Efficacy of Nd:YAG and GaAlAs lasers in comparison to 2% fluoride gel for the treatment of dentinal hypersensitivity

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Lasers demonstrate excellent therapeutic action and are often employed in dentistry for the treatment of diverse clinical conditions. The aim of this study was to compare the efficacy of neodymium-doped yttrium-aluminum-garnet (Nd:YAG) laser, gallium-aluminum-arsenide (GaAlAs) laser, and 2% neutral fluoride gel in the treatment of dentinal hypersensitivity. Twenty-three patients were evaluated, involving a total of 48 quadrants with at least 1 tooth with dentinal hypersensitivity (89 teeth total). Pain intensity was recorded on a visual analog scale at the time of clinical examination (baseline), immediately after treatment, and 1 week posttreatment. Teeth were treated with 60 seconds of 2% neutral fluoride gel application or 60 seconds of laser treatment—Nd:YAG laser at a distance of 0.5 cm (unfocused; 1 W and 10 Hz for 60 seconds, perpendicular to the cervical surfaces) or GaAlAs laser in contact (40 mW; 4 J/cm^2; spot: 0.028 cm^2; 15 seconds per point on 4 points [mesial, medial, distal, and apical])—as well as sham treatments so that patients remained blind to their treatment group. All treatments provided adequate pain reduction immediately posttreatment, but laser treatments resulted in significantly greater reductions in pain intensity.

Received: April 26, 2016
Accepted: May 31, 2016

Key words: dentinal hypersensitivity, GaAlAs laser, Nd:YAG laser

GENERAL DENTISTRY SELF-INSTRUCTION CE CREDIT
Exercise 396, p. 71
Subject: Dentinal Hypersensitivity & Treatment (161)

Dentinal hypersensitivity (DH) is a common dental symptom characterized by acute, short-term pain as a result of nerve endings being exposed to mechanical, thermal, and osmotic stimuli through the dentinal tubules.[1-3] Dentinal hypersensitivity is more prevalent in young adults, in the female population, and on the buccal surfaces of the mandibular premolars and mandibular canines.[4,5] The occurrence rate for DH in these areas ranges from 8% to 57%.[6-8] In the general population, the prevalence of DH ranges from 10% to 30%. The pain caused by DH may result in eating difficulties and inadequate oral hygiene.[9,10]

A number of theories have been proposed to explain the mechanism behind DH. In 1959, Seltzer & Bender proposed the odontoblastic transduction theory, in which the excitability of odontoblasts by a variety of chemical and mechanical stimuli on the dentin surface results in the release of a neurotransmitter to the nerve endings in the pulp, thereby causing pain.[11] However, this theory has been questioned, since no such neurotransmitter has yet been identified.[8] Another hypothesis that was put forth in the same year stated that, besides neurotransmitters, odontoblasts may also release vasoactive proteins and amino acids.[12]

The most widely accepted hypothesis is the hydrodynamic theory, put forth by Brännström in 1963.[13] According to Brännström, when dentin is exposed to a stimulus through the dentinal tubules, the fluid within the tubules is displaced.[13] This movement toward or away from the pulp generates positive or negative pressure on the nerve endings of the plexus that surrounds the odontoblasts, leading to mechanical deformation of the nerve fibers, along with a broadening of the channels of Na^+ ions in the cell and the depolarization of the fibers, thereby causing pain.[1,13,14]

A precise diagnosis is required to establish adequate treatment for DH, as this condition may be confused with reversible pulpitis, fractured tooth syndrome, or postoperative sensitivity.[15] Thus, the variable responses to thermal, chemical, and tactile stimuli should be investigated, and there should be no radiographic evidence of apical pathosis.[10] Treatment options for DH are based on the hydrodynamic theory and include the application of fluoridated compounds (varnishes and gels) to form fluoridated hydroxyapatite in the dentinal tubules, aiming to reduce dentin permeability and subsequent nerve transmission.[16] The use of oxalates with resin and glass ionomer restorations is also intended to obliterate the entrances to the dentinal tubules.[10] Another option is laser therapy, which appears to induce formation of dentin through stimulation of odontoblasts and to cause depolarization of the membrane, thereby increasing the pain threshold.[17]

Lasers can be employed with high or low intensity and have been incorporated in the field of dentistry due to their beneficial effect on irradiated tissues, such as increased microcirculation, revascularization, anti-inflammatory action, analgesic action, and the stimulation of cell growth and regeneration.[18] Due to its short wavelength, low-intensity laser therapy (*soft laser*) is capable of penetrating tissues at a lower temperature (0.1°C), where it causes biomodulation by stimulating cellular activity and increasing the production of adenosine triphosphate, which elevates the excitability threshold of nerve endings, resulting in analgesia.[10,15] Soft laser also maintains the membrane resting potential of the nociceptive receptor. As a late-onset effect, soft laser increases the metabolic activity of odontoblasts, which leads to the production of dentin and obliteration of the dentinal tubules.[10] The main types of phototherapy employed for this purpose are helium-neon laser, arsenide-gallium diode, and gallium-aluminum-arsenide (GaAlAs) diode.

High-intensity laser (*hard laser*) emits high-power irradiation with a destructive potential and is generally used in surgery or for the removal of carious tissue. Hard laser has a cutting photothermal action and the ability to cause vaporization, coagulation, and sterilization of tissues. The main media for this type of laser are argon, excimer, krypton, dye, ruby, yttrium-aluminum-garnet (YAG), and carbon dioxide (CO_2).[19] When used in unfocused mode, hard laser can promote biomodulation and thus can be used for the treatment of DH.[20]

Laser therapy is considered a promising therapeutic resource for DH. However, a number of aspects need to be defined, such as the best type of laser, irradiation parameters, exposure time, and number of treatment sessions. The aim of the present study was to compare the efficacy of neodymium-doped yttrium-aluminum-garnet (Nd:YAG) and GaAlAs lasers, as well as a 2% fluoride gel, in the treatment of DH.

Materials and methods

Study design

A randomized, single-blinded clinical trial was conducted with a split-mouth design in which each quadrant was considered an experimental unit.

Sample selection

Outpatients were recruited from the Oral Medicine Unit of the Federal University of Pernambuco, Recife, Brazil, in accordance with the ethical standards of the university's committee on human experimentation. Patients were selected based on the eligibility criteria listed in the next section. Twenty-three patients were evaluated, involving a total of 48 quadrants with at least 1 tooth with DH, resulting in a sample of 89 teeth.

Eligibility criteria

Teeth with DH—diagnosed through a positive reaction to the application of compressed air for up to 30 seconds—were included in the study. All quadrants needed to have at least 1 tooth with DH stemming from gingival recession. The teeth with DH had to be free of caries and could not have any defective restorations detected during the clinical examination. Exclusion criteria comprised the use of toothpaste for sensitive teeth, professional treatment with desensitizing agents performed in the previous 12 months, and the use of analgesics or anti-inflammatory agents during the study.

Treatments

For pain evaluation and randomization, the quadrants were relatively isolated with cotton rolls and were submitted to compressed air applied perpendicular to the cervical surface at a distance of 0.5 cm for 30 seconds. In some cases, this test was interrupted because the patient reported unbearable pain. A visual analog scale (VAS) was used to record pain intensity in each quadrant with DH on a scale of 0 (absence of pain) to 10 (unbearable pain). This represented the baseline VAS score. Next, opaque envelopes containing the number 1, 2, or 3 were randomly distributed for the determination of the type of treatment to which each quadrant would be submitted. Only the examiner was aware of the allocation, whereas the participants were blinded to the form of treatment. At the end of treatment and 7 days posttreatment, the quadrants were reevaluated with compressed air for 30 seconds, and the VAS was used to record pain intensity.

All individuals received dental prophylaxis with a rubber cup, pumice stone, and water for 60 seconds prior to treatment. Compressed air was then applied for 30 seconds, the teeth were dried with cotton pellets for 30 seconds, and the quadrant was isolated with cotton rolls. The participants used protective eyewear during the laser treatments.

Groups

The fluoride group was composed of 16 quadrants with a total of 27 teeth with DH. Sham laser was administered with the positioning of the nonactivated tip of both GaAlAs (Photon Lase III, DMC USA) and Nd:YAG laser (Fidelis Plus III , Fotona LLC) devices for 60 seconds each. Next, cotton pellets were used to apply neutral 2% fluoride gel (Flugel, Nova DFL) to the cervical surface for 60 seconds.

The Nd:YAG group comprised 17 quadrants with a total of 33 teeth with DH. The Nd:YAG laser was administered perpendicular to the cervical surface in noncontact mode, unfocused at a distance of 0.5 cm under 1 W and 10 Hz for 60 seconds. Next, sham laser was administered, with the positioning of the nonactivated tip of the GaAlAs laser device for 60 seconds, and then petroleum jelly was applied to simulate the application of fluoride.

The GaAlAs group comprised 15 quadrants with a total of 29 teeth with DH. The GaAlAs laser was administered in contact mode at 40 mW and 4 J/cm^2 with a spot of 0.028 cm^2. The laser was applied for 15 seconds per point at 4 points (mesial, medial, distal, and apical surfaces), totaling 60 seconds. Next, sham laser was administered, with the positioning of the nonactivated tip of the Nd:YAG laser device for 60 seconds, and then petroleum jelly was applied to simulate the application of fluoride.

Statistical analysis

SPSS, version 17.0 (IBM Corporation), was used for statistical analysis, with a 95% confidence level. As the Shapiro-Wilk test demonstrated a nonnormal distribution of the data, nonparametric tests were performed. The Kruskal-Wallis test was used for intragroup comparisons of pain intensity at different evaluation times: Diff 1 (difference between baseline and immediately posttreatment); Diff 2 (difference between baseline and 1 week posttreatment); and Diff 2 – 1 (difference between 1 week posttreatment and immediately posttreatment). The Mann-Whitney test was used for paired intergroup comparisons at Diff 1 and Diff 2. The percentage of quadrants showing improvement was also calculated in each group at the different evaluation times.

Results

The sample included 48 quadrants with at least 1 tooth with DH. A total of 89 teeth among 23 patients (20 women and 3 men; age range of 20-65 years) were treated.

Pretreatment, the mean VAS values for pain intensity were 8.24 in the fluoride group, 8.20 in the Nd:YAG group, and 7.88 in the GaAlAs group. A statistically significant difference in VAS values was observed between baseline and immediately posttreatment evaluations ($P \leq 0.05$) as well as between baseline and 1-week posttreatment evaluations ($P \leq 0.05$) (Table 1). In contrast, no statistically significant difference was observed between immediately posttreatment and 1-week posttreatment values ($P > 0.05$), demonstrating the maintenance of treatment results over a 1-week interval.

Both types of laser treatment provided greater pain reduction than fluoride treatment (Table 2). However, no statistically significant differences were found between Nd:YAG and GaAlAs lasers.

At Diff 1, the pain was reduced in 81.2% of quadrants submitted to fluoride application, 93.75% of those submitted to Nd:YAG laser, and 100.00% of those submitted to GaAlAs laser (Table 3). At Diff 2, pain was reduced in 81.25% of quadrants submitted to fluoride application and 100.00% of the those submitted to Nd:YAG and GaAlAs lasers (Table 3).

Table 1. Reduction of pain intensity scores on the VAS in the study groups over time.

Timeline	Group	n	Mean (SD) reduction	*P*
Diff 1	Fluoride	16	2.50 (1.86)	0.001[a]
	Nd:YAG	17	4.94 (2.56)	
	GaAlAs	15	5.20 (2.11)	
Diff 2	Fluoride	16	3.00 (2.07)	0.001[a]
	Nd:YAG	17	6.59 (1.84)	
	GaAlAs	15	6.53 (1.41)	
Diff 2 – 1	Fluoride	16	0.50 (2.48)	0.413
	Nd:YAG	17	1.65 (2.03)	
	GaAlAs	15	1.33 (1.45)	

[a]Statistically significant difference.

Abbreviations: Diff 1, difference between baseline and immediately posttreatment; Diff 2, difference between baseline and 1 week posttreatment; Diff 2 – 1, difference between 1 week posttreatment and immediately posttreatment; GaAlAs, gallium-aluminum-arsenide laser; Nd:YAG, neodymium-doped yttrium-aluminum-garnet laser; VAS, visual analog scale (0 to 10).

Table 2. Intergroup comparisons over time.

	P		
Timeline	Fluoride × Nd:YAG	Fluoride × GaAlAs	GaAlAs × Nd:YAG
Diff 1	0.005[a]	0.001[a]	0.723
Diff 2	0.001[a]	0.001[a]	0.904

[a]Statistically significant difference.

Abbreviations: Diff 1, difference between baseline and immediately posttreatment; Diff 2, difference between baseline and 1 week posttreatment; GaAlAs, gallium-aluminum-arsenide laser; Nd:YAG, neodymium-doped yttrium-aluminum-garnet laser.

Discussion

Treatment for DH may involve an anti-inflammatory agent, obliteration of the dentinal tubules, or blocking of the neural response.[13,21,22] The search for the most effective treatment determined the methodology employed in the present study.

Neutral 2% fluoride was selected as the positive control for the present study because this substance is widely employed in dental clinics for the treatment of DH.[6,8] The choice of the GaAlAs laser parameters was based on research by Groth, which has been repeated in other studies.[15,23-25] For the Nd:YAG laser, the parameters most often reported in the literature were employed.[26-28]

Immediately posttreatment, a reduction in pain intensity was found in all groups (Table 1). However, these data demonstrated that better results were achieved with the lasers than with fluoride. Moreover, the Mann-Whitney test found no statistically significant differences between the 2 types of laser. The mean reduction in VAS was from 8.24 to 5.74 with fluoride, 8.20 to 3.26 with Nd:YAG, and 7.88 to 2.68 with GaAlAs. No statistically significant difference was found between the 2 types of laser. This immediate improvement is in agreement with data described by Almeida et al in a study evaluating the administration of GaAlAs laser on teeth with hypersensitivity following periodontal treatment.[29]

Dantas et al compared fluoride at a concentration of 4% (twice the concentration used in the present study) to GaAlAs laser (with different parameters from those employed herein) and concluded that both methods led to an immediate improvement in pain but the laser achieved better results.[30] Dilsiz et al analyzed the efficacy of erbium-doped yttrium-aluminum-garnet ([Er:YAG] 60 mJ/p, 20 seconds), Nd:YAG (100 mJ, 15 Hz, 100 seconds), and GaAlAs (100 mW, 20 seconds) lasers (without contact, scanning) for treatment of DH and compared the results with those in a control group without treatment.[5] The lasers were administered in 3 sessions, and pain was measured after each session. The Nd:YAG laser achieved significantly better results than did the other treatment modalities. This finding is in disagreement with the data in the present study, in which no significant differences were found between the 2 types of laser employed at either of the 2 posttreatment evaluations. This divergence may be explained by differences in the parameters and number of sessions employed.

Table 3. Number (%) of quadrants without (No) or with (Yes) a reduction of pain intensity over time.

Treatment	Diff 1		Diff 2		Total
	No	Yes	No	Yes	
Fluoride	3 (18.75)	13 (81.25)	3 (18.75)	13 (81.25)	16 (100.00)
Nd:YAG	1 (6.25)	16 (93.75)	0 (0.00)	17 (100.00)	17 (100.00)
GaAlAs	0 (0.00)	15 (100.0)	0 (0.00)	15 (100.00)	15 (100.00)
Total	4 (8.33)	44 (91.67)	3 (18.75)	45 (93.75)	48 (100.00)

Abbreviations: Diff 1, difference between baseline and immediately posttreatment; Diff 2, difference between baseline and 1 week posttreatment; GaAlAs, gallium-aluminum-arsenide laser; Nd:YAG, neodymium-doped yttrium-aluminum-garnet laser.

In the present study, 1 week posttreatment, both lasers achieved superior results in comparison to fluoride, with no statistically significant difference between the 2 types of laser. These results are in agreement with data reported by Ipci et al, who compared 2% fluoride applied for 2 minutes, soft laser (CO_2, 1 W, continuous mode, 10 seconds), hard laser (Er:YAG, 30 Hz, 60 mJ, 10 seconds, without contact), fluoride combined with soft laser, and fluoride combined with hard laser.[31] The authors found improvements when the lasers were employed and no significant difference among the laser groups; the worst performance was achieved when fluoride was used alone, whereas the greatest reductions in pain intensity were found in the groups that combined fluoride and laser. Thus, even when the application time of fluoride was increased to 4 minutes (in comparison to 60 seconds in the present study) and despite the differences in the types of lasers used in comparison to the present study, fluoride alone continued to achieve the worst results.[31]

Ciaramicoli et al allocated patients with DH to 3 groups.[32] Group 1 was submitted to Nd:YAG laser. In group 2, the etiologic factors of DH, such as premature contact and incorrect toothbrushing, were eliminated. In group 3, the 2 previous methods were combined. A reduction in pain was achieved with the application of laser therapy, which is in agreement with the present findings. However, a greater reduction was achieved when the 2 methods were combined. This finding underscores the importance of controlling irritating factors in the etiology of DH.

Maamary et al investigated the treatment of DH with Nd:YAG laser placed in contact with a tooth that was previously covered in a graphite paste.[33] The reduction in pain reported on a VAS was from 7.34 to 3.21 points immediately following application and to 2.07 points 1 week later, demonstrating the effectiveness of such treatment. According to the authors, contact with the laser melts the tooth surface and obliterates the entrances to the dentinal tubules, thereby diminishing hypersensitivity.[33] In the present study, application of a hard laser without contact acted in a similar manner to a soft laser, promoting biomodulation.

After all analyses, Nd:YAG and GaAlAs lasers led to equally greater reductions in pain intensity than were achieved through the application of fluoride. These findings are in agreement with data described by Shintome et al, who analyzed the same lasers with different parameters (Nd:YAG, 30 mJ and 10 Hz scanning without contact; GaAlAs, 4 points at 50 mW and 2 J).[34]

Conclusion

The results showed that fluoride application, Nd:YAG laser, and GaAlAs laser were effective in managing DH up to 7 days posttreatment. No statistically significant differences were found between the 2 lasers, but both types of laser were more effective than fluoride application.

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References

1. Belal MH, Yassin A. A comparative evaluation of CO_2 and erbium-doped yttrium aluminium garnet laser therapy in the management of dentin hypersensitivity and assessment of mineral content. *J Periodontal Implant Sci.* 2014;44(5):227-234.
2. Orchardson R, Gillam DG. Managing dentin hypersensitivity. *J Am Dent Assoc.* 2006;137(7):990-998.
3. Rees J, Addy M. A cross-sectional study of dentine hypersensitivity. *J Clin Periodontol.* 2002;29(11):997-1003.
4. Nunn JH. Prevalence and distribution of tooth wear. In: Addy M, Embery G, Edgar WM, Orchardson R, eds. *Tooth Wear and Sensitivity: Clinical Advances in Restorative Dentistry.* London: Martin Dunitz; 2000:93-104.
5. Dilsiz A, Aydin T, Canakci V, Gungormus M. Clinical evaluation of Er:YAG, Nd:YAG, and diode laser therapy for desensitization of teeth with gingival recession. *Photomed Laser Surg.* 2010;28(Suppl 2):S11-S17.
6. Wara-aswapati N, Krongnawakul D, Jiraviboon D, Adulyanon S, Karimbux N, Pitiphat W. The effect of a new toothpaste containing potassium nitrate and triclosan on gingival health, plaque formation and dentine hypersensitivity. *J Clin Periodontol.* 2005;32(1):53-58.
7. Ahmed TR, Mordan NJ, Gilthorpe MS, Gillam DG. In vitro quantification of changes in human dentine tubule parameters using SEM and digital analysis. *J Oral Rehabil.* 2005;32(8):589-597.
8. Walters PA. Dentinal hypersensitivity: a review. *J Contemp Dent Pract.* 2005;6(2):107-117.
9. Bartold PM. Dentinal hypersensitivity: a review. *Aust Dent J.* 2006;51(3):212-218.
10. He S, Wang Y, Li X, Hu D. Effectiveness of laser therapy and topical desensitising agents in treating dentine hypersensitivity: a systematic review. *J Oral Rehabil.* 2011;38(5):348-358.
11. Seltzer S, Bender IB. Inflammation in the odontoblastic layer of the dental pulp. *J Am Dent Assoc.* 1959;59:720-724.
12. Schiff T, Saletta L, Baker RA, Winston JL, He T. Desensitizing effect of a stabilized stannous fluoride/sodium hexametaphosphate dentifrice. *Compend Contin Educ Dent.* 2005;26(9 Suppl 1):35-40.
13. Brännström M. Dentin sensitivity and aspiration of odontoblasts. *J Am Dent Assoc.* 1963;66:366-370.
14. Sgolastra F, Petrucci A, Gatto R, Monaco A. Effectiveness of laser in dentinal hypersensitivity treatment: a systematic review. *J Endod.* 2011;37(3):297-303.
15. Palazon MT, Scaramucci T, Aranha AC, et al. Immediate and short-term effects of in-office desensitizing treatments for dentinal tubule occlusion. *Photomed Laser Surg.* 2013;31(6):274-282.

16. Freitas Sda S, Sousa LL, Moita Neto JM, Mendes RF, Prado RR. Dentin hypersensitivity treatment of non-carious cervical lesions - a single-blind, split-mouth study. *Braz Oral Res.* 2015;29:45.
17. Sowiski J, Ayad F, Petrone M, et al. Comparative investigations of the desensitizing efficacy of a new dentifrice. *J Clin Periodontol.* 2001;28(11):1032-1036.
18. Dilsiz A, Aydın T, Emrem G. Effects of the combined desensitizing dentifrice and diode laser therapy in the treatment of desensitization of teeth with gingival recession. *Photomed Laser Surg.* 2010;28(Suppl 2):S69-S74.
19. Pereira AG, Teixeira DN, Soares MP, Gonzaga RC, Fernandes-Neto AJ, Soares PV. Periodontal and restorative treatment of gingival recession associated with non-carious cervical lesions: case study. *J Int Acad Periodontol.* 2016;18(1):16-22.
20. Kim MH, Kim RJ, Lee WC, Lee IB. Evaluation of dentin tubule occlusion after laser irradiation and desensitizing agent application. *Am J Dent.* 2015;28(5):303-308.
21. Frechoso SC, Menéndez M, Guisasola C, Anegui I, Tejerina JM, Sicilia A. Evaluation of the efficacy of two potassium nitrate bioadhesive gels (5% and 10%) in the treatment of dentine hypersensitivity. A randomised clinical trial. *J Clin Periodontol.* 2003;30(4):315-320.
22. Lopes AO, Aranha AC. Comparative evaluation of the effects of Nd:YAG laser and a desensitizer agent on the treatment of dentin hypersensitivity: a clinical study. *Photomed Laser Surg.* 2013;31(3):132-138.
23. Groth EB. *Contribuição para o Estudo da Aplicação do Laser de Baixa Potência de GaAlAs no Tratamento da Hipersensibilidade Dentinária* [master's thesis]. São Paulo: Faculdade de Odontologia, Universidade de São Paulo; 1993.
24. Blatz MB. Laser therapy may be better than topical desensitizing agents for treating dentin hypersensitivity. *J Evid Based Dent Pract.* 2012;12(3 Suppl):229-230.
25. Yilmaz HG, Kurtulmus-Yilmaz S, Cengiz E, Bayindir H, Aykac Y. Clinical evaluation of Er,Cr:YSGG and GaAlAs laser therapy for treating dentine hypersensitivity: a randomized controlled clinical trial. *J Dent.* 2011;39(3):249-254.
26. Maleki-Pour MR, Birang R, Khoshayand M, Naghsh N. Effect of Nd:YAG laser irradiation on the number of open dentinal tubules and their diameter with and without smear of graphite: an in vitro study. *J Lasers Med Sci.* 2015;6(1):32-39.
27. Gholami GA, Fekrazad R, Esmaiel-Nejad A, Kalhori KA. An evaluation of the occluding effects of Er;Cr:YSGG, Nd:YAG, CO_2 diode and lasers on dentinal tubules: a scanning electron microscope in vitro study. *Photomed Laser Surg.* 2011;29(2):115-121.
28. Dilsiz A, Canakci V, Ozdemir A, Kaya Y. Clinical evaluation of Nd:YAG and 685-nm diode laser therapy for desensitization of teeth with gingival recession. *Photomed Laser Surg.* 2009;27(6):843-848.
29. Almeida ECB, Menezes MRA, Aguiar CM. Treatment of dentinal hyperesthesia with laser [in Portuguese]. *Odontol Clin Cient.* 2006;5(2):143-152.
30. Dantas EM, de Menezes RAM, Dantas PMC. 2010. Avaliação clínica do efeito do fluoreto de sódio a 4% e do laser AsGaAl sobre a hipersensibilidade dentinária cervical. *Rev Fac Odontol Univ Passo Fundo.* 2010;12(1):16-20.
31. 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(1):85-91.
32. Ciaramicoli MT, Carvalho RC, Eduardo CP. Treatment of cervical dentin hypersensitivity using neodymium:yttrium-aluminum-garnet laser. Clinical evaluation. *Lasers Surg Med.* 2003;33(5):358-362.
33. Maamary S, De Moor R, Nammour S. Treatment of dentine hypersensitivity by means of the Nd:YAG laser. Preliminary clinical study [in French]. *Rev Belge Med Dent.* 2009;64(3):140-146.
34. Shintome LK, Umetsubo LS, Nagayassu MP, Jorge AL, de Paiva Gonçalves SE, Torres CR. Avaliação clínica da laserterapia no tratamento da hipersensibilidade dentinária. *Cienc Odontol Bras.* 2010;10(1):26-33.