control with carbomer 940 gel (placebo treatment) after 14 days ($p < 0.05$). In the laser group, a significant difference was observed between the periods of 7, 30 and 90 days and the initial baseline value. Regarding VAS, it was verified that in all periods of time after the desensitizing treatment, the results were significant when compared to the baseline values.

All of the groups displayed decreases in painful symptoms initially caused by dentin hypersensitivity, including on teeth that received the placebo. In the comparison of efficacy between the desensitizing treatments, the statistical analyses revealed that, for both evaluation methods (ETAB and VAS), it was impossible to detect statistically significant differences among low-level laser application, 2% topical fluoride and carbomer gel.

Analyzing the pain reduction for each measurement, it was observed that ETAB increased for all the administered treatment methods (Figure 1). In evaluating the absolute averages, fluoride reach edits a peak effect after 90 days (an increase of 11.52 s), while laser reached its peak after 30 days (an increase of 8.81 s).

Decreases in hypersensitivity levels were also noticed in measurements with VAS because the scores in the post-therapy sessions were lower than those obtained at baseline (Figure 2). Laser had its peak effect (regarding decreases in pain) after 30 days (45.93%), while fluoride reached its peak effect after 90 days (38.31%).

The Spearman's rank correlations applied to the evaluation methods revealed that all recorded values were significant at $p \leq 0.001$, verifying that the scores obtained with VAS decreased when ETAB increased.

Discussion

The identification and diagnosis of dentin hypersensitivity must be made only after a detailed medical history is obtained and a meticulous clinical exam of the teeth is conducted, with particular attention to the following characteristics: gingival recession, dentin exposure (generally in the buccal surfaces) and the effects to several stimuli that will disappear when removed, thus eliminating the possibility of the involvement of any other type of pathology or morbidity [14,17,19].

It is recommended that home-care methods (i.e. those performed by the patients themselves) are given priority in reducing the painful symptoms associated with dentin exposure because they are simpler and less invasive [14]. These include patient education regarding the avoidance or decreased utilization of the following: (1) excessive forces during tooth brushing, (2) acidic food intake and (3) use of abrasive dentifrices, coupled with the use of desensitizing agents. If such home-care methods fail to bring effective outcomes, other non-invasive techniques may be involved, such as those performed in the dental practice setting [1,14]. When even those therapies are not effective, more aggressive alternatives (e.g. hybridization of dental adhesives in restorative treatment) may be utilized [13]. It is important to note that a restorative procedure implies the loss of tooth structure, as seen with the formation of cavities.

In the present study, unlike other studies that used more than one stimulus [28,29], dentine hypersensitivity was diagnosed by using an evaporative stimulus via an air blast from a dental air syringe. This stimulus was used due to its ease of handling and the ability to control the exposure time to air blast [30]. The air blast causes hydraulic movement, provoking the evaporation of dentinal fluid and producing pain via the activation of mechanoreceptors. Their reposition, in

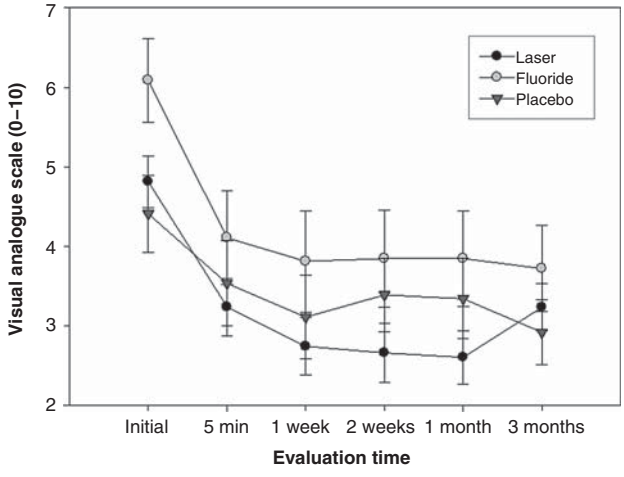

Figure 2. Comparison of the averages for each treatment by evaluation with the visual analogue scale (VAS).

turn, is influenced by pulpal tissues. This method was demonstrated to be effective in the diagnosis of dentin hypersensitivity, which corroborates previous findings by Yates et al. [29] and Addy et al. [10].

The diode low-level laser and the sodium fluoride gel showed different modes of action in the remission of painful symptoms associated with dentin hypersensitivity. The fluoride effect is based on the reaction of the sodium fluoride with the calcium ions, which are present in dentin, via the formation of calcium fluoride (CaF_2) crystals that are deposited partially or totally over the openings of the dentinal tubules. Several applications of the gel are needed to observe effective results (i.e. occlusion of open dentinal tubules), leading to longer treatment times [31]. Furthermore, Chersoni et al. [1] warned that the obliterating layers formed by sodium fluoride (NaF) are highly fragile due to being easily removable mechanically. Trowbridge and Silver [31] justified the inefficacy of this material by pointing to the reduced size of these CaF_2 crystals, which are only 0.05 μm in diameter.

According to Walsh [22] and Ladalardo et al. [21], the other type of treatment employed in this study, the low-level laser, acts through the induction of alterations in the net of the neuronal transmissions that provoke analgesic and anti-inflammatory effects, which explains the immediate effect observed after 5 min in this clinical evaluation. There is also a biostimulant of physiologic function, which occurs instead of alterations in the exposed dentin surfaces, as is the case with most other treatment modalities [21,22]. Aun et al. [32] described the biostimulant effect of the low-level laser in rat pulps by verifying dentin neoformation with odontoblastic prolongation and by observing the production of significant amounts of secondary dentin with the physiologic obliteration of dentin tubules, with consequent remission of sensitivity. It is important to emphasize that the therapeutic effects of lasers may differ between individuals [21–23].

Previous studies have demonstrated that the effectiveness of laser therapy over time is similar to that associated with the topical application of fluoride, which does not compensate for the more expensive costs needed to acquire laser equipment (i.e. especially if lasers are used exclusively for the treatment of dentin hypersensitivity). The results of this study are in agreement with the study by Corona et al. [19], where statistically significant differences were not observed between low-level laser treatment and the topical application of 2% sodium fluoride gel over time. However, there was a considerable relief from sensitivity, as described by the patients, immediately after the treatments [19].

Evaluating the therapeutic effect of dentin hypersensitivity treatment can be difficult because pain is a subjective measure [10]. Furthermore, treatment performance largely depends on the relationship between the professional and the patient, which is known as the placebo effect. This, according to Wilder-Smith [23], is often associated with treatment and clinical evaluation of dentin hypersensitivity. It often involves psychologically and physiologically complex interactions resulting from established relations, as well as from a desire (by both providers and patients) for cures or remissions in symptoms [20]. Therefore, the placebo effect must be evaluated, especially if the patient describes a positive outcome immediately after treatment [31]. It is normal for patients to create expectations about a cure, although the dentist must inform the patients that treatment for dentin hypersensitivity involves controlling of painful symptoms via a gradual approach [20].

Another limitation of the study that must be considered, besides the placebo effect, are the possibility of saliva-induced sodium fluoride diffusion and the analgesic and anti-inflammatory effect of the nerve endings promoted by low-level lasers that can mask the performance of the carbomer 940 gel. However, the desensitizing agent and the control were applied in the same mouth (split-mouth model) to facilitate comparisons by the patient and to promote variations in the tested groups.

This study showed that both tested therapies were efficacious in controlling painful symptoms associated with dentin hypersensitivity over the entire 90-day follow-up period. No patient experienced pain recurrences matching the levels observed prior to the desensitizing treatments. Based on the efficacy of the cases treated in the present study, it is recommended that new controlled clinical studies evaluate how dentist–patient interactions can similarly influence the use of dental products in the treatment of dentin hypersensitivity.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

[1] Chersoni S, Bertacci A, Pashley DH, Tay FR, Montebugnoli L, Prati C. *In vivo* effects of fluoride on enamel permeability. Clin Oral Investig 2010;15:443–9.
[2] Miglani S, Aggarwal V, Ahuja B. Dentin hypersensitivity: recent trends in management. J Conserv Dent 2011;13:218–24.
[3] Orhan K, Aksoy U, Can-Karabulut DC, Kalender A. Low--level laser therapy of dentin hypersensitivity: a short-term clinical trial. Lasers Med Sci 2010;26:591–8.
[4] Walters PA. Dentinal hypersensitivity: a review. J Contemp Dent Pract 2005;6:107–17.
[5] Bamise CT, Kolawole KA, Oloyede EO, Esan TA. Tooth sensitivity experience among residential university students. Int J Dent Hyg 2010;8:95–100.
[6] Drisko CH. Dentine hypersensitivity: dental hygiene and periodontal considerations. Int Dent J 2002;52:385–93.

[7] Rytomaa I, Jarvinen V, Kanerva R, Heinonen OP. Bulimia and tooth erosion. Acta Odontol Scand 1998;56:36–40.
[8] Drebenstedt S, Zapf A, Rodig T, Mausberg R, Ziebolz D. Efficacy of two different CHX-containing desensitizers: a controlled double-blind study. Oper Dent 2012;37:161–71.
[9] Brannstrom M, Linden LA, Astrom A. The hydrodynamics of the dental tubule and of pulp fluid. A discussion of its significance in relation to dentinal sensitivity. Caries Res 1967;1:310–17.
[10] Addy M, West NX, Barlow A, Smith S. Dentine hypersensitivity: is there both stimulus and placebo responses in clinical trials? Int J Dent Hyg 2007;5:53–9.
[11] Bartold PM. Dentinal hypersensitivity: a review. Aust Dent J 2006;51:212–18; quiz 76.
[12] Cunha-Cruz J, Stout JR, Heaton LJ, Wataha JC. Dentin hypersensitivity and oxalates: a systematic review. J Dent Res 2010;90:304–10.
[13] Sykes LM. Dentine hypersensitivity: a review of its aetiology, pathogenesis and management. SADJ 2007;62:66–71.
[14] Orchardson R, Gillam DG. Managing dentin hypersensitivity. J Am Dent Assoc 2006;137:990–8; quiz 1028–9.
[15] Banerjee A, Hajatdoost-Sani M, Farrell S, Thompson I. A clinical evaluation and comparison of bioactive glass and sodium bicarbonate air-polishing powders. J Dent 2010;38: 475–9.
[16] Forsback AP, Areva S, Salonen JI. Mineralization of dentin induced by treatment with bioactive glass S53P4 *in vitro*. Acta Odontol Scand 2004;62:14–20.
[17] Hoang-Dao BT, Hoang-Tu H, Tran-Thi NN, Koubi G, Camps J, About I. Clinical efficiency of a natural resin fluoride varnish (Shellac F) in reducing dentin hypersensitivity. J Oral Rehabil 2009;36:124–31.
[18] Sgolastra F, Petrucci A, Gatto R, Monaco A. Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. J Endod 2011;37:297–303.
[19] Corona SA, Nascimento TN, Catirse AB, Lizarelli RF, Dinelli W, Palma-Dibb RG. Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity. J Oral Rehabil 2003;30:1183–9.
[20] Kimura Y, Wilder-Smith P, Yonaga K, Matsumoto K. Treatment of dentine hypersensitivity by lasers: a review. J Clin Periodontol 2000;27:715–21.
[21] Ladalardo TC, Pinheiro A, Campos RA, Brugnera Junior A, Zanin F, Albernaz PL, et al. Laser therapy in the treatment of dentine hypersensitivity. Braz Dent J 2004;15:144–50.
[22] Walsh LJ. The current status of low level laser therapy in dentistry. Part 2. Hard tissue applications. Aust Dent J 1997; 42:302–6.
[23] Wilder-Smith P. The soft laser: therapeutic tool or popular placebo? Oral Surg Oral Med Oral Pathol 1988;66:654–8.
[24] Vieira AH, Passos VF, de Assis JS, Mendonca JS, Santiago SL. Clinical evaluation of a 3% potassium oxalate gel and a GaAlAs laser for the treatment of dentinal hypersensitivity. Photomed Laser Surg 2009;27:807–12.
[25] Birang R, Poursamimi J, Gutknecht N, Lampert F, Mir M. Comparative evaluation of the effects of Nd: YAG and Er: YAG laser in dentin hypersensitivity treatment. Lasers Med Sci 2007;22:21–4.
[26] Ipci SD, Cakar G, Kuru B, Yilmaz S. Clinical evaluation of lasers and sodium fluoride gel in the treatment of dentine hypersensitivity. Photomed Laser Surg 2009;27:85–91.
[27] Yilmaz HG, Kurtulmus-Yilmaz S, Cengiz E. Long-term effect of diode laser irradiation compared to sodium fluoride varnish in the treatment of dentine hypersensitivity in periodontal maintenance patients: a randomized controlled clinical study. Photomed Laser Surg 2011;29:721–5.
[28] Plagmann HC, Konig J, Bernimoulin JP, Rudhart AC, Deschner J. A clinical study comparing two high-fluoride dentifrices for the treatment of dentinal hypersensitivity. Quintessence Int 1997;28:403–8.
[29] Yates RJ, Newcombe RG, Addy M. Dentine hypersensitivity: a randomised, double-blind placebo-controlled study of the efficacy of a fluoride-sensitive teeth mouthrinse. J Clin Periodontol 2004;31:885–9.
[30] Lier BB, Rosing CK, Aass AM, Gjermo P. Treatment of dentin hypersensitivity by Nd:YAG laser. J Clin Periodontol 2002;29:501–6.
[31] Trowbridge HO, Silver DR. A review of current approaches to in-office management of tooth hypersensitivity. Dent Clin North Am 1990;34:561–81.
[32] Aun CE, Clasen MF, Gavini G, Lage-Marques JLS. Morphological changes caused by the action of CO2 laser in dentin surfaces and on retrofilling materials. Rev Odontol UNICID 1998;10:7–15.